City Resilience Index

Inside the CRI: Reference Guide

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Director

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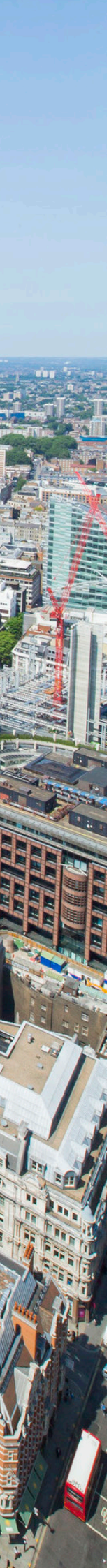


Introduction

The City Resilience Index (CRI) Online Tool provides a user-friendly platform for cities around the world to engage with the CRI. Upon registering, users follow a series of simple processes to complete the resilience assessment using a range of city data.

This Measurement Guide accompanies the Online Tool, providing a detailed overview of the qualitative and quantitative questions that constitute the basis of measurement of the CRI. It accompanies the beta version of the CRI online tool.

This Measurement Guide is structured according to the following sections, which represent the four key dimensions of the City Resilience Framework and Index:

- Health and wellbeing
- Economy and society
- Infrastructure and ecosystems
- Leadership and strategy

What is City Resilience Index?

Urban populations are facing an increasingly diverse range of natural and man-made pressures – including rapid urbanisation, climate change, terrorism, and increasing vulnerability to natural hazards. Many of these pressures are complex, interrelated and difficult to predict with any great accuracy into the future. In order to build resilience, cities must learn to adapt and thrive while managing uncertainty.

The City Resilience Index (CRI) is being developed by Arup with support from The Rockefeller Foundation. It builds on extensive research undertaken by Arup to establish an accessible, evidence-based definition of urban resilience, which culminated in the publication of the City Resilience Framework (CRF) in April 2014. The Framework is structured around four dimensions and 12 goals that are critical for the resilience of our cities.

The CRI provides cities with a means to assess and monitor their present day resilience, alongside progress towards a more resilient future. The assessment can assist cities in developing a deeper understanding of the systems, processes and functions that shape their resilience profile. Findings will empower cities to better identify appropriate actions to strengthen resilience, while allowing them to measure progress over time.

Read more at: www.arup.com/CRI

(Image Opposite)

London, UK

Structure of the City Resilience Index

4 Dimensions

Our research suggests that resilience of a city relates to four key dimensions:

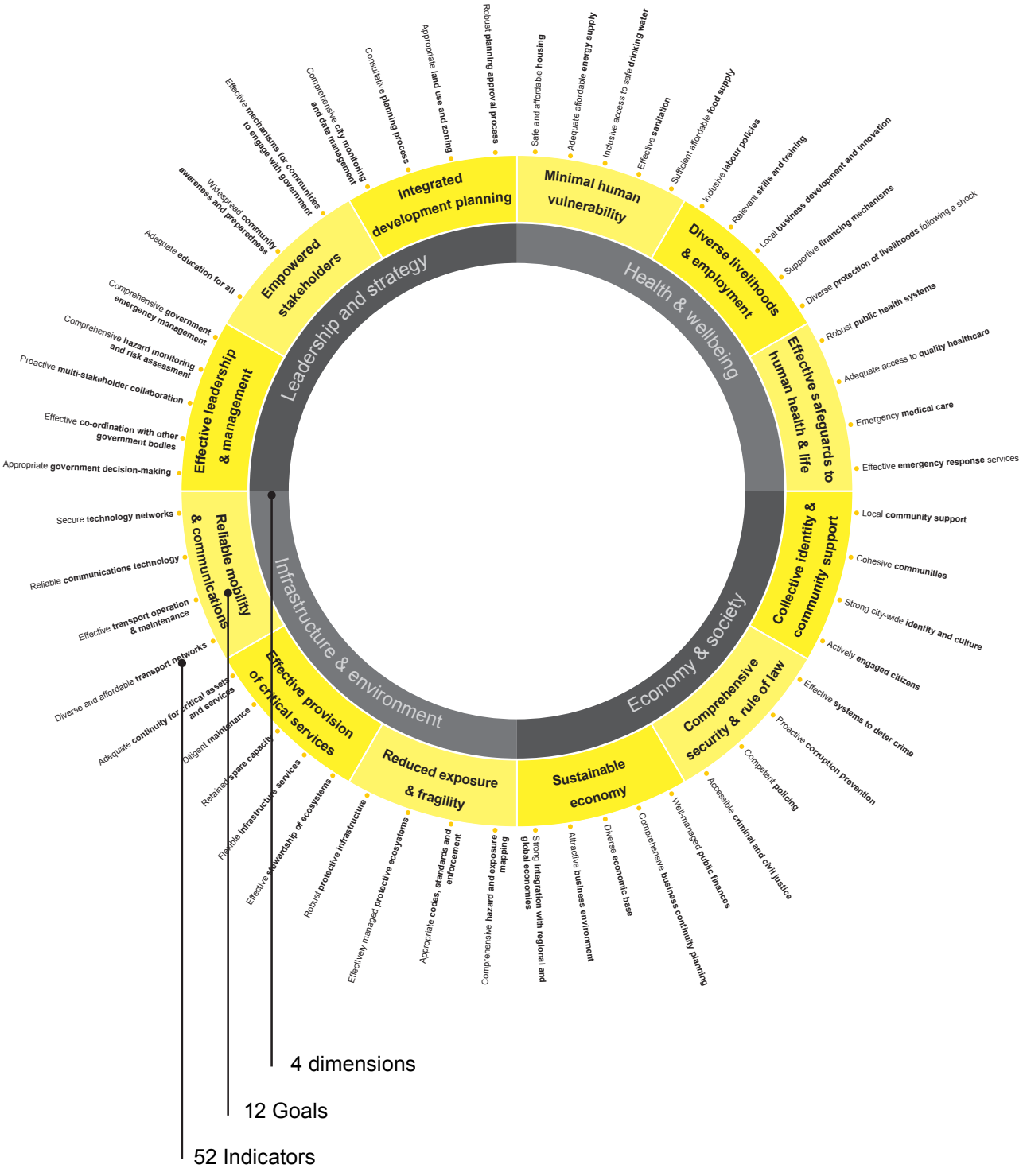
- Health and well-being, ensuring the health and wellbeing of everyone living and working in the city;
- Economy and society, the social and financial systems that enable urban populations to live peacefully, and act collectively;
- Infrastructure and environment, man-made and natural systems that provide critical services, protect and connect urban citizens; and
- Leadership and strategy, the need for informed, inclusive, integrated and iterative decision making in our cities.

12 Goals

Underpinning these four dimensions, there are 12 goals that each and every city should strive towards in order to achieve resilience. Our research tells us that universally these are what matters most when a city faces a wide range of chronic problems or a sudden catastrophe. However, it is recognised within the framework that the relative importance of each goal and how they are realised will be unique for every city.

52 Indicators

Research to develop the City Resilience Framework and Index has identified 52 indicators. The indicators add further definition to the 12 goals and identify the critical factors that contribute towards the resilience of urban systems. The indicators also integrate the seven qualities of resilient systems (e.g. robust, inclusive, flexible) that Arup's empirical research has identified as of vital importance.


Leadership and strategy
Health & wellbeing
Infrastructure & environment
Economy & society
Integrated development planning
Minimal human vulnerability
Diverse livelihoods & employment
Effective safeguards to human health & life
Collective identity & community support
Comprehensive security & rule of law
Sustainable economy
Reduced exposure & fragility
Effective provision of critical services
Reliable mobility & communications
Effective leadership & management
Empowered stakeholders
Robust planning approval process
Safe and affordable housing
Adequate affordable energy supply
Inclusive access to safe drinking water
Effective sanitation
Sufficient affordable food supply
Inclusive labour policies
Relevant skills and training
Local business development and innovation
Supportive financing mechanisms
Diverse protection of livelihoods following a shock
Robust public health systems
Adequate access to quality healthcare
Emergency medical care
Effective emergency response services
Local community support
Cohesive communities
Strong city-wide identity and culture
Actively engaged citizens
Effective systems to deter crime
Proactive corruption prevention
Competent policing
Accessible criminal and civil justice
Well-managed public finances
Comprehensive business continuity planning
Diverse economic base
Attractive business environment
Strong integration with regional and global economies
Comprehensive hazard and exposure mapping
Appropriate codes, standards and enforcement
Effectively managed protective ecosystems
Robust protective infrastructure
Effective stewardship of ecosystems
Flexible infrastructure services
Retained spare capacity
Diligent maintenance
Adequate continuity for critical assets and services
Diverse and affordable transport networks
Effective transport operation & maintenance
Reliable communications technology
Secure technology networks
Appropriate government decision-making
Effective co-ordination with other government bodies
Proactive multi-stakeholder collaboration
Comprehensive hazard monitoring and risk assessment
Comprehensive government emergency management
Adequate education for all
Widespread community awareness and preparedness
Effective mechanisms for communities to engage with government
Comprehensive city monitoring and data management
Consultative planning process
Appropriate land use and zoning
4 dimensions
12 Goals
52 Indicators

Health and wellbeing

This dimension relates to **people** – the health and well-being of everyone living and working in the city. This dimension considers to what extent the city enables everyone to meet their basic needs (food, water, and shelter), particularly in times of crisis. It considers how well the city supports diverse livelihood opportunities, including access to business investment and social welfare. Finally, it considers if a city is able to safeguard the health of its population through its normal and emergency healthcare provisions.

Structure:

This dimension of the City Resilience Index comprises three Goals, as follows:

1. Minimal human vulnerability
2. Diverse livelihood and employment
3. Effective safeguards to human life and health

(Image Opposite)

Can Tho, Vietnam

Goal 1. Minimal Human Vulnerability

Description: This relates to the extent to which everyone's basic needs are met.

Rationale: Resilient cities are able to provide the basic physiological needs of the population, including adequate provision of food, water, sanitation, energy and shelter. Minimising human vulnerabilities involves providing a standard of living that goes beyond mere survival. Evidence from cities suggests that the affordability of these services, particularly for vulnerable groups, is also critical to ensuring the whole population has daily access, including during times of disruption. Chronic failure to provide these services can cause strain on other aspects of the city's functioning, including environmental pressures, economic stagnation, and social unrest. A basic level of wellbeing also allows people to deal with unforeseen circumstances such as shock events.

Focus: The focus of this Goal is on providing an adequate and dependable supply of essential services to a city's whole population every day, including during times of disruption, to ensure everyone's basic needs are met. Specific indicators that underpin this Goal area include: safe and accessible housing, energy supply, inclusive access to safe drinking water, effective sanitation, and sufficient and affordable food supply.

Structure: This Goal comprises five indicators, as follows:

1.1 Safe and accessible housing

1.2 Adequate energy supply

1.3 Inclusive access to safe drinking water

1.4 Effective sanitation

1.5 Sufficient food supply

Indicator 1.1.: Safe and affordable housing

Goal:

Safe housing that is affordable for all city residents.

Rationale:

Safe, adequate housing provides the shelter and security that are essential for the health and well-being of city residents, both daily and during times of shock or stress. Inadequate housing can lead to long-term social, economic and environmental challenges from the individual level to city level, and exacerbate risks to life and health during and after a shock. Inadequate housing is more likely fail during certain shock events and the subsequent loss of shelter can significantly impact on the ability of affected individuals, and the broader community, to recover.

Focus:

This indicator looks at the affordability of safe housing for all city residents. Issues associated with government control over housing, such as planning, zoning, codes and standards for housing are covered elsewhere in the CRI, in particular by Goals 7 and 12.

Qualities:

- Inclusive
- Robust

Qualitative questions:

1.1.2.	To what extent does the city have an adequate supply of safe and affordable housing?
1.1.2.	To what extent is the city's housing stock safe to live in?
1.1.3.	To what extent are there mechanisms in place for effective planning for emergency shelter and temporary housing?

Indicator 1.1.: Reference tables

1.1.1: To what extent does the city have an adequate supply of safe and affordable housing?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's supply of affordable housing is able to meet demand. This housing meets the requirements of residents (in terms of space and quality). There is an effective funding model to provide safe housing to the poor. There are incentives and affordable financing mechanisms available within the city to help upgrade the standard of existing housing stock so that it is better able to cope with predicted stresses and hazards. Land and property rights and rental regulation provide city residents with security. Programmes exist to legitimise informal settlements, in support of some of the city's poorest citizens.	There is an acute shortage of affordable housing in the city. People lack security of tenure and property rights are not acceptable. There are large parts of the city where informal (unplanned) settlements have established unsuitable to live in.
Quantitative metrics	**Preferred metric**	**Metric Definition**
	Number of homeless people per 100,000 population (ISO 37120)	The following definition is used by the United Nations to define homelessness. Absolute Homelessness refers to those without any physical shelter. This would include those who are living rough (i.e. outside, in parks or on the beach, in doorways, in parked vehicles, or parking garages), as well as those in emergency shelters or in transition houses, for example women fleeing abuse.
	Supplementary Metrics	
	• Number of households living in informal settlements in the wider metro area (1st part = UNSDN, 2015, ISO 37120, 2014, 2nd part = GHI) • Percentage of household income spent on housing (mortgage or rent?) by the poorest 20 percent of the population (Adapted from the University of Buffalo Regional Institute) • Percentage of population with secure rights to land? (Modified ISO 37120) • Average Floor area per person (UN Population Division)	

1.1.2: To what extent is the city's housing stock safe to live in?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's housing stock is controlled by well-designed and enforced codes, standards and regulations. Residential development in disaster-prone areas has been avoided and the city's residential neighbourhoods are located in areas where exposure to hazards is low. Information / training / support is provided to owners and renters giving advice on construction and repairs, including things to check and signs of damage, due to shock events or longer term structural stresses. Information is continually reviewed, updated and incorporated into city housing.	There is a lack of housing standards and regulation. Specific building codes do not exist and construction / upgrade advice to owners and renters is non-existent. Some disaster-prone areas within the city have a high residential population. There are large parts of the city where a significant proportion of residential dwellings are likely to be poorly constructed. Tenure of land in many parts of the city is unclear.
Quantitative metrics	**Preferred metric**	**Metric Definition**
	Percentage of houses which have passed national safety standards (UK Office for National Statistics)	This metric asks what percentage of the city's housing stock has passed national safety standards. A building control housing inspection usually examines the structural security of the building, space, foundations, drainage, fire regulations, brickwork and walls, ventilation, materials used and various other elements specific to the country in question and local conditions. A UK example of inspection components can be found here: http://www.haringey.gov.uk/planning-and-building-control/building-control/building-control-inspections
	Supplementary Metrics	
	• Percentage of houses which have passed national safety standards (UK Office for National Statistics) • Housing Deprivation - percentage of population living in the dwelling which is considered as overcrowded, while also exhibiting at least one of the housing deprivation measures (1) a leaking roof, or damp walls, floors, foundations, or rot in window frames or floor (referred afterwards as 'leaking roof'), 2) neither a bath, nor a shower, nor an indoor flushing toilet, or 3) too dark.) (Eurostat)	

1.1.3: To what extent are there mechanisms in place for effective planning for emergency shelter and temporary housing?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is an emergency housing plan for the city for times of emergency and/or housing is a consideration within the Major Incident Plans for the city. Plans exist which appropriately consider the need for shelter at various stages of a disaster including immediate short-term shelter and medium-long-term replacement housing. Plans consider not just the accommodation but also the facilities and staff required for these premises to be run effectively. The Housing Plan is a considered, well-transitioned process able to meet the potential impact of local hazards and subsequent demand from the city population.	There are no mechanisms in place for effective planning for emergency shelter and temporary housing.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population that could be served by city's access to stock of emergency shelters for 72 hours (Arup, 2015)	A city should have identified suitable premises across the city which can serve as appropriate shelter in an emergency. The shelter should meet the following American Red Cross Requirements: • Available to open at all times (contact details of keyholder known) • Capacity: 20sq.ft./person for evacuation shelter (40sq.ft. general shelter) • 1 toilet per 40 persons (6 for 200 persons and 14 for 500 persons) • 1 hand wash sink per 20 persons. • Sufficient resource/space to feed and supply water to shelter population • 40 to 60 square feet of sleeping space per person (an area of 5' by 8') (http://www.cdc.gov/nceh/ehs/Docs/Guide_for_Local_Jurisdictions_Care_and_Shelter_Planning.pdf) In addition to these basic requirements, the shelter should be meet specific requirements with respect to local hazards. For example, for Hurricanes/Typhoons, the American Red Cross stipulate that a shelter should: • Be outside of storm surge zone • Not be in danger of flooding • Meet building a fire safety requirements • Have been assessed by a structural engineer regarding its ability to withstand wind loads • Have had a recent risk assessment considering these and other factors (http://www.floridadisaster.org/Response/engineers/documents/newarc4496.pdf)
	Supplementary Metrics	
	• Percentage of population within a 2 mile radius of an appropriately sized, designated rest centre/emergency shelter (Arup, 2015) • Safe hazard shelter vs perceived public demand (Arup, 2015)	

Indicator 1.2: Adequate energy supply

Goal:

Sufficient and affordable energy supply for all.

Rationale:

Access to adequate, affordable energy, in the form of electricity and/or fuels (gas, oil, wood, peat, etc.), is essential for basic household functions. While the extent of energy used by city residents will vary according to a variety of social and environmental factors, access to a minimum level of energy supply is required by all to meet basic requirements, such as cooking, space heating and providing hot water to maintain adequate hygiene. Inadequate access to energy can adversely affect health, educational attainment and livelihood opportunity. Failure of energy supplies following a shock event will impact on the ability of individuals and communities to recover physically and economically.

Focus:

The focus of this Goal is on providing an adequate and dependable supply of essential services to a city's whole population every day, including during times of disruption, to ensure everyone's basic needs are met. Specific indicators that underpin this Goal area include: safe and accessible housing, energy supply, inclusive access to safe drinking water, effective sanitation, and sufficient and affordable food supply.

Qualities:

- Flexible

Qualitative questions:

1.2.1.	To what extent is there an affordable, reliable distribution of electricity and fuels to households?
1.2.2.	To what extent is there a safe distribution of electricity and fuels to households?
1.2.3.	To what extent are there mechanisms in place for effective alternative (back-up) energy supplies for households?

Indicator 1.2.: Reference tables

1.2.1: To what extent is there an affordable, reliable distribution of electricity and fuels to households?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	All households are either connected to the electricity grid and have affordable access to an adequate supply of alternative fuels (e.g., gas, oil, wood, coal). The cost of electricity and fuels are affordable to all households. The electricity supply is reliable and no households experience outages on a frequent basis.	The majority of households are not connected to the electricity grid and do not have ready access to affordable, alternative fuel supplies (e.g., gas, oil, wood, coal). The electricity supply is highly unreliable with frequent, long outages. AND/OR An adequate supply (sufficient to undertake basic household functions) of electricity and other fuels that is not affordable for many people.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average percentage of household income spent on fuel and electricity by the poorest 20 percent of the population (IAEA/IEA/UNDESA)	In this metric we are examining fuel poverty. We focus on the poorest 20 percent of the population as this will provide a clear indication of the extent to which the overall population struggles to access electricity
	Supplementary Metrics	
	• Percentage of households spending more than 10% of their income on electricity (UK ONS) • Number of days per year that households do not have fuel or electricity for the poorest 20 percent of the population (IAEA/IEA/UNDESA) • The average number of electrical interruptions per customer per year (ISO 37120)	

1.2.2: To what extent is there a safe distribution of electricity and fuels to households?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	All households are either connected to the electricity grid and have ready access to safe alternative fuel supplies (e.g., gas, oil, wood). Government programmes exist to promote safety awareness and support those currently relying on unsafe methods of fuel supply.	The majority of households are not connected to the electricity grid and rely on informal connections or other unsafe alternatives, posing increased fire risk.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city population with authorized electrical service (ISO 37120)	Percentage of households with a safe, legal electricity connection.
	Supplementary Metrics	
	• Percentage of the population formally connected to the gas network (Arup, 2015) • Number electrical fires per year (Arup, 2015)	

1.2.3: To what extent are there mechanisms in place for effective alternative (back-up) energy supplies for households?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are contingency plans for the city that identify how appropriate, alternative fuels will be supplied to households in case of a major event or extreme disruption. These plans are based on accurate, up-to-date data and consider the most appropriate alternatives for household functions (e.g., cooking, lighting, and heating). Mechanisms are in place to regularly review and update planning.	There are no contingency plans for the city that identify how supplied to households in case of a major event or extreme disruption.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of days that city fuel supplies could maintain essential household functions (through alternative sources) (Adapted from UNISDR 2014)	This examines the contingency planning of the city fuel providers and local government. It specifically examines whether they have back up arrangements in order to continue supply in the event of disruption.
	Supplementary Metrics	

Indicator 1.3: Inclusive access to safe drinking water

Goal:

Access to an adequate supply of safe drinking water.

Rationale:

Clean water is an essential requirement for human life. Stress or failure of the water supply systems can result in health epidemics and social unrest as citizens compete for scarce water supplies.

Focus:

This indicator is concerned with assessing the availability and adequacy of safe water supply for all city residents at the household level. Issues such as city-wide delivery of water infrastructure and services, and continuity planning by water service providers, are covered elsewhere in the CRI, in particular by Goal 8.

Qualities:

- Inclusive
- Robust
- Flexible

Qualitative questions:

1.3.1.	To what extent is there a safe, reliable and affordable distribution of potable water to households across the city?
1.3.2.	To what extent is there effective planning for alternative (back-up) water supplies?

Indicator 1.3.: Reference tables

1.3.1: To what extent is there a safe, reliable and affordable distribution of potable water to households across the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	All households in all parts of the city are connected to a well-regulated potable water supply with safety procedures in place to ensure stringent quality standards are met at all times.	The majority of households in extensive areas of the city are not connected to a reliably safe potable water supply. No water quality standards exist. No regulatory body exists to enforce water quality standards.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population that has access to safe and reliable water (WHO, 2012)	This metric examines what percentage of the population have regular, reliable access to a potable water supply, confirmed to be safe for human consumption. This concerns a continuous piped (or similar) supply connected to an appropriate network. This does not include water supplied by a river, well, or by connection to another house.
	Supplementary Metrics	
	• Average percentage of household income spent on potable water by the poorest 20percent of the population (Arup, 2015) • Percentage of city population with sustainable access to an improved water (ISO 37120)	

1.3.2: To what extent is there effective planning for alternative (back-up) water supplies?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are contingency plans for the city that identify how potable water will be distributed in case of a major event or extreme disruption. Well-developed mechanisms are in place to provide back-up water supplies to residents, particularly including vulnerable populations, during emergencies. Plans based on accurate, up-to-date data. Mechanisms in place to regularly review and update planning.	No mechanism for planning alternative water supplies. No plans in place for back-up supplies.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population which can be supplied water by alternative methods for 72 hours during disruption (Arup, 2015)	This examines the contingency planning of the city water providers, local government and local population. It specifically examines whether they have back up arrangements in order to continue supply in the event of disruption. This may include emergency water tankers, bottled water supply or alternative sources.
	Supplementary Metrics	
	Percent of population which has set aside emergency bottled water (FEMA)	

Indicator 1.4: Effective sanitation

Goal:

Safe, reliable and affordable sanitation provided to all areas of the city.

Rationale:

Effective provision of sanitation is vital to maintain hygienic conditions, prevent the spread of diseases and protect environmental quality. Stress or failure of sanitation systems could result in health epidemics and social unrest.

Focus:

This indicator is concerned with assessing the provision and effectiveness of adequate sanitation for all city residents at the *household level.* Issues such as *city-wide* delivery of sanitation infrastructure and services, and continuity planning by sanitation service providers, are covered elsewhere in the CRI, in particular by Goal 8.

Qualities:

- Robust

Qualitative questions:

1.4.1.	To what extent is there currently safe, reliable and affordable sanitation provided to all areas of the city?
1.4.2.	To what extent is there an emergency plan in the event that the sanitation system is disrupted and/or there is a surge in wastewater requiring treatment?

Indicator 1.4.: Reference tables

1.4.1: To what extent is there currently safe, reliable and affordable sanitation provided to all areas of the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	All households in all parts of the city are connected to reliably safe sewage network (i.e. not septic tanks) with safety procedures in place to prevent failures. Sanitation regulations and standards exist and are stringently enforced, with non-compliance occurring very rarely.	The majority of households in extensive areas have no access to sanitation. Failure of existing sanitation infrastructure is common. No standards for sanitation exist. No regulatory body exists to oversee enforcement of sanitation regulations and standards.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population with access to improved sanitation (ISO 37120)	Improved sanitation facilities include those connected to a piped sewer system or Septic tank. Ventilated pit latrines, protected by slab and composting toilets. Unimproved sanitation include toilets that do not flush to a sewerage system (e.g. river), Unprotected pit latrines without slab or open pit, simple bucket, hanging toilet or hanging latrine and open defecation. The metric only concerns private facility access, opposed to public facilities.
	Supplementary Metrics	
	• Proportion of the population connected to collective sewers (Arup, 2015) • Percentage of the population living in a dwelling without a flushing toilet for the sole use of their households (OECD BLI) • Percentage of city population served by wastewater collection (ISO 37120)	

1.4.2: To what extent is there an emergency plan in the event that the sanitation system is disrupted and/or there is a surge in wastewater requiring treatment?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Robust contingency arrangements / plans exist outlining actions and responsibilities, including alternative sanitation arrangements. Actions are communicated to citizens. Planning ensures overall sanitation system can manage disruption.	There are no plans in place to maintain adequate levels of sanitation in the event that there is a major disruption to the sanitation network or a surge in wastewater requiring treatment.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	The number of years since the city's wastewater contingency plan was updated (Arup, 2015)	A wastewater contingency plan should outline appropriate, sanitary arrangements in the event that wastewater operations are disrupted. It should include potential risks to regular operations (e.g. at pump stations) and actions to mitigate and respond to disruption. The overall aim is to ensure effluent discharged into the environment does not pose unacceptable risks to human health and the ecosystem (City of Cape Town WaterRisk Abatement Plan 2011 – available at capetown.gov.za)
	Supplementary Metrics	
	Percentage of population which can be served by alternative methods of sanitation during disruption (Arup, 2015)	

Indicator 1.5: Sufficient food supply

Goal:

Sufficient and affordable food supplies for all.

Rationale:

Food is an everyday essential requirement for human life. Stress of food supplies can lead to chronic malnutrition and result in individuals having to spend significant time and resources to obtain the food necessary to survive. This can affect the ability of the individual or community to meet other basic needs, especially for low income and disadvantaged groups. Failure of food supplies can result in famine, health epidemics and social unrest as citizens compete for scarce resources.

Focus:

This indicator is concerned with assessing the provision and adequacy of food supply for all city residents at the household level. Issues such ecological health and food freight networks are covered elsewhere in the CRI, in particular by Goals 8 and 9.

Qualities:

- Flexible

Qualitative questions:

1.5.1.	To what extent are adequate and nutritious food supplies affordable for all households?
1.5.2.	To what extent are there adequate and nutritious food supplies that are geographically accessible to households?
1.5.3.	To what extent are there mechanisms in place to ensure continuity of essential food supplies in an emergency and during times of stress (e.g., imports from major source of supply are disrupted / stopped)?

Indicator 1.5.: Reference tables

1.5.1: To what extent are adequate and nutritious food supplies affordable for all households?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has a secure, nutritious food supply that is little influenced by economic or political variables. There has been little/no fluctuation in the price of basic food commodities over the recent years. All households are able to access good quality, nutritious food at affordable prices. The city has implemented initiatives to increase production of food within city boundaries.	It is increasingly difficult for households to access good quality food at affordable prices. Prices of basic food commodities have been subject to large fluctuations in recent years and have become less affordable. The price of the city's main food staples is highly dependent on economic or political variables and there has been significant fluctuation in cost of these commodities in recent years.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of malnourished children under five as a percentage of all citizens under five (World Bank, 2015)	The way that malnutrition is measured may vary slightly by country but it is usually a measure of a child's weight per height falling significantly below the reference population.
	Supplementary Metrics	
	• Proportion of population below minimum level of dietary energy consumption (UNSDN, 2015) • Percentage of consumer spending on food at home as a proportion of income of the poorest 20 percent of the population (Arup, 2015) • Incidence of low birth rate amongst newborns (WHO, 2015)	

1.5.2: To what extent are there adequate and nutritious food supplies that are geographically accessible to households?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Initiatives have been implemented to assess the extent to which good quality, nutritious food is physically accessible to households across the city. The city has no neighbourhoods that could be described as 'food deserts' (i.e. no reasonable access to markets, supermarkets or other retail outlets that sell fresh, nutritious food at reasonable prices). All households have good access to outlets that sell adequate, fresh and nutritious foods at reasonable prices.	Many households have very limited or no access to outlets that provide adequate, fresh and nutritious foods (e.g. because there is an absence of markets or supermarkets in certain neighbourhoods).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average distance of the centre of the 20 percent most deprived neighbourhoods (LSOA level and the Index Measure of Deprivation) from a vegetable market or supermarket selling fresh food and vegetables (Arup, 2015)	This metric examines food accessibility. The focus is on the city's poorest neighbourhoods as a proxy for overall city performance with respect to quality food accessibility.
	Supplementary Metrics	

1.5.3: To what extent are there mechanisms in place to ensure continuity of essential food supplies in an emergency and during times of stress (e.g., imports from major source of supply are disrupted / stopped)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are contingency plans for the city that identify how essential food supplies will be secured for households in case of a major event or extreme disruption. Plans based on accurate, up-to-date data. Mechanisms in place to regularly review and update planning. There are effective initiatives and plans in place to increase security of supply of important foodstuffs.	There are no contingency plans for the city that identify how essential food supplies will be secured in case of a major event or extreme disruption. There are no initiatives or plans to increase security of supply of important foodstuffs.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage per capita food reserves within city (including supermarket agreements) for 72 hours (percentage population which could be served) (Adapted from UNISDR, 2014)	This metric examines what percentage of the population could be served in the first few days (before external help might be available), in the event that the city suffered a shock which impeded the city supply chain. This might include city emergency stores, arrangement with local supermarkets or other contingency arrangements.
	Supplementary Metrics	
	• Percentage of five main food staples that are imported (Arup, 2015) • Percent of population which has set aside emergency packaged food (FEMA)	

Goal 2. Diverse livelihood and employment

Description: This is facilitated by access to finance, ability to accrue savings, skills training, business support, and social welfare.

Rationale: In a resilient city, individuals are able to access diverse livelihood and employment opportunities to accrue personal savings that will support their development, as well as their survival during times of crisis. Additional social support systems are also in place to financially support citizens during times of hardship and unemployment. Businesses are able to access investment funding to grow and innovate, while entrepreneurship is encouraged and supported. A diversity of livelihood opportunities and dynamic business environment enables citizens and businesses to respond proactively to changing conditions within their city to maintain and enhance their wellbeing. A range of diverse business types and sizes, in different economic sectors, helps people to access job opportunities, even during challenging circumstances. Contingency measures, such as insurance and social welfare, contribute to supporting businesses and households through unforeseen challenges.

Focus: The focus of this Goal is on livelihood and employment opportunities for citizens. This Goal considers labour policies, alignment of current and projected skills requirements to training opportunities, and support for businesses to diversify, adapt and change so that employment opportunities are protected. Mechanisms to support the city's economy so that it is able to withstand shocks and thrive in the face of long-term stresses are considered elsewhere in the CRI, in particular by Goal 6.

Structure: This Goal comprises five indicators, as follows:

2.1 Inclusive labour policies

2.2 Relevant skills and training

2.3 Dynamic local business development and innovation

2.4 Supportive financing mechanisms

2.5 Diverse protection of livelihoods following a shock

Indicator 2.1: Inclusive labour policies

Goal:

Inclusive labour policies and standards, with an effective welfare system for low income groups.

Rationale:

A resilient city is able to provide its working-age residents with an adequate range of legitimate opportunities to earn financial resources, through pursuing employment and trade. The provision of sufficient legitimate opportunities discourages the pursuit of illegal trades which may also be harmful to the individual, for example, drug-trafficking, prostitution, or working in situations which constitute forced or 'slave' labour. The presence and enforcement of appropriate labour policies and standards protect and enhance the welfare of citizens, ensuring that they can obtain an adequate level of income, with acceptable working conditions. Inadequate development or enforcement of labour policies can expose workers to unfair or unsafe working conditions, as well as expose vulnerable people such as children, the elderly, or disadvantaged groups, to exploitative practices. This can increase the vulnerability of these workers to loss of employment or livelihood following a shock event, or chronic livelihood stress.

Focus:

This indicator considers the policies, standards and regulations that are in place to ensure the welfare of workers and equal access to employment opportunities for all citizens. It also considers if social support mechanisms are in place to provide financial support during times of unemployment and hardship.

Qu**alities:**

- Resourceful
- Inclusive

Qualitative questions:

2.1.1.	To what extent are there labour policies and standards in place that effectively deter discrimination and promote fair employment conditions?
2.1.2.	To what is extent is there a public aid system that is inclusive for all (dependent on need)?

Indicator 2.1.: Reference tables

2.1.1: To what extent are there labour policies and standards in place that effectively deter discrimination and promote fair employment conditions?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	International Labour Organization (ILO) labour standards have been ratified at the national level and there is widespread compliance in law and practice. Strong anti-discriminatory laws and regulations apply to the labour market and are enforced. Employment rates are broadly similar between different population groups. There are robust policies and standards in place to promote fair employment conditions. There are no policies or regulations in place to deter membership of organisations to protect workers' rights.	ILO labour standards have not been ratified at the national level. The labour market is entirely unregulated and discrimination is widespread. Unemployment among some population groups (gender, age, race etc.) is significantly higher than other groups. There are no policies or standards in place to promote fair employment conditions. There are no regulations in place that establish a minimum wage. Organisations to protect workers' rights are discouraged or illegal.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average hourly compensation cost (wage + benefits) for an hour of labour (US Dollars) (OECD)	This metric examines what the average worker in the city receives for an hour of work. This includes basic wage plus any benefits such as insurance, healthcare, bonuses etc.
	Supplementary Metrics	
	• Percentage jobs covered by anti-discrimination regulations (Arup, 2015) • Percentage of businesses paying the city/national living wage (Arup, 2015) • Highest percentage unemployment rate for any major group within the city (based on major ethnic groups, age and gender) (Arup, 2015)	

2.1.2: To what is extent is there a public aid system that is inclusive for all (dependent on need)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a comprehensive public aid system available. Financial assistance is provided to unemployed persons and this is available to all groups within the working-age population (regardless of ethnicity, gender and age). There are mechanisms in place to move people out of poverty and into employment and there is robust evidence that these mechanisms are effective.	There is no public aid system operating within the city. There is no financial assistance provided to unemployed persons or financial assistance is available but there are some population groups that are not considered eligible. There are no effective mechanisms in place to help unemployed people out of poverty and into employment.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population living below national poverty line (UNSDN, 2015)	This metric examines what percentage of the city population has annual earnings below the nationally defined poverty line.
	Supplementary Metrics	
	• Percentage of population with income below $1.25 (PPP) per day (UNSDN, 2015) • Percentage of population eligible for welfare benefits (Arup, 2015) • Percentage GDP spent on social welfare (Arup, 2015)	

Indicator 2.2: Relevant skills and training

Goal:

Effective mechanisms for matching skills to the current and emerging employment marketplace.

Rationale:

The provision of relevant livelihood skills training helps city residents to develop the necessary skills and capacities to pursue and find employment and adapt their livelihoods to meet the needs of changing employment marketplaces. The pursuit of livelihoods and employment allows an individual to accrue sufficient financial resources to cope with shocks and stresses. Helping city residents develop relevant skills and employability through matching skills with employment needs promotes placement, retention, and promotion of workers once placed. This also supports the city's economic stability by building the impact and availability of a competitive and quality workforce.

Focus:

This indicator considers the availability and suitability of skills programmes and initiatives, in order to either increase livelihood potential, and the ability of the city's workforce to grow and maintain skills relevant to a changing marketplace. This indicator focuses on the skills needs of the individual, rather than the requirements that businesses have of the city's workforce which is considered by Goal 6.

Qu**alities:**

- Resourceful

Qualitative questions:

2.2.1.	To what extent are there effective mechanisms in place for matching skills to the current and emerging employment marketplace?
2.2.2.	To what extent is there employment offering job security and opportunities for promotion for workers within the city?

Indicator 2.2.: Reference tables

2.2.1: To what extent are there effective mechanisms in place for matching skills to the current and emerging employment marketplace?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	It is well understood how the skills currently available within the city map to the number and type of jobs available and how this may change in the future. There is a department, agency or other organisation with responsibility for aligning skills training to meet the needs of emerging business markets in the city and a comprehensive set of initiatives is in place to achieve this. There are effective programmes in place to identify high-wage employers and high-demand professions and link individuals to these opportunities. Adult education and skills development opportunities are widely available across the city and accessible to all.	No attempt has been made to assess current skills available in the city and to compare these to the number and type of jobs available now. No projections of future skills availability and skills demand have been made. There are no departments, agencies or other organisations with responsibility for promoting and implementing programmes to match skills with current and future employment opportunities. There are few youth and adult skills development opportunities in the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of people unemployed for more than 6 months who have access to a programme that is intended to improve their employment chances (EU, 2015)	This metric examines opportunities for the long-term unemployed. Opportunities may include: • Sufficiently paid internships/work experience • Support to retrain or gain additional qualifications, • Training to improve general skills such as interview techniques, job applications etc.
	Supplementary Metrics	
	• Percentage of young adults (18-24 years) with access to a learning program (UNSDN, 2015) • Percentage of those on a learning programme who have subsequently gained employment? (Arup, 2015) • Percentage unemployed for one year or longer (Arup, 2015)	

2.2.2: To what extent is there employment offering job security and opportunities for promotion for workers within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are policies in place (at national, regional or city level) that aim to increase job security for employees. There are generally low labour turnover rates amongst employers within the city. Reliable contractual arrangements for workers are more commonplace than temporary contracts. There are abundant opportunities for promotion and career progression across the city's labour market.	There is a high labour turnover amongst employers within the city. There is little security within the labour market. Reliable contractual arrangements for workers are scarce and there is intensive use of temporary (or casual work) contracts and/or no-contract work. There are limited opportunities for promotion and career progression.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Job security: Probability to become unemployed (the number of people who were unemployed in this year, but were employed last year, divided by the total number of employed in last year, x 100 and expressed as a percentage) (OECD BLI)	This looks at how likely the population are to lose their jobs. This might be due to either a declining economy or a lack of regulations providing employment security.
	Supplementary Metrics	
	• Percentage of working population on permanent contracts v temporary contracts (Arup, 2015) • Stability Index: Number of employees with one or more years' service now / Number employed one year ago x 100 (Corporate Metric) • Separation rate (crude wastage rate): Number of leavers / average no employed x 100 (Corporate Metric)	

Indicator 2.3: Dynamic local business development and innovation

Goal:

Thriving, adaptable and inclusive local business environment.

Rationale:

An environment which supports local business development and innovation provides greater livelihood opportunities for its population and is less reliant on external economic influence. A dynamic local economy is inclusive to new business entrants, supporting job growth and access to sufficient employment opportunities. A healthy local business environment helps to retain economic profit within the city, boosting the local economy. This also helps the local economy withstand unforeseen shocks.

Focus:

This indicator considers the availability of livelihood and employment opportunities for city residents, including opportunities created through entrepreneurial activities and business start-ups. Mechanisms to promote the city as an attractive place to do business, in order to sustain a thriving economy, are considered by Goal 6.

Qu**alities:**

- Resourceful

Qualitative questions:

2.3.1.	To what extent is there a thriving, adaptable and inclusive local business environment across the city?
2.3.2.	To what extent does the city have accessible and sufficient employment opportunities?
2.3.3.	To what extent is entrepreneurship fostered within the city and support available for small business start-ups?
2.3.4.	To what extent are there mechanisms in place to promote procurement practices that support local businesses and businesses owned by women and minority groups?

Indicator 2.3.: Reference tables

2.3.1: To what extent is there a thriving, adaptable and inclusive local business environment across the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is strong economic activity across the city and a thriving environment for small and medium-sized local businesses (SMEs). There are initiatives in place to help local businesses respond to market changes. Informal economies are supported providing structure and legitimacy and pathways exist to transition from informal economies to formal economies, where required. Local livelihood cooperatives exist and are supported.	SMEs are declining in numbers. There are currently no initiatives in place to help local businesses respond to market changes or to create pathways to transition informal economies to formal economies. Local livelihood cooperatives are rare or entirely absent. Economic activity within some population groups is much less than within other population groups.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage employment change from the last year (Bureau of Labor Statistics, 2015)	Whilst the previous metric focuses on labour security, this metric examines whether overall employment opportunities have increased, decreased or remained level in the past year. A thriving business environment should be evident through positive and steady employment change.
	Supplementary Metrics	
	• Number of new businesses opened within last year (Case Western Reserve University) • Ratio of large to small businesses (Cutter et al, 2010) • Percentage of population that is informally employed (ILO, 2012)	

2.3.2: To what extent does the city have accessible and sufficient employment opportunities?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	All parts of the population have access to employment. There are local government programmes to help people to find work and initiatives such as economic incentives to businesses in order to provide persons with initial skills and opportunities. Incentives also exist for new businesses with both financial and non-financial support available supporting local business development and innovation.	There is large scale unemployment. There is a distinct lack of employment opportunities and an absence of initiatives or incentives to remedy the situation.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	City's unemployment rate (% of working-age population) (OECD BLI)	
	Supplementary Metrics	
	• Average distance/time travelled to work (accessibility) (Arup, 2015) • NEET Rates: Percentage of the 15-19 population not in education and unemployed (OECD Education at a Glance, 2008)	

2.3.3: To what extent is entrepreneurship fostered within the city and support available for small business start-ups?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are financial support mechanisms provided by the city government for business start-ups (e.g., city-focussed grants, regional/national funding sources and tax breaks etc.). Local capital for entrepreneurs and start-up businesses is readily accessible. There is a strong presence of venture capitalists operating within the city or region and active local investment networks. The city has clusters or hubs of start-up businesses and there is considerable informal support via start-up communities/networks. There are many non-financial initiatives in place to foster entrepreneurship and support new businesses (e.g., local enterprise partnerships, science parks, accelerators and incubators, universities business services).	There is little or no financial support provided by the city government available for business start-ups (e.g., city-focussed grants, regional/national funding sources and tax breaks etc.). Local capital for entrepreneurs and start-up businesses is hard to access. There are few venture capitalists operating within the city or region and an absence of local investment networks. The city has no clusters or hubs of start-up businesses and informal support via start-up communities/networks is largely absent. There is an absence of non-financial initiatives to foster entrepreneurship and support new businesses (e.g., local enterprise partnerships, advice services, science parks, accelerators and incubators, universities business services).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of new businesses registered within the city in past year, per 100,000 population (Case Western Reserve University)	This asks how many new businesses were officially registered within the city with inland revenue. This is something a new business is usually required to do for tax purposes.
	Supplementary Metrics	
	• 1-year survival rates for new businesses (Arup, 2015)	

2.3.4: To what extent are there mechanisms in place to promote procurement practices that support local businesses and businesses owned by women and minority groups?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	City government procurement practices include positive action to support local businesses, and minority- and women-owned businesses. Additionally, there are effective mechanisms in place (implemented by the city or national government, partner agencies and other organisations) to provide technical support to local, minority-owned and women-owned businesses to better enable them to develop and submit successful bids in response to both public and private tendering processes.	City government procurement practices do not include any provisions to positively support local businesses, and minority- and women-owned businesses. There are no mechanisms in place (implemented by the city or national government, partner agencies and other organisations) to provide technical support to local, minority-owned and women-owned businesses to better enable them to develop and submit successful bids in response to both public and private tendering processes.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of local businesses with female / minority owner (Arup, 2015)	Please consider, of all businesses operating within the city, what percentage has a female or ethnic minority owner or leader?
	Supplementary Metrics	
	• Percentage public procurement contracts awarded to women-owned / minority-owned businesses (% overall total). (Arup, 2015)	

Indicator 2.4: Supportive financing mechanisms

Goal:

Inclusive and resourceful finance mechanisms to enable businesses to adapt to changing circumstances and put in place contingencies for shock events.

Rationale:

Business that plan for continuity measures in the face of sudden or long-term changes to economic conditions are better prepared to identify growth opportunities as well as withstand shock events. This helps enhance the economic stability of the economy, as well as reduce risk of livelihood disruption for workers from shock events, enabling citizens to continue to provide for themselves and their families.

Focus:

This indicator considers the mechanisms in place to reduce the impact of shocks and long-term stresses on livelihoods.

Qu**alities:**

- Resourceful

Qualitative questions:

2.4.1.	To what extent is there access to credit to support small businesses and individual livelihoods from a well-regulated and diverse financial market?
2.4.2.	To what extent is support provided to help local, small businesses and businesses owned by women or minority groups to adapt to market changes and strengthen continuity plans for shock events?

Indicator 2.4.: Reference tables

2.4.1: To what extent is there access to credit to support small businesses and individual livelihoods from a well-regulated and diverse financial market?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The finance sector is well-regulated and diverse. Small and medium-sized businesses are readily able to access credit from mainstream financing sources (e.g., banks). Additionally, there is a mature micro-finance sector within the city (either public, private or both) that is available to all residents, regardless of age, gender or ethnicity.	The finance sector is very limited in size and unregulated or only weakly regulated. Micro-finance schemes are rare or entirely absent. There are very limited credit options available to support individual livelihoods and small businesses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Annual number of approved and regulated small business-loans or micro-credit per 100,000 population (Arup, 2015)	This examines how accessible credit opportunities are to the general population.
	Supplementary Metrics	
	• Size of micro-finance industry as a percentage of the loans industry in the city (GNO) • Percentage of population with access to programs for improving credit scores, credit counselling centres (Arup, 2015) • Percentage of overall loans that are provided by micro-finance schemes (Arup, 2015)	

2.4.2: To what extent is support provided to help local, small businesses and businesses owned by women or minority groups to adapt to market changes and strengthen continuity plans for shock events?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is support (financial and/or technical) available from the city government, its partner agencies or other funding bodies to help local, small businesses and businesses owned by women and minority groups to adapt to predicted market changes and long-term stresses. There is support (financial and/or technical) available from the city government, its partner agencies or other funding bodies to help these businesses prepare and plan for shock events so that disruption to their businesses and employees' livelihoods is minimised. The opportunities to access these support mechanisms is well communicated to relevant business owners.	No support (financial or technical) is available from the city government, its partner agencies or other funding bodies to help local, small businesses and businesses owned by women or minority groups to adapt to market changes and strengthen continuity plans for shock events.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage value of loans / credit provided to female / minority owned businesses as a percentage of overall loans (ILO)	
	Supplementary Metrics	

Indicator 2.5: Diverse protection of livelihoods following a shock

Goal:

Resourceful and inclusive measures to support businesses and workers following a shock

Rationale:

Mechanisms to provide emergency support to individuals and households when their livelihoods have been disrupted by a shock event are important to assist the recovery process and prevent social unrest. Support mechanisms include direct financial assistance, technical assistance, legal services and social support services.

Focus:

This indicator considers how individuals would be supported in recovering their livelihoods following a shock event. It considers support offered to small and medium-sized businesses, because these are likely to be owned and operated by city residents. It does not include business continuity planning, which is considered by Goal 6.

Qu**alities:**

- Resourceful

Qualitative questions:

2.5.1.	To what extent are households and businesses within the city insured against high risk hazards facing the city?
2.5.2.	To what extent are there mechanisms to provide emergency support to affected households following a disaster?
2.5.3.	To what extent are there mechanisms to provide emergency support to local, small- and medium-sized businesses following a disaster?

Indicator 2.5.: Reference tables

2.5.1: To what extent are households and businesses within the city insured against high risk hazards facing the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Assessments have been undertaken to assess the proportion of households and businesses within the city that have adequate insurance against high risk hazards facing the city. Measures have been put in place to encourage all households and businesses to obtain adequate levels of insurance for losses that could be incurred by high risk hazards facing the city. Additionally, the city has access to adequate, available funds capable of covering the estimated uninsured household losses following a major shock event. Alternatively, there are legal agreements in place that such funding would be met by another source (e.g., national government). Affordable insurance cover is available to all households, including vulnerable populations. There is insurance cover with risk-differentiated pricing to reduce moral hazard and incentivise physical and operational resiliency (e.g., making structures more resilient to earthquakes and developing emergency response plans).	The majority of households and businesses are understood to be uninsured in respect of the high risk hazards facing the city. Affordable insurance cover is not available to most household and businesses. The city government does not have access to adequate, available funds capable of covering the estimated uninsured household losses following a major shock event. Additionally, there are no legal agreements in place that such funding would be met by another source (e.g., national government). OR It is not known what proportion of households and businesses have relevant hazard insurance.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of buildings with insurance cover for high risk hazards relevant to the city (UN-Habitat)	This metric concerns what percentage of houses have insurance cover for hazards which pose a high risk to the city. This metric would likely need to be calculated through a combination of data from insurance companies (or survey data) and data from local emergency management authorities (to understand local hazards and hazard mapping). For many homes a standard insurance policy is sufficient (covering theft, fire etc.), but for homes at risk from specific hazards e.g. seismic, flood, or wind damage, an additional policy component will be required.
	Supplementary Metrics	
	• Percentage of businesses with insurance cover for high risk hazards relevant to the city (Arup, 2015) • Extent of natural hazard insurance coverage for homes, business, agriculture and public infrastructure (UNISDR, 2008)	

2.5.2: To what extent are there mechanisms to provide emergency financial support to affected households following a disaster?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place to provide support to households following a disaster so that they can recover their livelihoods quickly. Support includes financial assistance and non-financial support, such as technical assistance (filling out insurance claims, aid forms, tracking inventories etc.), and legal services (identifying titles for damaged/lost properties).	There are no mechanisms in place to provide support (financial or non-financial) to households following a disaster so that they can quickly recover their livelihoods quickly.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population which has access to disaster recovery mechanisms from shocks (Arup, 2015)	Disaster recovery support includes financial assistance and non-financial support, such as technical assistance (filling out insurance claims, aid forms, tracking inventories etc.), and legal services (identifying titles for damaged/lost properties). Note: Even if the city has not recently experienced a disaster, they should still have an awareness of what has been done in preparation - i.e. what mechanisms are in place.
	Supplementary Metrics	
	• Number of mechanisms in place to support affected households following a disaster (Arup, 2015)	

2.5.3: To what extent are there mechanisms to provide emergency financial support to small and medium-sized enterprises (SMEs) following a disaster?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place to provide support to small- and medium-sized businesses following a disaster. Support includes financial assistance and non-financial support, such as technical assistance (filling out insurance claims, aid forms, tracking inventories etc.), and legal services (identifying titles for damaged/lost properties). The city has access to adequate, available funds capable of covering the estimated uninsured losses incurred by small- and medium-sized businesses following a major shock event. Alternatively, there are legal agreements in place that such funding would be met by another source (e.g., national government).	There are no mechanisms in place to provide support (financial or non-financial) to local small- and medium-sized businesses following a disaster. The city does not have access to adequate, available funds capable of covering the estimated uninsured losses incurred by local small- and medium-sized business following a major shock event. Additionally, there are no legal agreements in place that such funding would be met by another source (e.g., national government).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of mechanisms in place to support local, small- and medium-sized businesses following a disaster (Arup, 2015)	The number of mechanisms (e.g. business forums, helplines, workshops) available which could provide businesses with financial and non-financial support such as technical assistance (filling out insurance claims, aid forms, tracking inventories etc.), and legal services (identifying titles for damaged/lost properties).
	Supplementary Metrics	
	• Access to micro-finance services in high hazard risk areas, evidence of utilization following disasters for recovery and reconstruction. (UNISDR, 2008). • Percentage of city businesses that feel they have support options in the event of a disaster (Arup, 2015)	

Goal 3. Effective safeguards to human health and life

Description: This relies on integrated health facilities and services, and responsive emergency services.

Rationale: Robust, effective delivery of health care, both physical and mental, is critical to the day-to-day prevention of illness and the spread of disease, as well as protecting the population during emergencies. This includes having an effective public health system to monitor and prevent the spread of disease and health epidemics. In order to respond effectively to changing demographics and health risks, health systems need to be forward-looking and adaptable. Effective responses to minimise loss of life during emergency events requires adequately resourced and trained emergency services.

Focus: The focus of this Goal is on the health care systems and emergency response services that operate within the city.

Structure: This Goal comprises four indicators, as follows:

3.1 Robust public health systems

3.2 Adequate access to quality healthcare

3.3 Well-resourced emergency medical facilities

3.4 Effective emergency response services

Indicator 3.1: Robust public health systems

Goal:

Robust monitoring and mitigation of public health risks.

Rationale:

Public health services help to ensure that city-scale health risks are monitored, epidemics are avoided and wider health issues are managed. Effective disease and general health monitoring and management, community outreach, health education and mental health support are all required within a complete health system. These support services help reduce the occurrence of health-related shocks and stresses.

Focus:

This indicator considers the extent to which wider public health services are in place. It assesses how extensive and inclusive community health outreach and education initiatives are. Finally, it examines how proactive the city is in its disease monitoring and control activities (monitoring, vaccination and pest control programmes, inspections and wider activity).

Qu**alities:**

- Robust

Qualitative questions:

3.1.1.	To what extent are health risks monitored and controlled within the city?
3.1.2.	To what extent are public health awareness and education programmes implemented across the city and extended to disadvantaged or vulnerable groups?
3.1.3.	To what extent are programmes to address substance abuse and addiction implemented across the city and extended to disadvantaged or vulnerable groups?

Indicator 3.1.: Reference tables

3.1.1: To what extent are health risks monitored and controlled within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are well-funded programmes in place to identify and monitor current and future health risks within the city. There are well-funded programmes in place to control the spread of diseases (e.g., infectious, water-borne or vector-borne) and vaccination programmes to reduce known health risks. There are effective screening programmes to monitor at risk groups (e.g., by age, gender, ethnicity) for high risk health issues (e.g., cancers, heart disease, sexual health, cognitive).There are specific initiatives in place to extend these programmes to minority and vulnerable groups. Public facilities (e.g., hospitals) are regulated and routinely inspected. Routine public health inspections of hospitality businesses (e.g., hotels, restaurants) are undertaken. The findings of these inspections are made available to the general public.	There is little or no monitoring of health risks within the city. There is a severe lack of funding for programmes to control the spread of diseases (e.g., infectious, water-borne or vector-borne), screening programmes, or to vaccinate against known health risks. Minority and vulnerable groups are often excluded from vaccination programmes (either deliberately or inadvertently). There is no regulation or routine inspection of public facilities and hospitality businesses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of children 12-23 months who have received specific vaccines for BCG, measles, and three doses each of DPT and polio vaccine (excluding polio 0 months) per poorest quintile of the population (percentage 12-23 year olds within poorest 20% population) UNSDN, 2015	This is the list of recommended vaccines according to the World Health Organisation. It was felt especially important to focus on the poorest 20% of the population. The results from this are also deemed to be an appropriate proxy for overall city performance.
	Supplementary Metrics	
	• New cases of vaccine preventable diseases (WHO, 2015)HIV incidence, treatment rate detection rate and mortality (modified UNSDN, 2015 Indicator) • Percentage of at risk groups received cancer screening tests / other screening tests (CDC, 2013) • Percentage of high risk groups vaccinated against influenza (Kruk) • Sexually transmitted infections (STIs) incidence (WHO, 2015)	

3.1.2: To what extent are public health awareness and education programmes implemented across the city and extended to disadvantaged or vulnerable groups?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to link the findings of public health risk monitoring to the development of strategies for public health awareness and education programmes. There are well-funded public health awareness and education programmes and programmes to promote healthy lifestyles and behaviours. The development and delivery of public health awareness and education campaigns is largely funded by the government (national, regional or city). There is provision in the school curriculum for sexual and general health education. Health information and warnings are communicated in minority languages and by methods appropriate for different ability groups (e.g., deaf, blind, illiterate etc.).	There are no mechanisms in place to link the findings of public health risk monitoring to the development of strategies for public health awareness and education programmes. There is little or no funding for public health awareness and education programmes or programmes to promote healthy lifestyles and behaviours. There is a strong reliance on NGOs to lead on delivering public health awareness and education campaigns. There is no provision in the school curriculum for sexual and general health education.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average life expectancy at birth (years) (World Bank)	Average life expectancy for the city population is felt to be an appropriate proxy for overall public health awareness and behaviour within the city.
	Supplementary Metrics	
	• Preventative health budget as a percentage of total health budget, Percentage of preventive health budget spent on communication (Kruk, ISET, 2014) • Percentage public health facilities receiving hygiene training (Arup, 2015) • Percentage of population overweight or obese (BMI > 25) (WHO, 2015)	

3.1.3: To what extent are programmes to address substance abuse and addiction implemented across the city and extended to disadvantaged or vulnerable groups?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has effective programmes for treating substance abuse and addiction. Programmes are accessible in terms of location, and affordability. These are equally available to all persons, especially those particularly disadvantaged or vulnerable, regardless of ethnicity, religious beliefs or income group. These programmes are adequately-funded, have sufficient capacity. The effectiveness of these programmes at tackling addiction is monitored. The city does not have a widespread drug problem.	There are no public programmes to help people recover from substance abuse or those that do exist are inaccessible in terms of location, affordability or other factors. The city has a widespread problem with substance abuse.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Drug-related mortality with drugs as primary cause of death per 100,000 population aged 15-64 (UNODC, 2012)	
	Supplementary Metrics	
	• Number of drug rehabilitation centres per 100,000 persons (Arup, 2015) • Drug-related mortality with ranking of drugs as primary cause of death, rate per million population aged 15-64 (UNODC) • Tobacco use amongst persons 18+ years (WHO, 2015)	

Indicator 3.2: Adequate access to quality healthcare

Goal:

Adequate and inclusive access to quality general healthcare.

Rationale:

Day-to-day medical resources are important to ensure the long-term health of city residents. A city is made up of the people who live there. It functions through their actions. A healthy population is able to function through day to day activities to pursue livelihood opportunities, grow the population, and maintain services the city provides every day as well as following a shock.

Focus:

This indicator concerns the availability, affordability, quality and sufficiency of day-to-day healthcare for all citizens.

Qu**alities:**

- Robust

Qualitative questions:

3.2.1.	To what extent do general healthcare services operate within capacity at all times and provide adequate and affordable healthcare to all?
3.2.2.	To what extent is effective maternal care and family planning available and affordable to all?
3.2.3.	To what extent are healthcare services for non-communicable diseases (NCDs) available and affordable to all?
3.2.4.	To what extent are mental healthcare services affordable and accessible to all?

Indicator 3.2.: Reference tables

3.2.1: To what extent do general healthcare services operate within capacity at all times and provide adequate and affordable healthcare to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	General healthcare services are accessible for all and there are mechanisms in place to ensure it is affordable for all. No population groups find it hard to access affordable healthcare. Staff shortages are rare within general healthcare services across the city and there are adequate resources of qualified, skilled, motivated healthcare practitioners within the city. There are mechanisms in place to ensure that the system is able to cope with surges in demand (e.g., during an epidemic or extreme weather conditions) and there is typically no significant negative impact on the health outcomes of patients seeking treatment from healthcare services at these times.	There are no mechanisms in place to ensure that general healthcare services across the city are affordable for all. Some population groups find it hard to access affordable healthcare. Staff shortages are very common within general healthcare services across the city and there are severe shortages of skilled and motivated healthcare practitioners within the city. There is no spare capacity, and no mechanisms in place to draft in additional resources, to cope with surges in demand (e.g., during an epidemic or extreme weather conditions), and there is typically a significant negative impact on the health outcomes of patients seeking treatment from healthcare services at these time.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of physicians (MD/DO degree) working within the city per 100,000 population (ISO 37120)	It includes private General Practitioners
	Supplementary Metrics	
	• Percentage of population that have health insurance coverage, including both public and private or have access to 'free' (at the point of delivery) healthcare (adapted from the University of Buffalo) • $ per year per capita spent on healthcare (World Bank) • Number of nurses / midwives per 100 000 population (ISO)	

3.2.2: To what extent is effective maternal care and family planning available and affordable to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Maternal care, family planning education, facilities and resources are well-funded, widely available and free at the point of service. Specific initiatives to reach minority and vulnerable groups are in place. Good level of professional healthcare and support provided to mother and baby during and after pregnancy.	Maternal care, family planning education, facilities and resources are severely under-funded and are not readily available or are unaffordable to many within the city. Minority and vulnerable groups are frequently unable to access these services.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Maternal mortality rate per 100,000 live births (UNSDN, 2015)	
	Supplementary Metrics	
	• Neonatal, infant, and under-five mortality rates (UNSDN, 2015) • Skilled attendant at birth (%) (UNICEF, 2013) • Contraceptive prevalence rate (UNSDN, 2015)	

3.2.3: To what extent are healthcare services for non-communicable diseases (NCDs) available and affordable to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are quality, well-funded facilities and personnel to manage NCD cases within the city. People receive timely, affordable and quality treatment. Specialist units, facilities and experts exist for specific NCDs such as cancer, cardiovascular issues, respiratory issues, diabetes, kidney problems etc.	There is a lack of quality facilities and personnel to NCDs. Resources are stretched and people are not getting access to appropriate and affordable treatment in a timely fashion. There is a lack of specialist treatment within the city for key NCDs such as cancer, cardiovascular issues, respiratory issues, diabetes, kidney problems etc.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Premature (before age of 70) NCD mortality rate per 100,000 population (WHO, 2012)	
	Supplementary Metrics	
	• Number of new cases of NCDs per year (Arup, 2015) • Probability of dying between exact ages 30 and 70 from any of cardiovascular disease, cancer, diabetes, or chronic respiratory disease (UNSDN, 2015) • Cancer survival rate (5-year age-standardised net survival for adults (aged 15–99 years) diagnosed with one of ten common malignant diseases) (CDC, 2010)	

3.2.4: To what extent are mental healthcare services affordable and accessible to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are free mental health services available within the city and they are accessible to all. There is sufficient health and psychological support available for: • Victims of crime and violence • Immigrants • Addiction patients Additionally, the city's emergency planning has considered a surge in demand for mental health support post-shock.	Mental health services are severely under-resourced within the city and are unable to meet demand for these services. There is a severe shortage of health and psychological support available for: • Victims of crime and violence • Immigrants • Addiction patients The city's emergency planning does not consider a surge in demand for mental health support post-shock.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of mental health practitioners per 100,000 population (ISO 37120)	Mental health practitioners includes psychiatrists, clinical psychologists, clinical social workers, qualified mental health counsellors and therapists and psychiatric nurses.
	Supplementary Metrics	
	• Percentage of mental health illnesses that are estimated to go untreated in the city (for the most recent year for which there is data) (Arup, 2015) • Percentage of population that has mental health insurance coverage, including both public and private or have access to 'free' (at the point of delivery) mental healthcare (University of Buffalo Regional Institute adapted) • Suicide rate per 100,000 (ISO)	

Indicator 3.3: Emergency medical resources

Goal:

Adequately resourced emergency medical services.

Rationale:

Emergency medical resources are essential in order to manage both individual and larger scale health emergencies. These resources preserve the lives of city residents in the crucial period following a shock. This helps city residents continue to live productive lives, helps maintain the unity of family units and communities, as well as supporting the functioning of the city as the people who provide services survive and are able to continue their actions.

Focus:

This indicator considers emergency medical resources beyond the hospital front door. This includes the physical infrastructure, equipment and personnel that form the emergency medical resources of the city (e.g., in emergency rooms / accident and emergency rooms). Importantly, it does not include consideration of the 'blue-light' medical emergency response service on the street (i.e. ambulances and paramedics), as this is covered by Indicator 3.4.

Qu**alities:**

- Resourceful
- Flexible

Qualitative questions:

3.3.1.	To what extent are emergency medical services adequately resourced to deal with major events?
3.3.2.	To what extent are emergency medical services adequately prepared to deal with major events?

Indicator 3.3.: Reference tables

3.3.1: To what extent are emergency medical services adequately resourced to deal with major events?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a good distribution of well-resourced emergency medical facilities across the city meaning all citizens are within appropriate proximity of a hospital. There are enough emergency physicians and nurses to deal with surges in causalities from major incidents. There are sufficient specialist skills / training within this pool of staff to deal with specialist emergency cases (e.g., burns, pandemic cases) and appropriate medical equipment and facilities. There are formal arrangements between networks of hospitals and health organisations (including NGOs) to help manage surge incidents.	There are very few emergency medical facilities across the city. These are not effectively distributed spatially. There are not enough emergency physicians (surgeons, doctors) and nurses to deal with surges in causalities from major incidents. There are no agreements with neighbouring hospitals to accept certain casualties in a major incident.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Hospital beds per 100,000 people (ISO 37120)	In-patient hospital beds
	Supplementary Metrics	
	• Average number of kilometres [OR TRAVEL TIME] to closest trauma centre per person (Arup, 2015) • Emergency physicians or nurses per 1000 (Kruk) • Number persons died whilst awaiting treatment / year? (Arup, 2015)	

3.3.2: To what extent are emergency medical services adequately prepared to deal with major events?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is effective, integrated emergency planning within the healthcare system to deal with major events. All emergency medical facilities have business continuity plans in place and plans for dealing with major disasters. A city-wide plan exists for co-ordinating medical resources following a major event and roles and responsibilities are clearly defined within this. Disaster preparedness drills are routinely undertaken at the individual facility level (at least annually) and the city-wide level (at least every 3 years).	Emergency planning within the healthcare system to deal with major events is non-existent or severely limited. There is no city-wide plan for co-ordinating medical resources following a major event. Roles and responsibilities for dealing with a major event have not been defined. Disaster preparedness drills are rarely, if ever, undertaken at the individual facility level or the city-wide level.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of hospitals that have carried out disaster preparedness drills in the last year (Adapted from UNISDR, 2008)	Disaster preparedness drills should test the ability of hospital infrastructure and personnel to continue to function in an emergency. It should consider aspects such as back-up power supply (e.g. emergency generators), surge capacity (a rapid rise in casualties), contamination, security threats, evacuation, as well as any natural hazards the hospital might face.
	Supplementary Metrics	
	• Number times hospital has failed to meet surge demands in last 5 years (Arup, 2015) • Percentage of hospitals that have developed business continuity plans and plans for dealing with major disasters (UNISDR, 2008 adapted)	

Indicator 3.4: Effective emergency response services

Goal:

Adequately resourced emergency response services.

Rationale:

Adequate availability of emergency medical services saves lives every day. Effective emergency response services helps to reduce the risk that suffering a medical emergency will impair the individual's quality of life. This helps to reduce chronic stress on medical services as well as reduces the individual's reliance on social or government support.

Focus:

This indicator considers the training and resourcing of emergency response services, which include (but are not limited to) firefighters, ambulance/ paramedics, coastguard, search and rescue. The police service in its capacity to respond to emergencies (blue-light responses) is also considered here. Overall policing in relation to security and crime prevention is considered by Goal 5.

Qu**alities:**

- Resourceful
- Flexible

Qualitative questions:

3.4.1.	To what extent are the ambulance service adequately trained and resourced to effectively respond to call-outs?
3.4.2	To what extent are the fire services adequately trained and resourced to effectively respond to call-outs?
3.4.3.	To what extent are police adequately trained and resourced to effectively respond to call-outs?
3.4.4.	To what extent is there an adequately trained, resourced and coordinated official emergency response to manage major incidents and the immediate aftermath of disasters?
3.4.5.	To what extent does city have mechanisms in place to mobilise critical non-financial resources (people, equipment) for providing emergency response and staple goods for subsequent relief (i.e. food and basic necessities) after a disaster event?

Indicator 3.4.: Reference tables

3.4.1: To what extent are the ambulance service adequately trained and resourced to effectively respond to call-outs?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Paramedics / ambulance services operate below maximum capacity at all times and are able to respond to 100% of day-to-day call-outs. There are always sufficient paramedics to respond to incidents relating to health (ambulance). There is a robust call-out system to receive and process public emergency calls. Paramedics / emergency health responders have adequate capacity and/or arrangements to manage surges in the number of incidents. They are well trained, equipped and regulated. They are also prepared and equipped to deal with specific large scale emergencies that the city may face (e.g., earthquakes, terrorism etc.) ensuring that those effected can be located and assisted.	There are no ambulance response services operating within the city or there is a severe capacity deficit in the city's everyday emergency response capability. This leaves it unable to effectively manage (everyday) health callouts. Paramedics / emergency health responders are not trained, equipped, generally prepared to respond to major incidents which may require specific expertise (e.g., earthquakes, terrorism etc.)., terrorism etc.).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of paramedics per 100,000 population (United States Department of Commerce)	Paramedic: a frontline healthcare professional trained to give emergency medical care to people who are seriously ill with the aim of stabilizing them before they are taken to the hospital. Often the term Paramedic is used in conjunction with Ambulance, the name 'Ambulance Paramedic' denoting the most common workplace for these health professionals (Adapted from Oxford Dictionary, 2015 and http://www.studentparamedic.org.au))
	Supplementary Metrics	
	• Average emergency (ambulance) callout response time last year (minutes) (Arup, 2015) • Percentage of paramedics trained to deal with risks related to the city's local hazard profile (Arup, 2015)	

3.4.2: To what extent are the fire services adequately trained and resourced to effectively respond to call-outs?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Fire response services operate below maximum capacity at all times and are able to respond to 100% of day-to-day call-outs. There are always sufficient firefighters to respond to fire incidents. There is a robust call-out system to receive and process public emergency calls. Firefighters have surplus capacity and/or arrangements to manage surges in the number of incidents. They are well trained, equipped and regulated. They are also prepared and equipped to deal with specific large scale emergencies that the city may face (e.g., earthquakes, terrorism etc.) ensuring that those effected can be located and assisted.	There are no fire response services operating within the city or there is a severe capacity deficit in the city's everyday emergency response capability. This leaves it unable to effectively manage (everyday) fire incidents. Firefighters are not trained, equipped, generally prepared to respond to major incidents which may require specific expertise (e.g., earthquakes, terrorism etc.).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of fire-fighters per 100,000 population (ISO 37120)	Number of full-time, **operational** firefighting personnel who regularly respond to daily calls. This does **not** include non-emergency personnel such as officers for fire prevention, safety, training, administration, senior management, communication and dispatch and any others not directly involved in firefighting. Does not include volunteer firefighters.
	Supplementary Metrics	
	• Average response time for fire department from initial call (ISO 37120) • Number of fire related deaths per 100,000 population (minutes) (ISO 37120) • Percentage of firefighters trained to deal with risks related to the city's local hazard profile (Arup, 2015)	

3.4.3: To what extent are police adequately trained and resourced to address day to day call-outs?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Police response services operate below maximum capacity at all times and are able to respond to 100% of day-to-day call-outs. There are always sufficient police to respond to incidents relating to law and order (e.g., police). There is a robust call-out system to receive and process public emergency calls. Police have surplus capacity and/or arrangements to manage surges in the number of incidents. They are well trained, equipped and regulated. They are also prepared and equipped to deal with specific large scale emergencies that the city may face (e.g., earthquakes, terrorism etc.) ensuring that those effected can be located and assisted.	There are no police response services operating within the city or there is a severe capacity deficit in the city's everyday emergency response capability. This leaves it unable to effectively manage (everyday) incidents relating to law and order (police response). Police are not trained, equipped, generally prepared to respond to major incidents which may require specific expertise (e.g., earthquakes, terrorism etc.).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of (operational) police officers per 100,000 population (ISO 37120)	Permanent full-time (or full-time equivalent) operational police officers should meet the following criteria: • Work in an official capacity; • Have full arrest powers; • Carry formal police identification. • Be paid from governmental budget Part-time employees can be converted to full-time equivalents (e.g. four employees working 10 h per week would equal one full-time employee working a 40 h week). Temporary officers shall not be included.
	Supplementary Metrics	
	• Average emergency (police) callout response time last year (Arup, 2015) • Percentage of police trained to deal with risks related to the city's local hazard profile (Arup, 2015)	

3.4.4: To what extent is there an adequately trained, resourced and coordinated official emergency response to manage major incidents and the immediate aftermath of disasters?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Emergency responders (police, fire, ambulance etc.) are trained, equipped and coordinated to manage major incidents (e.g., earthquakes, terrorism etc.). Search and Rescue capability exists with robust strategic arrangements to utilise assets such as the military, NGOs or other trained volunteers as appropriate, Response teams are equipped to meet the needs of all high risk disaster scenarios. This includes any specialist equipment and training (e.g., response to hazardous materials). The city has undertaken a detailed inventory of the full set of response assets both within the city's direct control as well as assets outside its control (i.e. controlled by the private sector or other government body). The inventory is based on accurate, up-to-date data. Mechanisms are in place to regularly review and update the inventory. Responders receive regular training in disaster management/ search and rescue (at least once per year).	There is no emergency response and search and rescue capacity within the city and none available for deployment within the city from regional or national sources if required. It is unable to provide immediate response to major incidents / emergencies.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of search and rescue trained emergency responders with collapsed structures expertise per 100,000 population (Arup, 2015)	Number of qualified search and rescue responders who are specifically trained to casualties respond in collapsed structure environments. These may or may not be specifically trained teams from existing emergency services and military but most have the appropriate training.
	Supplementary Metrics	
	• Number multi-stakeholder emergency scenario drills / year (Arup, 2015) • Number by type of internationally certified emergency and recovery management specialists. (UNISDR, 2008) • Search and Rescue specialists per 100,000 population (Arup, 2015)	

3.4.5: To what extent does city have mechanisms in place to mobilise critical non-financial resources (people, equipment) for providing emergency response and staple goods for subsequent relief (i.e. food and basic necessities) after a disaster event?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are city-wide mechanisms in place that address emergency resource accessibility. The city has undertaken a detailed inventory of the full set of relief assets both within the city's direct control as well as assets outside its control (i.e. controlled by the private sector or other government body). The inventory is based on accurate, up-to-date data. Mechanisms are in place to regularly review and update the inventory. This includes emergency relief (food, shelter, water etc.). It addresses logistics including use of distribution teams and vehicles to manage demand. Responders and volunteers are all effectively trained and coordinated to ensure the immediate needs of those affected by a disaster can be met. Resource preparation / planning reflects the worst-case scenario potential of the city's risk profile.	There are no city-wide emergency plans in place that incorporate planning for emergency resource accessibility. No mechanism to mobilise critical non-financial resources. The city has not undertaken an inventory of assets. OR The city has undertaken an inventory, but the inventory was incomplete (i.e., did not include assets outside of direct city control) or is out of date. No mechanism to establish agreements to utilise critical assets / supplies that are not within direct city controls during times of need.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of reviews of city-wide emergency protocols undertaken in the past 5 years (Arup, 2015)	There should be a city-wide emergency protocol which outlines coordinated actions from all city emergency responders and how this relates to wider regional and national response. It should outline which agency assumes leadership in different emergency scenarios, the response roles of different agencies and the human and non-human resources available.
	Supplementary Metrics	
	• Coverage by type and objective of assessment of human resources capacity, technical and financial assessments for disaster risk reduction. (UNISDR, 2008) • Percentage budget allocated for emergency relief (Arup, 2015)	

Economy and Society

This dimension relates to the **organisation** of cities – how social and economic systems enable urban populations to live peacefully, and act collectively. Included within this dimension are the systems that enforce law and order and ensure fiscal management. Also considered is the environment within a city that 8creates collective identity and mutual support – open spaces and cultural heritage play an important role in this.

Structure:

This dimension of the City Resilience Index comprises three Goals, as follows:

4. Collective identity and community support
5. Comprehensive security and rule of law
6. Sustainable economy

(Image Opposite)

Mumbai, India

Goal 4. Collective identity and community support

Description: This is observed as active community engagement, strong social networks and social integration.

Rationale: Communities that are active, appropriately supported by the city government and well-connected with one another contribute to the bottom-up creation of a city with a strong identity and culture. This enables individuals, communities and the city government to trust and support each other, engage with each other, and face unforeseen circumstances together without civil unrest or violence.

Focus: The focus of this Goal is on relationships within communities and between communities. It also considers the sense of identity, civic pride and engagement with city life by citizens.

Structure: This Goal comprises four indicators, as follows:

4.1 Local community support

4.2 Cohesive communities

4.3 Strong identity and culture

4.4 Actively engaged citizens

Indicator 4.1.: Local community support

Goal:

Cohesive social structures providing support at individual, household and local community level.

Rationale:

Top-down support for individuals and households to reduce isolation, strengthen family units and foster good relationships within communities is important to support the development of cohesive social structures within communities. It is also important for helping to ensure that individuals are not isolated during times of shock or stress, and communities work together to adapt to stresses and recover from shocks.

Focus:

This indicator concerns the top-down support provided by city government, other agencies and partners, and formal networks to provide social and emotional support to individuals, households and family units.

Qualities:

- Reflective
- Inclusive

Qualitative questions:

4.1.1	To what extent is help provided for vulnerable individuals who may not otherwise have immediate social support?
4.1.2	To what extent is support provided within communities to strengthen family units?
4.1.3	To what extent do local communities and community organisations provide an additional avenue of immediate support for citizens?

Indicator 4.1.: Reference tables

4.1.1: To what extent is help provided for vulnerable individuals who may not otherwise have immediate social support?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Robust safeguards exist to protect and support disadvantaged or vulnerable persons (e.g. domestic abuse, child protection). Mechanisms ensure that social protection issues such as abuse, underage marriage and street children are comprehensively addressed (uncovered and dealt with). These mechanisms have proven to be widely effective and ensure that no citizen is forgotten about during times of shock or stress. These mechanisms are consistently reviewed. Inclusive social care mechanisms also exist to ensure that vulnerable persons (who may otherwise be isolated/lack support) are supported and their needs are met. These might include (not is not limited to) support groups, home visits and additional welfare support.	There is an absence of safeguards to protect and support disadvantaged or vulnerable persons (e.g. domestic abuse, child protection). Issues such as abuse, underage marriage and street children are not effectively monitored and addressed. A lack of effective mechanisms and activities leaves certain citizens (who need social support) even more vulnerable and isolated, during times of both shock and/or stress.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage children living outside of the care of a responsible adult (Arup, 2015)	This includes street children and any other children who do not have appropriate adult care. It does not include those which are under appropriate, safe care of verified adults in children's homes, or those under foster care or adoption.
	Supplementary Metrics	
	• Number of hospice / nursing home facilities in city? (Arup, 2015) • Child marriage – percentage of women 20-24 years old who were married or in union before age 18) (UNICEF, 2013) • Percentage of children under age 5 whose birth is registered with a civil authority (UNSDN, 2015) • Percentage of harmful traditional practices, including female genital mutilation/cutting (UNSDN, 2015) • Percentage of referred cases of sexual and gender-based violence against women and children that are investigated and sentenced (UNSDN, 2015)	

4.1.2: To what extent is support provided within communities to strengthen family units?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are formal and informal mechanisms in place to provide support and assistance to families in order to strengthen family units (e.g., tax breaks; price reductions for families for public transport; childcare support). Families receive social support in times of hardship (e.g., food banks/other support, external mediation / family advice and/or counselling to resolve disputes.). There are regular family-focused events throughout the city.	There are no programmes in place to provide support and assistance to families in order to strengthen family units. Families are not receiving any kind of social support. There are few, if any family-orientated events within the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Family benefits public spending as a percentage of total city GDP (OECD)	Public spending on family benefits includes financial support that is exclusively for families and children. Spending recorded in other social policy areas such as health and housing also assist families, but not exclusively, and it is not included here. Broadly speaking there are three types of public spending on family benefits: 1. Child-related cash transfers to families with children: this includes child allowances, public income support payments during periods of parental leave and income support for sole parents families 2. Public spending on services for families with children: includes, direct financing and subsidising of childcare and early education, spending on assistance for young people (e.g. residential facilities), family services, including centre-based facilities and home help services. 3. Financial support for families through the tax system. Includes tax exemptions; child tax allowances; child tax credits. (www.oecd.org/social/family/database)
	Supplementary Metrics	
	• Percentage of population living alone (European Union, Eurostat) • Percentage of people responding agree or strongly agree to survey "If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not? (OECD BLI) • Average household size (Arup, 2015) • Percentage of children under 5 experiencing responsive, stimulating parenting in safe environments (UNSDN, 2015)	

4.1.3: To what extent do local communities and community organisations provide an additional avenue of immediate support for citizens?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There frequently a strong sense of belonging within local communities and neighbours generally know each other providing an additional level of support. There is also support provided by community groups, which vary in their scale and type. These may include (but are not limited to): • Spatial communities (local neighbours, streets, neighbourhoods, parishes etc.); • Communities of shared interest (e.g., local sports teams, other hobbies); • Communities of shared circumstance (e.g., disability groups, expatriate communities etc.); • Communities of shared experience (e.g., flood groups). This community provides an additional avenue of support for persons, outside of the immediate family. Funding is provided to community groups (e.g., by the city government, private sector) to ensure that they can continue to operate.	There is frequently little sense of support within communities, with little interaction between neighbours. Few community groups exist and people have little connection or interaction with those within their community / communities.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of people who responded that they know the names of their immediate neighbours (by survey) (Adapted from AP-NORC (at the University of Chicago))	This can be based on a sample survey but should include at least 100 households from each district or borough within the city
	Supplementary Metrics	

Indicator 4.2.: Cohesive communities

Goal:

Cohesive, harmonised communities across the city.

Rationale:

Cohesive communities foster a sense of shared community purpose, support and maintain networks, relationships, services and goods. This in turn builds community participation and engagement as well as responsibility for action and reduces social tensions between communities. This is especially critical following a shock when networks and relationships are most likely to be disrupted. Characteristics of trust, knowledge of who and how to access help, and a sense of mutual support helps a community rebound faster and more fully, and can even enhance feelings of cohesion through shared experiences.

Focus:

This indicator considers the relationships between communities across the city. It addresses harmony across different communities and support for certain community groups which might otherwise be disadvantaged or marginalised.

Qualities:

- Reflective
- Integrated

Qualitative questions:

4.2.1.	To what extent are communities within the city cohesive across different racial and cultural groups?
4.2.2.	To what extent is support provided to communities to empower disadvantaged groups?
4.2.3.	To what extent is support provided to communities to support young citizens?

Indicator 4.2.: Reference tables

4.2.1: To what extent are communities within the city cohesive across different racial and cultural groups?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Communities are well-integrated across the city and there is a high level of tolerance between people from different backgrounds living within the city. Strong and positive relationships are being developed between people from different backgrounds and circumstances in the workplace, in schools and within neighbourhoods. There are no gated communities for specific race or income groups. Professional and wider life opportunities are equally available to all citizens and discrimination by hierarchy is not tolerated (by the city government or by wider society).	There is considerable tension between people from different backgrounds living in the city. Violence between different racial and cultural groups is common. For different racial, religious or cultural groups within the city there are commonly separate educational arrangements, separate community and voluntary bodies, employment, places of worship, language, social and cultural networks. Gated communities for specific race or income groups are common. There are still built-in limits for certain groups.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Hate crimes reported per 100,000 population (FBI, 2015)	A hate crime is defined as a criminal offence committed against a person or property, where there is evidence that the offence was motivated by hate, based on race, national or ethnic origin, language, colour, religion, sex, age, mental or physical disability, sexual orientation, or any other similar factor. (http://www.statcan.gc.ca/pub/85-002-x/2014001/article/14028-eng.htm) If a country has no reporting and/or measurement mechanism for hate crime data sources should report a base assumption of 510 crimes.
	Supplementary Metrics	
	• Percentage of respondents from ethnic minorities who have experienced discrimination or hostility based on their ethnicity, culture background or religious beliefs (Arup, 2015) • Percentage of community-based organizations (including local health departments, tribal health services, nongovernmental organizations, and State agencies) providing population-based primary prevention services in violence (CDC, 2008) • Hate crimes per 100,000 (motivated by bias against a particular race, religion, sexual orientation, ethnicity, or disability) (FBI Hate Crime Statistics 2013)	

<table>
<tr><th colspan="3">4.2.2: To what extent is support provided to communities to empower disadvantaged groups?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td>Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td>There are networks and programmes within the city that provide support for disadvantaged and vulnerable groups, including women, minority (religion, race etc.) groups and disability groups. Programmes exist to tackle tensions between groups and increase local cohesion.</td><td>There are no networks or programmes within the city that provide support for disadvantaged and vulnerable groups, including women, minority groups (religion, race etc.) and disability groups.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td>Metric Guidance</td></tr>
<tr><td>Women as a percentage of total elected to city-level office
(ISO 37120)</td><td>Percentage of all city government officials that are female</td></tr>
<tr><td colspan="2">Supplementary Metrics</td></tr>
<tr><td colspan="2">Percentage of seats held by women and minorities in elected city office according to their respective share of the population (UNSDN, 2015 Adapted)
Ethnic minorities as a percentage of total elected to city-level (ISO 37120 Adapted)
Percentage of women employed in the city government workforce (ISO 37120)</td></tr>
</table>

4.2.3: To what extent is support provided to communities to support young citizens?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are effective initiatives in place to empower young people to engage with issues affecting the city and their communities, with programmes specifically targeted at young people from disadvantaged and minority groups. Mechanisms provide support and opportunities to help young people to feel part of their community and city overall. There are specific and effective measures are in place to address youth unemployment and youth violence.	The city experiences problems associated with young people who feel disenfranchised. There is a significant absence of programmes to engage youth in society, develop their life skills or address youth unemployment and youth violence.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Youth unemployment rate (percentage of youth labour force) (UNSDN, 2015)	Persons above national legal working age and under 24 years of age who are without work and are currently available for work.
	Supplementary Metrics	
	• Youth crime rate (Arup, 2015) • Percentage of 13-19 year olds that have access to a community group / youth support (Arup, 2015) • Percentage of 15-24 year olds who responded positively to a survey question 'Is your city a good place to live?'	

Indicator 4.3.: Strong identity and culture

Goal:

Cohesive local identity and culture, in which all citizens feel a sense of belonging in the city.

Rationale:

Reinforcing local identity and culture contributes to positive relationships between individuals while reinforcing their collective ability to improve the environment where they live, work, create and play. A strong city-wide sense of identity also helps communities pull together to act collectively during times of shock or stress.

Focus:

This indicator explores the sense of collective identity at the city-wide scale. It examines the extent to which a city spirit, culture and identity exists.

Qualities:

- Robust
- Integrated

Qualitative questions:

4.3.1	To what extent is there a sense of cohesive identity and culture within communities and neighbourhoods across the city?
4.3.2	To what extent is there a cohesive sense of city-wide identity and culture, in which all citizens feel a sense of belonging?

Indicator 4.3.: Reference tables

4.3.1: To what extent is there a sense of cohesive identity and culture *within communities and neighbourhoods* across the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Within many neighbourhoods and communities across the city, residents share a strong sense of identity and culture. Residents have a strong sense of belonging to, and pride in, these communities. Neighbourhood festivals and events (music, sport etc.) are well attended and supported. In some cases, the community-level sense of pride and identity may be distinct from the sense of identity at the city-level but is not in conflict with the city-level identity (i.e. it compliments and strengthens the city-wide sense of identity).	There is little feeling of community identity and culture within neighbourhoods across the city. Residents rarely, if ever, have a sense of belonging to, and pride in, their communities. Neighbourhood festivals and events (music, sport etc.) are rare. OR Some neighbourhoods have a strong sense of identity and culture which is in conflict with, and weakens, the identity of the city as a whole.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of respondents who felt a sense of pride in their neighbourhood (Arup, 2015)	This can be based on a sample survey but should include at least 100 households from each district or borough within the city
	Supplementary Metrics	

<table>
<tr><th colspan="3">4.3.2: To what extent is there a cohesive sense of city-wide identity and culture, in which all citizens feel a sense of belonging?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td>Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td>There is a strong local culture and identity within the city. Civic pride in the city is strong and there is a strong sense of belonging across all population groups. Local festivals and events (music, sport etc.) are well attended, supported and provide opportunities to bring the city population together through shared experiences. Arts and culture, public spaces and landmarks exist throughout the city helping make up its identity. Public memorials exist to remember past experiences and events.</td><td>The city does not have a strong identity or culture and pride in the city is largely absent. There is a large transient population with no sense of belonging to the city. Local festivals and events are often poorly attended and supported. Past events are not remembered and little activity exists to help the community collectively recover from shock events.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td>Metric Guidance</td></tr>
<tr><td>Number of months throughout the year that have a major, free public festival (Arup, 2015)</td><td>How many of the months in a calendar year have a free public festival held within the city that attracts visitors from across and outside of the city?</td></tr>
<tr><td colspan="2">Supplementary Metrics</td></tr>
<tr><td colspan="3">Estimated attendance at largest city carnival / festival/cultural event as a percentage of the population (World Cities Culture Forum, 2013)
(Estimated) percentage of local people participating in largest city festival (Friesen) Number of public libraries per 100,000 population (World Cities Culture Forum, 2013)
Number of public libraries per 100,000 population (World Cities Culture Forum, 2013)
Number of other heritage/historical sites (World Cities Culture Forum, 2013)
Visits to top five museums and galleries per capita (World Cities Culture Forum, 2013)</td></tr>
</table>

Indicator 4.4.: Actively engaged citizens

Goal:

Citizens actively engage, express opinion and participate within society.

Rationale:

A city whose citizens are actively engaged in city life, voice their opinions on matters concerning the running of the city and participate in identifying solutions to problems and chronic stresses, is more likely to be able to identify and implement successful initiatives to build resilience.

Focus:

This indicator looks at whether civil society is able and willing to make a difference and improve upon the stresses affecting a city's resilience. It addresses whether citizens have the freedom and will to actively participate and engage in city life. It is focused on bottom-up, grassroots participation, as opposed to top-down engagement initiatives that the city government may implement. Top-down engagement activities by city government is considered by Goals 10 and 11.

Qualities:

- Resourceful
- Inclusive

Qualitative questions:

4.4.1	To what extent are all parts of the population engaged with, and participating in, matters affecting the city?
4.4.2	To what extent does the private sector contribute to society and the spirit of community within the city?
4.4.3	To what extent are there strong networks of community-based organisations across the city to mobilise, organise and exchange knowledge?

Indicator 4.4.: Reference tables

4.4.1: To what extent are all parts of the population engaged with, and participating in, matters affecting the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a strong civil society, with active and engaged citizens among all population groups. There is a high degree of grassroots/community activity which positively contributes to improvements in city life and society. Freedom of speech is legally protected. There are mechanisms in place to empower vulnerable members of society and ensure that their views are heard within city government and agencies. Community-based organisations and community leaders are mobilised and are actively engaged with city government on community issues.	Civil society is weak, with little or no engagement with city government and agencies by citizens in some population groups. There is a lack of active grassroots level activity seeking to improve the city and society. Freedom of speech is not legally protected. There are no mechanisms in place to empower vulnerable members of society and ensure that their views are heard within city government and agencies. There is widespread sentiment among communities that the city government does not adequately represent their views.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Voter participation in last municipal election (as a percentage of eligible voters) (ISO 37120)	Do not provide an answer if there have been no municipal elections in the last 5 years. In countries where voting is mandatory, the per cent of votes not blank or spoiled shall be recorded. This will indicate the share of positive voter participation. There is a distinction between eligible to vote and registered to vote.
	Supplementary Metrics	
	• Number of civic organizations per 10,000 population (Cutter et al, 2010) • Average minutes per day spent on volunteer activities (OECD BLI adapted) • Number of social advocacy organizations per 10,000 population (Cutter et al, 2010)	

4.4.2: To what extent does the private sector contribute to society and the spirit of community within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Businesses within the city make a positive contribution beyond their immediate economic benefits. They pursue changes that make a positive benefit to society overall. There is a culture of corporate social responsibility which adds further value to the city. There are foundations and trusts that support community organisation within the city.	The private sector makes little effort to engage and make a contribution to local society. Corporate social responsibility is absent within the city and large businesses are perceived as external to the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Proportion of corporate charitable giving within community as a percentage of city GDP (Arup, 2015)	This question asks how much money is donated by businesses within the city to charitable causes also based within the city (as a % of total city GDP).
	Supplementary Metrics	
	• Proportion of businesses located within the city that publish an annual corporate responsibility report (Arup, 2015) • Ratio of charitable : for profit board memberships (Friesen)	

4.4.3: To what extent are there strong networks of community-based organisations across the city to mobilise, organise and exchange knowledge?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are strong networks of community-based organisations that collaborate on initiatives across the city. There is a strong sense of collaboration and knowledge-sharing within communities and local knowledge and coping/adaptation strategies for shocks and stresses are widely shared. There is effective collaboration between community-based organisations, the private sector and the city government and its partner agencies.	There are few community-based organisations and co-operation and co-ordination between these organisations is largely absent. There is little engagement between the city government and community-based organisations and community leaders. There is a little or no knowledge-transfer between communities, particularly with regard to coping/adaptation strategies.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of charities operating in the city per 100,000 population (Arup, 2015)	Charities registered as operating within the city.
	Supplementary Metrics	
	• Percentage of community groups which attend events / meet with other community groups (Arup, 2015) • Percentage of community groups signed up to a community based network (Arup, 2015)	

Goal 5. Comprehensive security and rule of law

Description: This includes law enforcement, fair justice, and prevention of crime and corruption.

Rationale: Maintaining a just, stable and secure society is important in a resilient city, not just to maintain social order but also for the effective enforcement of laws and regulations that also strengthen resilience (such as building codes and environmental regulations). Important to achieving this is an integrated approach to law enforcement and justice that combines deterrents with effective policing, a transparent criminal and civil judicial system, and robust measures to combat corruption. An effective judicial system promotes civic education as a preventive measure, as well as responsive action through fair justice. Sufficiently resourced policing practices that promote safety and security are a feature of daily life in a resilient city, and continue during times of unrest.

Focus: The focus of this Goal is on the measures that are in place to deter crime and corruption and enforce law and regulations.

Structure: This Goal comprises four indicators, as follows:

5.1 Effective systems to deter crime

5.2 Proactive corruption prevention

5.3 Competent policing

5.4 Accessible criminal and civil justice

Indicator 5.1.: Effective systems to deter crime

Goal:

Integrated, collaborative and resourceful mechanisms to deter crime.

Rationale:

Effective systems to deter crime are critical to increase a sense of safety amongst city residents, reducing the costs associated with fighting crime, and to create a secure business environment that will attract inward investment. High crime rates can lead to long-term social and economic breakdown through the de-stabilisation of communities and a degradation of the city's competitive advantage in attracting and retaining residents, talent and investment. Crime prevention reduces the costs associated with maintaining the police personnel and operations, courts, jails, and prisons directed toward addressing crimes.

Focus:

This indicator considers the exposure of citizens and businesses to crime, and whether the city has in place systems aimed at reducing the opportunity or attractiveness of criminal behaviour, preventing crime from happening, helping offenders and affected parties reconcile, and reducing recidivisms.

Qualities:

- Robust
- Resourceful

Qualitative questions:

5.1.1	To what extent do preventative programmes play a role in tackling crime and violence within the city?
5.1.2	To what extent are there mechanisms in place within the city to assist the rehabilitation and reintegration of people with criminal convictions?
5.1.3	To what extent does the city promote an urban environment designed to deter crime and violence?

Indicator 5.1.: Reference tables

5.1.1: To what extent do preventative programmes play a role in tackling crime and violence within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Preventative programmes play a critical role in tackling crime and violence within the city and are widely implemented. There is a diverse range of formal and informal practices and programmes in place to prevent crime, involving communities, families, schools, labour markets, policy and the criminal justice system. There is a department, agency or third-party organisation with responsibility for strategic oversight of crime prevention within the city and for developing strategies and prioritising funding for crime prevention initiatives. There are clearly defined criteria for allocating funding to programmes, based on results delivered by these programmes. These programmes are regularly evaluated and there is an adequate level of funding available for programmes that are demonstrably effective.	There are few or no formal and informal practices and programmes in place to prevent crime. Measures to tackle crime are generally reactionary, after the event, involving the police and the criminal justice system. There is no department, agency or third-party organisation with responsibility for strategic oversight of crime prevention within the city or for developing strategies and prioritising funding for crime prevention initiatives.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Homicides per 100,000, per year (Arup, 2015)	Homicides recorded within the city.
	Supplementary Metrics	
	• Percentage of people who say they are concerned about crime (MOPAC) • Total crime per 100,000, per year (Arup, 2015) • Number of participants and graduates from anti-violence programs (CUNY) • Percentage of juveniles enrolled in schools both in jail/prison, and also following their release	

5.1.2: To what extent are there mechanisms in place within the city to assist the rehabilitation and reintegration of people with criminal convictions?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are policies and strategies in place that promote rehabilitation of convicted criminals and reintegration within civic society. There are formal and informal programmes and initiatives to help prepare convicted criminals for effective release from prison and reintegration into the community and to help prevent re-offending. Such programmes may include education and training, behavioural treatment, addiction dependency treatment, mentoring, and coaching financial and life skills.	There are no mechanisms (e.g. policies, strategies and programmes) in place (at a national, regional or city level) aimed at supporting the rehabilitation and reintegration of people with criminal convictions within the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage re-offending by youths leaving custody (MOPAC)	Percentage of those aged between 15 and 24 years of age who have reoffended upon leaving prison.
	Supplementary Metrics	
	• Percentage of adults re-offending upon leaving custody • Percentage of offenders placed in treatment or alternative programs (Arup, 2015) • Percentage of individuals who have at least part time jobs 3 months after release from jail/prison; (2) percentage of juveniles enrolled in schools both in jail/prison, and also following their release (CUNY)	

5.1.3: To what extent does the city promote an urban environment designed to deter crime and violence?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are effective policies and strategies in place (at a national, regional or local level) aimed at advancing principles of safe urban design. Training is provided to city planners on the principles of designing safe urban environments. There are planning requirements for certain new developments to comply with guidance on designing out crime from urban spaces. There is comprehensive guidance available from the city planning authority or other organisation to assist developers in designing out crime from new developments.	There are no strategies, policies or programmes in place (at a national, regional or local level) aimed at advancing principles of safe urban design. There is little or no training provided to city planners on the principles of designing out crime within urban development. There is no widely distributed guidance available from the city planning authority or other organisation to assist developers in designing out crime from new developments.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of women and men who report feeling safe walking alone at night in the city or area where they live (UNSDN, 2015)	This can be based on a sample survey but should include at least 100 households from each district or borough within the city
	Supplementary Metrics	
	• Percentage of public areas including sidewalks covered by functioning street lights (Arup, 2015)	

Indicator 5.2.: Proactive corruption prevention

Goal:

Fair and transparent systems to fight corruption and promote justice.

Rationale:

Transparent and accountable auditing and scrutiny of public services helps to deter corruption and misuse of funds. Effective and transparent efforts to deter corruption builds community trust as well as reduces wasteful use of resources. Unchecked day-to-day corruption can reduce the effectiveness of other measures to strengthen resilience (such as building codes and environmental protection regulations), and lead to chronic stress on economic growth, community relationships, and city functions. While corruption following a shock can exacerbate civil unrest, loss of life and property, and impair a city's ability to recover.

Focus:

This indicator considers whether there are mechanisms in place to ensure that systems of just conduct are effective, address corruption at all levels within the city, and promote accountability within the city government and its officials.

Qualities:

- Robust

Qualitative questions:

5.2.1.	To what extent are corruptions within the city government adequately addressed?
5.2.2.	To what extent is the city government considered transparent and trustworthy?

Indicator 5.2.: Reference tables

5.2.1: To what extent are corruptions within the city government adequately addressed?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to ensure independent third-party mentoring and investigation of corruption within the city government, such as review of implementation of existing laws and pervasiveness of bribery. Suspected offenses are appropriately addressed to the justice system.	There are no strategies, policies or programmes in place (at a national, regional or local level) to investigate and address corruption within the city government. There is no independent third party oversight and validation of government operations.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of local major local government contracts and tenders (of more than $15,500) made public (Arup, 2015)	
	Supplementary Metrics	
	• Percentage of media outlets that agree or strongly agrees that they have the freedom to report on corruption cases without fear of intimidation • Country score on Corruptions Perception Index (Transparency International) • Number of corruption convictions (ISO 37120)	

5.2.2: To what extent is the city government considered transparent and trustworthy?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to ensure regular, independent auditing of city government accounts and results are clearly and publically available. The city publishes comprehensive, clear and transparent listings of contracts and tender and all payments made to the government. A survey has been conducted to understand the public and private-sector's perception of the trustworthiness of the city government. (e.g., such as accountability to the rule of law, alignment with the public interest, transparency of governance process and legislation). The findings are reported and recommendations for improvement are acted on by the city / national government.	There are no strategies, policies or programmes in place (at a national, regional or local level) to ensure the city's governance process and representatives are independently reviewed for trustworthiness. The city government is perceived as untrustworthy.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Proportion of city residents that agree corruption is somewhat or very common (Arup, 2015)	This can be based on a sample survey but should include at least 100 households from each district or borough within the city
	Supplementary Metrics	

Indicator 5.3.: Competent policing

Goal:

Effective policing measures and systems for a safe and secure city.

Rationale:

Effective, ethical and transparent policing plays an important role in creating a safe and secure environment for citizens and private entities. An effective police force that is trusted by its citizens can help to prevent civil unrest and instigate order during times of emergency.

Focus:

This indicator considers whether mechanisms are in place to ensure a comprehensive and contextually appropriate approach to law enforcement. This indicator does not consider the 'blue-light' emergency response services provided by the police after a shock event, as these are considered by Goal 3.

Qualities:

- Resourceful

Qualitative questions:

5.3.1	To what extent is policing and criminal investigation in the city effective?
5.3.2	To what extent are security forces available to enforce order in the city following a disaster?

Indicator 5.3.: Reference tables

5.3.1: To what extent is policing and criminal investigation in the city effective?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a comprehensive city-wide mandate for police agencies. There is a robust methodology for recording and investigating crime, and statistics are openly available to the public. Police procedure is monitored by an independent third-party, with results made publically available and recommendations are considered / acted on by appropriate parties. The outcomes of police actions and criminal investigations show no disproportionate bias (positive or negative) to any population group (based on geographic location, average neighbourhood income or property value, perceived gender, age, ethnicity etc.).	There is no independent oversight of policing and criminal investigation. Crime statistics are not independently verified. Crime statistics are not publically available. The outcomes of police actions and criminal investigations show disproportionate bias (positive or negative) to certain population groups (based on geographic location, average neighbourhood income or property value, perceived gender, age, ethnicity etc.).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Homicide arrest rate: The number of persons arrested for intentional homicide in a given year divided by the number of reported intentional homicides in the same year, x 100 and expressed as a percentage. (For the most recent year for which data are available). (UN Rule of Law)	
	Supplementary Metrics	
	• The share of the area of the city in neighbourhoods that are regularly patrolled by the police (0-100%) (GHI) • Number of homicides per 100 000 population (ISO 37120) • Number of formal complaints received for police force (Arup, 2015) • Crime detection rate - the ratio between the number of crimes where the police succeed in identifying a suspect and the total number of recorded crimes each year is called the detection rate, or sometimes the clearance rate.(NAO)	

5.3.2: To what extent are security forces available to enforce order in the city following a disaster?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a comprehensive plan in place to engage, monitor, and manage security forces called to enforce order following a disaster. Roles and responsibilities are clearly defined for actors such as emergency services, local / neighbourhood councils, private security firms, military, etc. Plans are clearly communicated to the public. There are mechanisms in place to appoint an independent third party to monitor the fairness, transparency and effectiveness of external emergency response forces. Findings are reported and acted on by the city government.	There are no strategies, policies or programmes in place (at a national, regional or local level) to engage security forces to enforce order in the city following a disaster. OR There are no mechanisms in place to ensure oversight of security forces called to enforce order following a disaster.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of the police force which has undertaken disaster response training in the last 5 years (Arup, 2015)	This question asks what percentage of the city police force has undertaken specific training within the last 5 years to deal with major incidents such as natural disasters or man-made threats (e.g. terrorism)
	Supplementary Metrics	
	Number Major incident training scenarios undertaken by police in last 5 years (Arup, 2015)	

Indicator 5.4.: Accessible criminal and civil justice

Goal:

Effective, affordable, impartial and accessible mechanisms to promote justice and resolve civil disputes.

Rationale:

Fair and transparent justice systems promote trust in the rule of law and the accountability of the city government and its officials, individuals and private entities. The clear and consistent application of laws and equitable law enforcement, and the timely, competent and ethical delivery of justice reinforces stability within communities. Conversely, failures within the justice system can impact on social stability, economic growth and the protection of human rights. During times of stress or shock, the rule of law and a sense of citizenship are critical to maintaining order and facilitating a peaceful recovery.

Focus:

This indicator considers the transparency, accessibility, fairness and effectiveness of the criminal and civil justice systems within a city.

Qualities:

- Resourceful
- Inclusive

Qualitative questions:

5.4.1	To what extent is the criminal justice system fair, inclusive and transparent?
5.4.2	To what extent is the criminal justice system timely and effective?
5.4.3	To what extent is there an effective civil justice system that is accessible to all?

Indicator 5.4.: Reference tables

5.4.1: To what extent is the criminal justice system fair, inclusive and transparent?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to ensure the city's justice system is fair and respects individual rights of both victim and defendant, with impartiality regardless of the person's income, race, national or social origin, gender or religion. There are mechanisms in place to protect the rights of victims and defendants during criminal court proceedings. There are mechanisms in place to provide legal representation and support to those who cannot afford to pay for this themselves. An independent third-party monitors the fairness of the justice system and reports publically. The public and media are able to attend criminal trials.	The criminal justice system is open to corruption and/or improper political or private influence. There is no independent third-party organisation that monitors the fairness of the justice system. Mechanisms to protect the rights of victims and defendants during court proceedings are absent or largely ineffective. There are no mechanisms in place to provide legal representation and support to those who cannot afford to pay for this by other means. There is a disproportionately high number of prosecutions and convictions brought on people from minority or vulnerable groups. The public and media are excluded from attending criminal trials.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage difference of criminal or civil punishments imposed by judges for the same type of crime from a total average compared to the defendant's or victim's race, for the two biggest ethnic groups. (Expressed as percentage difference) (UN Rule of Law)	This question asks, for the two biggest ethnic groups within the city, what is the average percentage difference in sentencing for the same crime.
	Supplementary Metrics	
	• Percentage of extent that public agrees that the courts treat people fairly regardless of their income, race, national or social origin, gender or religion (UN Rule of Law) • Percentage of judges who are women (UN Rule of Law) • Ethnic/religious/demographic make-ups of prison populations vs. general population (Friesen).	

5.4.2: To what extent is the criminal justice system timely and effective?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is an independent body / organisation that has responsibility for oversight and inspection of the criminal justice system. Regular inspections and audits are undertaken to monitor and assess the effectiveness of the criminal justice system. There is a code of professional conduct that legal professionals are bound to uphold. There are processes and procedures in place within the system to ensure quality control. Defence councils are trained and certified to demonstrate they have sufficient professional capacity to effectively council, assist and represent defendants Cases are generally heard in a timely manner without undue delay to proceedings, determinations, sentencing or appeals.	There are no formal or informal mechanisms in place to oversee and regulate the criminal justice system to ensure it is effective. There are no processes and procedures in place within the system to ensure quality control. There is no code of professional conduct for legal professionals and no requirement for legal professionals to demonstrate they have sufficient professional capacity to effectively council, assist and represent defendants There are frequently long delays before cases are heard in court and further delays to proceedings, determinations, sentencing and/or appeals.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of people taken into police custody who have the option of a lawyer made available to them before questioning (Arup, 2015)	This question asks how often the option of a lawyer is provided to a person accused of a crime before they undergo police questioning. If the accused cannot provide their own lawyer, best practice suggests the option of free legal aid should be available.
	Supplementary Metrics	
	• Percentage of public agrees that prosecution decisions are made in a fair, efficient and effective manner • Percentage of people in pre-trial detention as a percentage of total prison population • Percentage of all detainees who have been held in detention for more than 12 months while awaiting sentencing or a final disposition of their case (UN Rule of Law)	

5.4.3: To what extent is there an effective civil justice system that is accessible to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Citizens have access to affordable legal advice and representation, without having to pay excessive or unreasonable fees. There are alternative, affordable dispute resolution mechanisms in place that citizens can access without bringing a case to court. Civil proceedings are dealt with in a timely manner without lengthy delays. The civil justice system is impartial, regardless of the person's income, race, national or social origin, gender or religion. There is no improper influence by public officials or private interests. The civil justice system provides effective protection of property rights.	Citizens do not have access to affordable legal advice and representation. There are often excessive or unreasonable fees associated with bringing civil proceedings to court. There is an absence of alternative, affordable dispute resolution mechanisms. Civil proceedings are often lengthy, with frequent delays. Arbitrary distinctions are often made during determinations, based on a person's income, race, national or social origin, gender or religion. Civil justice determinations are often influenced by public officials or private interests. The civil justice system does not provide effective protection of property rights.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Weeks between a small claims case (less than £10,000 / $15,500) being submitted to court and hearing (expressed in weeks) (Arup, 2015)	This metric examines the efficiency of the legal system by asking for the average time lag between a civil small claims case (defined as being for less than $15,000) being submitted to court and the court hearing actually occurring.
	Supplementary Metrics	
	• Percentage of people in pre-trial detention as a percentage of total prison population (UNDP) • Percentage of all detainees who have been held in detention for more than 12 months while awaiting sentencing or a final disposition of their case (UN Rule of Law) • Average hourly cost for a civil lawyer as a percentage of average city hourly wage (Arup, 2015)	

Goal 6. Sustainable economy

Description: This is observed in sound management of city finances, diverse revenue streams, and the ability to attract business investment, allocate capital, and build emergency funds.

Rationale: A resilient city implements sound fiscal procedures in government operations, promoting an attractive, vibrant local economy to attract and retain business and promote a healthy economic base, and enhancing the ability of private sector to ensure businesses can also function during, and recover from, emergencies. A thriving city economy that channels revenue streams into the city's budget provides funds to maintain infrastructure, support communities and build the city's competitiveness as a place to do business. Sound management of city finances is essential to make the most effective use of the city budget.

Focus: The focus of this indicator is on management of public finances, the preparedness of businesses to adapt to change and recover from shocks, the diversity of the city's economic base, the ability of the city to attract and retain businesses, and the links between the city and wider economies. This includes good governance, integration with the regional and global economy and measures to attract investment, as well as actions the private sector can take to support themselves.

Structure: This Goal comprises five indicators, as follows:

6.1 Well-managed public finances

6.2 Comprehensive business continuity planning

6.3 Diverse economic base

6.4 Attractive business environment

6.5 Strong integration with regional and global economies

Indicator 6.1.: Well-managed public finances

Goal:

Adequate public finances and sound fiscal management.

Rationale:

City governments need adequate financial reserves in order to function – such as to pay staff or to spend on delivering services and planning activities. Sound financial management ensures that financial resources are robust, collected efficiently, used strategically and that the city operates within its budget. Careful structuring of city budgets will help to ensure the availability of funds to regularly invest in infrastructure and to plan for and respond to emergencies. This helps to promote long-term financial stability of the city government, as well as enables the government to respond to emergencies and adapt to changing circumstances. Resilient cities are also resourceful, optimising revenues and expenditures, and leveraging funds from non-government and business sources where appropriate. For example: public-private partnerships, direct investment and grant funding.

Focus:

This indicator concerns the city budget and how well this is managed. It considers revenue streams, deficit and emergency planning and contingency budgets.

Qualities:

- Robust

Qualitative questions:

6.1.1	To what extent does the city have access and transparent control over diverse revenue streams?
6.1.2	To what extent does the city have sufficient funding for delivery of day-to-day city government services?
6.1.3	To what extent are Disaster Risk Reduction (DRR) planning and activities adequately resourced and to what extent are there mechanisms in place to provide adequate and rapid funding sources to the city government for emergency response?

Indicator 6.1.: Reference tables

6.1.1: To what extent does the city have access and transparent control over diverse revenue streams?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has entirely independent direct access and control over diverse revenue streams. The city has a complete ability or mechanism to borrow or issue bonds to finance infrastructure. The city has mature fee structures and payment systems for resource use and taxation that are reported publically, are effectively enforced, and independently audited.	The city does not have any direct access and control over diverse revenue streams (e.g., access and control is entirely managed by an entity external from the city government or the city has no ability or mechanism to borrow or issue bonds to finance infrastructure). The city has no fee structures and payment systems for resource use and taxation. OR The structures and systems exist but are entirely closed to public reporting, are not effectively enforced and/or not audited.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Own-source revenue as a percentage of total revenues (ISO 37120)	This metric explores how much control the city government has over its revenue. It examines whether it operates with a degree of economic independence or whether it is dependent on central government allocation. Own-source concerns local government revenues originating from local fees, charges and taxes. This is expressed as a percentage of total revenues which include all revenues provided by other levels of government. These include formula driven payments or repatriation of income tax and grants from higher levels of government.
	Supplementary Metrics	
	• Percentage of municipal net debt of city GDP • Debt service ratio (debt service expenditure as a percentage of a municipality's own-source revenue (ISO 37120) • Own-source revenue as a percentage of total revenues (ISO 37120)	

6.1.2: To what extent does the city have sufficient funding for delivery of day-to-day city government services?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has a healthy budget and 'cushion' for planned or unexpected funding demands to cover municipal supplies. The city budget includes locally-sourced funding to deal with a major event, and it is assessed to be adequate to deal with a significant amount of need incurred from a major event and is protected.	The city operates at a deficit or frequently experiences budget shortfalls in funding to cover city government services. The city budget does not include any locally-sourced funding to deal with a major event. OR The budget exists but is inadequate and routinely to be diverted to other purposes.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Debt service ratio: total long-term debt servicing costs including lease payments, temporary financing and other debt charges divided by total own source revenue and expressed as a percentage (ISO 37120)	This is the percentage of total government revenue spent repaying debt including lease payments, temporary financing and other debt charges.
	Supplementary Metrics	
	• Ratio of the city general fund surplus or deficit compared to the city general fund revenues (California Policy Centre) • Capital spending as a percentage of total expenditures (ISO 37120)	

6.1.3: To what extent are Disaster Risk Reduction (DRR) planning and activities adequately resourced and to what extent are there mechanisms in place to provide adequate and rapid funding sources to the city government for emergency response?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has adequate financial resources for DRR planning and to undertake DRR activities (including economic recovery plans or strategies for post-disaster scenarios). Additionally, plans exist that identify mechanisms to access additional capital for emergency situations. This includes robust plans to channel emergency response funding to the municipality from regional or national sources. Funding need and plans based on accurate, up-to-date data. Mechanisms in place to regularly review and update funding needs and planning. All actions necessary for disaster resilience are costed and included in the budgets of city government and emergency response stakeholders. Responsibility for long-term planning for provision of funding sources for emergency response is clearly assigned.	The city has no financial resources for DRR planning or to undertake DRR activities (including economic recovery plans or strategies for post-disaster scenarios). No plans exist that identify mechanisms to access additional capita for emergency situations. The budgets of city government and emergency response stakeholders do not include costs for actions necessary for disaster resilience. No mechanisms are in place to provide adequate and rapid funding sources for emergency response. No mechanism in place to channel emergency response funding to the municipality from regional or national sources. No plans in place for securing alternative funds.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Emergency planning budget as a percentage of total city budget (Arup, 2015)	This metric asks what percentage of local government budget is specifically allocated for emergency planning and preparedness. This may be the budget of a specific governmental department responsible for emergency planning or specific components of each department's budget. It does **not** include emergency service budget (police, fire, ambulance). This is examined separately as a supplementary metric.
	Supplementary Metrics	
	Combined police, fire and ambulance budget as percentage of total budget (Arup, 2015)	

Indicator 6.2.: Comprehensive business continuity planning

Goal:

Resourceful, reflective and flexible business continuity planning across both public and private sectors.

Rationale:

Continuity planning by businesses is critical to ensuring that the private sector is prepared to be able to adapt to change and continue to function following shocks. Support from the city government or industry partnerships can help businesses both put in place robust contingency plans and build networks that can be leveraged during a crisis. Businesses that are prepared for emergencies are less likely to be impacted by shock events and more likely to be able to function and provide employment following an emergency. On a larger scale, the city economy will be less impacted and on a smaller scale, individual livelihoods will be less disrupted.

Focus:

This indicator concerns the preparedness of businesses, particularly those that are important to the city economy, to adapt to change and continue to function following a shock. This indicator does not consider emergency support that may be offered to small businesses to maintain personal livelihoods following a shock event because these considerations are included under Goal 2.

Qualities:

- Resourceful
- Reflective

Qualitative questions:

6.2.1	To what extent has the city identified the business sectors that will be critical to the continuity of city functions?
6.2.2	To what extent has the city implemented initiatives to ensure that these critical private sector firms have developed adequate business continuity plans?
6.2.3	To what extent have comprehensive business continuity plans been created and updated by disadvantaged or vulnerable economic sectors (e.g., small and medium-sized businesses (SMEs), minority business enterprises (MBEs))?

Indicator 6.2.: Reference tables

6.2.1: To what extent has the city identified the business sectors that will be critical to the continuity of city functions?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	A detailed inventory of business sectors and individual businesses critical to the continuity of city functions has been developed. The inventory identifies businesses / sectors critical to the city both following a shock and as the city adapts to predicted long-term stresses. The inventory is based on accurate, up-to-date data and clearly recorded. There are mechanisms in place to regularly review and update the inventory.	There are no mechanisms to identify and record businesses / sectors important for the continuity of city functions (e.g., following a shock or as the city adapts to predicted long-term stresses). No inventory of business sectors or individual businesses critical to the city's functioning has been developed. OR There is an inventory of businesses critical to the city but this is incomplete (e.g., did not encompass all relevant business sectors) or is out-dated (>10 years old).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since city economic asset assessment (public and private) (Arup, 2015)	A city economic asset assessment should include a full exploration of the city's key economic sectors, services and infrastructure. It should examine their exposure and vulnerability to natural hazards and human threats and explore what contingencies are in place to ensure the continued operation of key assets, services and infrastructure. The objective is to ensure that shocks and stresses provide as little disruption to the local economy (and the livelihoods it provides) as possible.
	Supplementary Metrics	
	• Proportion of business sectors that have been identified as critical to continuity of city functions as city adapts to predicted long-term stresses (expressed as percentage contribution to city-wide GDP) (Arup, 2015) • Proportion of business sectors that have been identified as critical to continuity of city functions during the week following a shock (expressed as percentage contribution to city-wide GDP) this metric is concerned with short term (less than a week) continuity (Arup, 2015)	

6.2.2: To what extent has the city implemented initiatives to ensure that these critical private sector firms have developed adequate business continuity plans?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place that require or strongly encourage critical business sectors and individual firms to develop business continuity plans. There is clear comprehensive guidance available to firms developing plans, with identification of relevant shocks and stresses. There is guidance available on how critical businesses sectors can coordinate with each other and other key actors following a shock event or to manage stresses. There are mechanisms in place to assess the quality of continuity plans produced by critical business sectors and critical businesses (i.e., review, reporting on businesses that have tested the plans). Mechanisms are in place to regularly review and update the guidance.	There are no mechanism to encourage or require critical business sectors or individual businesses to develop or implement business continuity plans. OR The city has no information on the extent to which critical business sectors or individual businesses have developed continuity plans.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of large businesses (500+ employees) within the city that have developed business continuity plans in accordance with ISO 22301 (Arup, 2015)	ISO 22301 is the internationally recognised benchmark for business continuity. It is something which all major businesses (of more than 500 employees) should be accredited with. Whilst the previous metric examines city awareness of key sectors, services and assets, this metric focuses solely on the continuity of the city's major
	Supplementary Metrics	
	• Percentage of large businesses which have comprehensive insurance for the high risk hazards within the city's risk profile (Arup, 2015)	

6.2.3: To what extent have comprehensive business continuity plans been created and updated by disadvantaged or vulnerable economic sectors (e.g., small and medium-sized businesses (SMEs), minority business enterprises (MBEs))?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place to encourage and support businesses in disadvantaged or vulnerable economic sectors to develop business continuity plans. Clear, comprehensive guidance is available to firms developing plans, with identification of relevant shocks and stresses. The guidance includes how businesses can adapt to stresses and coordinate with each other and other key actors following a shock event. The quality of these plans is regularly assessed (i.e., review, reporting on businesses that have tested the plans). Mechanisms are in place to regularly review and update the guidance.	There are no mechanisms in place to encourage business continuity planning by disadvantaged or vulnerable economic sectors. OR The city has no information on the extent to which these business sectors have developed continuity plans.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of registered SMEs the city has engaged with regarding business continuity in the last 5 years (Arup, 2015)	The city department with responsibility for business continuity and/or emergency planning should be engaged with local businesses to help them prepare for potential disruption. Whilst small and medium sized businesses may not have achieved formal business continuity certification (ISO 22301), they should have at least made arrangements to manage disruption and recorded them in a business continuity plan. The city should be visiting businesses, raising awareness, providing business continuity plan templates and helping them to complete and update these plans. An UK Government example of a business continuity plan template is available here http://www.ready.gov/sites/default/files/documents/files/sampleplan.pdf
	Supplementary Metrics	
	• Percentage of SMEs which have comprehensive insurance for the high risk hazards within the city's risk profile (Arup, 2015) • Percentage of medium-small businesses (less than 500 employees) within the city that have made business continuity arrangements (Arup, 2015)	

Indicator 6.3.: Diverse economic base

Goal:

Robust, flexible and diverse local economy.

Rationale:

A diverse economic base minimises a city's reliance on a single industry, increases access to new markets, and helps to reduce the vulnerability of the city's economy to disruption from stress or failure of any given industry or large employer. A diverse economy can absorb the impacts of sector-based shocks without major impact on the city's revenue streams. This in turn helps to strengthen the stability of the economy, reducing risks of shocks and uncertainty for businesses, investors and workers. A strong local economy also helps to assist economic recovery in the event that a city does suffer a shock as a broader range of opportunities for new investment and growth creation are available.

Focus:

This indicator explores the diversity of the businesses and sectors operating within the city.

Qualities:

- Resourceful

Qualitative questions:

6.3.1	To what extent does the city have a diverse local economy?
6.3.2	To what extent does the city have a stable economic base?
6.3.3	To what extent does the city have a productive local economy?
6.3.4	To what extent are new market opportunities explored and pursued?

Indicator 6.3.: Reference tables

<table>
<tr><th colspan="3">6.3.1: To what extent does the city have a diverse local economy?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td>Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td>The city's economy has a diverse sectorial base with easy entry to employment and creation of new businesses. The city has a strong middle class economy. Economic planning is co-ordinated with the wider regional area.</td><td>The city's economy is exposed to disruption through characteristics such as reliance on one or a few economic sectors or employers, or barriers to entry to employment / changing employment. The city lacks a strong middle class economy with a significant wage gap. Economic planning is not co-ordinated with the wider regional area.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td>Metric Guidance</td></tr>
<tr><td>Percentage employment per sector by broad industry group
(Arup, 2015)</td><td>For consistency, we aggregate into the following industry groups:
- Agriculture and Forestry
- Fishing
- Mining and Quarrying
- Manufacturing
- Electricity, gas, steam and air conditioning supply
- Water supply, sewerage, waste management and remediation
- Construction
- Wholesale and retail trade
- Transportation and storage
- Accommodation and food service activities
- Information and communication
- Financial and insurance activities
- Real estate activities
- Professional, scientific and technical activities
- Administrative and support service activities
- Public administration and defence; compulsory social security
- Education
- Human health and social work activities
- Arts, entertainment and recreation
- Other service activities (Adapted from UK ONS Industrial Classification 2007)
Cities may add to this list if a core industry of theirs is not included</td></tr>
<tr><td colspan="2">Supplementary Metrics</td></tr>
<tr><td colspan="2">• Percentage share of small businesses (20 employees or fewer) (Arup, 2015)
• Sum of difference of proportion of a city's jobs in goods-producing and service-producing sectors compared to national sectors (Arup, 2015)
• Sum of difference of proportion of a city's jobs in government sectors compared to national government (Arup, 2015)</td></tr>
</table>

6.3.2: To what extent does the city have a stable economic base?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's economy demonstrates stable long-term growth or has shown faster rebound from disruptive economic shocks than regional cities.	The city's economy is exposed to uncertain fluctuation in growth and contraction, demonstrating lower economic strength than competitor cities or the national average.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average GDP per capita percentage change over last 5 years (Brookings, 2015)	This question asks by how many percent, the average per capita GDP within the city has changed over the last 5 years.
	Supplementary Metrics	
	• Percentage employment change from the previous year (Brookings, 2015)	

6.3.3: To what extent does the city have a productive local economy?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's economy has a strong local economy that captures a wide spectrum of the value chain in production or services. Employees in industrial sectors demonstrate greater productivity per employee than regional or national average.	The city's economy is primarily characterised by lower value goods or raw materials and tends to export materials to other cities for higher value finishing or production. Industries are less productive per employee than the regional or national average.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	GDP (PPP,$) per capita (Brookings, 2015)	
	Supplementary Metrics	
	• Percentage of households with annual income above US$20,000 (Adapted from McKinsey, 2012)	

6.3.4: To what extent are new market opportunities explored and pursued?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city government (or its partner agencies) takes an active role in working with industry, academic, or other institutions to explore and promote new market opportunities. There are city government-funded organisations dedicated to provide independent advice to the public and private sector on emerging markets and to leverage local and regional partnerships between the private and public sectors to stimulate job creation. The contribution of the informal economy is understood and quantified.	There are no mechanisms in place to explore and promote new market opportunities within the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of total medium and large businesses (250 employees +) within the city that are a member of the chamber of commerce (Arup, 2015)	
	Supplementary Metrics	
	Number of new businesses registered within the city in past year, per 100,000 population (Case Western Reserve University)	

Indicator 6.4.: Attractive business environment

Goal:

Diverse and resourceful investments within the city, driven by a strong urban brand and economic and social environment.

Rationale:

Businesses are often able to locate and invest to meet their own strategic needs. Cities must retain a competitive advantage to attract and retain business investment. Cultivating and promoting the city as an attractive place for businesses helps to retain capital, as well as creates momentum as businesses locate near each other to benefit from economies of scale and reduced transaction costs. This is especially critical following a shock event where businesses may have been affected and could consider relocating – resulting in both a contraction of economic growth and loss of revenue to the city and employment opportunities for residents.

Focus:

This indicator explores the extent to which the city can attract external investment. This is achieved through an effective strategy, skills workforce and accommodating business environment. The result is a stronger economy able to better address prominent city stresses such as poverty and unemployment.

Qualities:

- Reflective
- Resourceful

Qualitative questions:

6.4.1	To what extent does the business environment attract diverse inward investment?
6.4.2	To what extent is the city seen as a good place to do business?
6.4.3	To what extent can businesses access a skilled work base to meet their needs?

Indicator 6.4.: Reference tables

6.4.1: To what extent does the business environment attract diverse inward investment?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has a comprehensive strategy to attract business investment from outside the city / metropolitan area that is coordinated with priority business sectors to promote a strong diverse economy. The city strategy has clear roles and responsibilities defined. The city benefits from employment opportunities created by foreign investment as well as captures tax receipts.	The city does not have a strategic plan to attract business investment from outside the city. OR The city is not able to benefit from foreign investment (such as lack of access to employment opportunities or inability to capture tax receipts).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average FDI (foreign direct investment)-attributable jobs over the last 3 years per 100,000 16-64 year olds (Arup, 2015)	How many jobs within the city come from foreign investment? This is calculated by taking the mean average of annual FDI job figures over the past 3 years. The city also needs to know the size of its population aged 16-64 years old (working population), divide FDI jobs by this figure and multiply by 100,000.
	Supplementary Metrics	

6.4.2: To what extent is the city seen as a good place to do business?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city is perceived as a supportive environment for business. Regulations for businesses protect property rights and are effective, transparent, and appropriate. The city is perceived as a competitive business environment, retaining and attracting businesses and recent graduates. Cities with manufacturing bases have high rates of local sales and export to regional, national or global markets. The city proactively identifies gaps within its infrastructure service delivery that may prohibit or discourage business investment.	The city is perceived as a difficult or unreliable environment for doing business. The city is perceived as uncompetitive in relation to other cities in the region or nation with similar characteristics. Businesses show a high or increasing trend in closing or relocating outside the city, and graduates move away from the city after completing education or training. Cities with manufacturing bases have low rates of local sales and export to regional, national or global markets. There are gaps in infrastructure service delivery that prevent or discourage businesses from investing or remaining in the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of businesses per 100,000 16-64 year olds (ISO 37120)	Total number of businesses are registered within the city, divided by the size of the city's 16-64 year old population and multiplied by 100,000
	Supplementary Metrics	
	• Score on the World Bank "Ease of doing business" index (some national and city level scores) (World Bank) • Amount of investment in urban infrastructure in 10 years per capita (Arup, 2015) • Number of Fortune 500 companies, with offices within the city. (Arup, 2015)	

6.4.3: To what extent can businesses access a skilled work base to meet their needs?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Businesses are able to meet employment needs across the spectrum of skill maturity needed (e.g., apprentice level to director level). Advertised jobs are filled quickly and employers are broadly able to meet their needs with local hires.	Businesses are not able to match employment needs with available skill base in the work force.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of adults with higher education as a percentage of total population aged 16-64 (Adapted from ISO 37120)	We use the World Bank definition of higher or tertiary education as all post-secondary education. Universities are a key part of all tertiary systems, but also the growing set of public and private tertiary institutions in every country—colleges, technical training institutes, community colleges, nursing schools, research laboratories, centres of excellence, distance learning centres etc. (http://web.worldbank.org)
	Supplementary Metrics	
	• Percentage of jobs advertised not met after 6 months (job vacancy rate) • Higher Education Degrees per 100,000 (ISO)	

Indicator 6.5.: Strong integration with regional and global economies

Goal:

Strong integration between the city's economy and wider economic systems.

Rationale:

Strong connections with regional and global economies helps businesses pursue opportunities, attract a wider investment base, and draw talent. These relationships also bring in additional business and opportunities for knowledge exchange. A wide-ranging and diverse trade and investment network also helps minimise the vulnerability of the city's economic supply chain to the impacts of shock and stresses within the city and beyond the city.

Focus:

This indicator considers how connected the city's economy is with the wider economy (regional, national, international).

Qualities:

- Resourceful

Qualitative questions:

6.5.1	To what extent does the city have strong, integrated economic relationships with other cities and regions?
6.5.2	To what extent is the city economy competitive?

Indicator 6.5.: Reference tables

6.5.1: To what extent does the city have strong, integrated economic relationships with other cities and regions?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has strong, collaborative partnerships with other cities to promote strong economic relationships. The city has a comprehensive plan to develop and maintain partnerships, with roles and responsibilities clearly defined.	The city has no clear strategy to develop economic relationships with other cities and regions.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Value of city exports as a percentage of city GDP (Arup, 2015)	Annual value of city exports / GDP x 100
	Supplementary Metrics	

6.5.2: To what extent is the city economy competitive?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city leads regional or national average in exports for relevant sectors, capturing higher sales and market share. City infrastructure fully supports the business needs of major companies and improvements are made in areas where infrastructure is lacking. This provides an environment attractive to external companies who bring investment and job opportunities to the city. Policies and regulations are measured and responsible to the needs of the city and its citizens but do not unnecessarily dissuade new companies who are looking to invest within the city.	The city's economy lags behind the regional or national average in exports. City infrastructure does not fully support the business needs of major companies and this makes the city less attractive to external companies looking to invest within the city. Restrictive business policies and regulations further dissuade new companies from starting-up within the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average city GDP per capita minus national average GDP per capita expressed as a percentage (Arup, 2015)	For the most recent year that both pieces of data are available.
	Supplementary Metrics	
	• Economic growth rate (World Bank) • Number of Global 500 headquarters located in each city, as per the CNN Money Fortune Global 500 list. (PWC, 2014)	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Infrastructure and Ecosystems

This dimension relates to **place** – the quality of infrastructure and ecosystems that protects, provide and connect us. The CRI considers the robustness of infrastructure and ecosystems that protect us from natural hazards. Also important within this dimension is the continuity of critical services, under shock or stress situations. In particular, water supply, power distribution, and solid waste management; the transportation systems that enable the flow of goods, services, people and information.

Structure:

This dimension of the City Resilience Index comprises three Goals, as follows:

7 Reduced exposure and fragility

8 Effective provision of critical services

9 Reliable mobility and communications

(Image Opposite)

Kwun Tong Bypass,
Hong Kong

Goal 7. Reduced exposure and fragility

Description: This relies on a comprehensive understanding of the hazards and risks to which a city is exposed that informs the development of integrated strategies to physically protect the city combining sound environmental stewardship, robust design and maintenance of man-made infrastructure, and enforcement of appropriate building codes and regulations.

Rationale: A comprehensive understanding of the hazards and long-term risks faced by a city and its exposure to these hazards and risks is fundamentally important to developing effective measures to protect the city. Armed with this knowledge, cities can protect themselves by ensuring that: the buildings and infrastructure constructed within the city are safely designed and appropriately located; that natural areas providing protection to the city (such as mangroves and forested slopes) are retained and maintained; and that a robust and integrated network of man-made protective structures is established at key locations across the city.

Focus: The focus of this Goal is the exposure of the city to hazards and long-term risks and the measures that a city can put in place to physically protect itself and reduce its vulnerability. It considers the extent to which a city has attempted to identify the hazards and risks it faces and the strategies employed by the city to physically reduce exposure and fragility. Other measures to reduce physical exposure, such a land-use zoning and planning controls are dealt with by Goal 12. Policy and regulatory measures to safeguard ecosystem services are considered by Goal 8.

Structure: This Goal comprises four indicators, as follows:

7.1 Comprehensive hazard and exposure mapping

7.2 Appropriate codes, standards and enforcement

7.3 Effectively managed protective ecosystems

7.4 Robust protective infrastructure

Indicator 7.1.: Comprehensive hazard and exposure mapping

Goal:

Robust systems in place to map the city's exposure and vulnerability to hazards based on current data.

Rationale:

Comprehensive knowledge of the hazards a city faces and its vulnerability to those hazards is critical for a city to adequately protect itself from those hazards. This knowledge should be based on clear, accurate, timely and robust data and should be widely disseminated so that city managers can develop appropriate responses across all city departments. This can prevent loss of life and physical damage to the environment, infrastructure and property with subsequent social unrest and economic stress.

Focus:

This indicator considers the depth and extent of knowledge and understanding of the physical hazards facing the city and the city's exposure to these hazards. It considers the extent to which local hazards are identified, monitored and mapped and how this how the hazard risk is subsequently reduced (through zonation, relocation and/or physical upgrades). This indicator concerns exposure of physical assets. Goal 10 considers hazard monitoring and risk assessment from a wider emergency planning perspective.

Qualities:

- Reflective
- Robust

Qualitative questions:

7.1.1	To what extent has the range and likelihood of hazards that the city faces, and exposure to these hazards, been assessed?
7.1.2	To what extent have hazard risk assessments considered the effect of long-term stresses?

Indicator 7.1.: Reference tables

7.1.1: To what extent has the range and likelihood of hazards that the city faces, and exposure to these hazards, been assessed?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Comprehensive exposure and vulnerability assessments have been undertaken across the full extent of the city within the past 5 years and maps have been produced showing the areas of the city at most risk from known hazards. These assessments have been validated by appropriate experts.	No attempt has been made to characterise the range and likelihood of hazards facing the city or the exposure of different parts of the city to these hazards.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city area for which a comprehensive exposure and vulnerability assessment has been undertaken within the past 5 years. (Arup, 2015)	An exposure and vulnerability assessment should look at what parts of the city are exposed to local hazards (e.g. flooding, earthquakes, landslides etc.), how many people and assets are located within these areas and what vulnerabilities these persons (e.g. poverty, poor housing, discrimination) and assets (infrastructural weakness) may hold. This work may combine several departments and stakeholders, for example G.I.S departments, emergency planners and research institutions.
	Supplementary Metrics	

7.1.2: To what extent have hazard risk assessments considered the effect of long-term stresses?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Comprehensive hazard risk assessments have been undertaken that identify long-term stresses present in the city and consider the effect of these stresses on the city in combination with the city's hazard risk profile.	Hazard risk assessments, where these exist, have not considered the effect of long-term stresses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Years since the city's climate change strategic plan was updated (Arup, 2015)	A climate change strategic plan should show awareness of the potential short, medium and long-term impacts of climate change hazards upon the city, its different areas (e.g. coastal areas) and services (e.g. social care). In addition to demonstrating such an awareness, the plan should list short, medium and long-term actions that the city is taking to address this risk in terms of both mitigation and importantly adaptation. An example from the city of Chicago – http://www.chicagoclimateaction.org/filebin/pdf/finalreport/CCAPREPORTFINALv2.pdf
	Supplementary Metrics	
	• Percentage of hazard risk assessments for the city that have also considered the exacerbating effects of long-term stresses (e.g. climate change, population growth, demographic change etc.) (Arup, 2015)	

Indicator 7.2.: Appropriate codes, standards and enforcement

Goal:

Building and infrastructure codes and standards are forward looking, appropriate to local context and risk profiles, and enforced.

Rationale:

Robust and enforced codes and standards for the planning, design, construction, operation and maintenance of buildings and infrastructure, which adequately reflect up-to-date hazard and exposure assessments for the city, are critical to ensuring the built environment is safe and appropriate for the shocks and stresses a city may face. Absent, inappropriate or inadequately enforced codes and standards could result in buildings and infrastructure that are unable to meet daily needs or unable to withstand physical damage during a shock event. This could lead to inappropriate development and chronic waste of resources, or loss of life, social disruption and economic loss to citizens and the city during a shock event.

Focus:

This indicator concerns the development, implementation and enforcement of building codes. It examines whether they are appropriate in relation to the current and emerging risk profile of the city.

Qualities:

- Reflective
- Robust

Qualitative questions:

7.2.1	To what extent are infrastructure and building codes that are appropriate to the risk profile of the city enforced?
7.2.2	To what extent are building codes communicated and usable?
7.2.3	To what extent are there requirements and mechanisms to regularly update infrastructure and building codes to reflect the latest long-term stress projections, the latest hazard risk profiles and new learning from disaster events?

Indicator 7.2.: Reference tables

7.2.1: To what extent are infrastructure and building codes that are appropriate to the risk profile of the city enforced?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are codes and standards that stipulate minimum safety and performance standards for the design and construction for buildings and infrastructure, including: • Public utility infrastructure • Housing, including affordable housing • All other building uses • All building material types and seismic design • Protective infrastructure (e.g., sea walls, slope stabilisation structures) • Stormwater drainage • Electricity infrastructure • Water supply infrastructure • Wastewater and sanitation infrastructure Additionally, these codes are legally and actively enforced via regulations, the planning approval process and 3rd party verification during and after construction.	There are no codes and standards that stipulate minimum safety and performance standards for the design and construction for buildings and infrastructure. OR Such codes and standards do exist in some form but are not enforced (either due to lack of enforcement mechanisms or due to corruption).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Estimated percentage of new buildings completed within the city in the last 5 years that conform to current building codes and standards (Adapted from UNISDR Scorecard)	
	Supplementary Metrics	
	• Estimated % of new infrastructure completed each year within the city that conforms to building codes and standards • Percentage of health facilities in full compliance to adopted natural hazard building codes and zoning requirements.	

7.2.2: To what extent are building codes communicated and usable?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Building codes and standards as well as being appropriate, are also effectively communicated to citizens. Local guidance exists which is presented in an accessible style, highlighting essential requirements in relation to both general building design and the city's specific risk profile. Additional avenues of information and technical support are available (e.g., affordable, professional advice, inspections, additional information (websites etc.)). All of this helps to improve the safety of local construction.	Building codes and standards are not effectively communicated to the local population. No guidance exists to explain complex legislation in an accessible way. Resultantly there is much local construction (homes etc.) which does not comply with building codes.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of buildings within the city with planning permission records (Arup, 2015)	Percentage of buildings which have received permission for their construction by local planning authorities.
	Supplementary Metrics	
	• Estimated percentage of buildings within the city that meet the safety requirements of current building codes and standards (UNISDR Scorecard)	

7.2.3: To what extent are there requirements and mechanisms to regularly update infrastructure and building codes to reflect the latest long-term stress projections, the latest hazard risk profiles and new learning from disaster events?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a requirement and mechanism in place to review and update all infrastructure and building codes on a regular basis (every 5 years or less) to reflect the latest long-term stress projections and the latest hazard risk profiles and new learning from disaster events. This requirement is fully implemented/enforced.	There are no requirements, processes or other mechanisms in place to ensure that infrastructure and building codes are regularly updated to reflect the latest long-term stress projections, the latest hazard risk profiles or new learning from disaster events. All infrastructure and building codes are out of date (>15 years old).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since oldest current building code was reviewed (Arup, 2015)	This metric examines how up to date building codes currently in use are. It will likely be completed by someone from the city planning department.
	Supplementary Metrics	

Indicator 7.3.: Effectively managed protective ecosystems

Goal:

Well-developed understanding and acknowledgement of the role of ecosystems in providing physical protection to the city.

Rationale:

Healthy, natural ecosystems can play a vital role in preventing or attenuating the impacts of natural hazard events on a city. Natural areas within the city and beyond the city boundaries can provide physical protection to the city and its residents, while also supporting livelihoods dependant on natural resources.

Focus:

This indicator considers ecosystems in their capacity to physically protect the city. It considers if a city understands and values the protective benefits afforded by its natural assets and if these are considered alongside man-made protective infrastructure as a means for providing physical protection to the city. Other critical services provided by ecosystems (such as livelihood, health and quality of life benefits) are considered by Goal 8, along with the regulatory framework and enforcement mechanisms to safeguard ecosystems generally.

Qualities:

- Resourceful
- Robust

Qualitative questions:

7.3.1	To what extent have ecosystems within and surrounding the city been identified and evaluated in terms of their importance in providing protective services to the city?
7.3.2	To what extent have ecosystems been considered alongside man-made infrastructure within strategies to physically protect city?
7.3.3	To what extent are ecosystems that provide physical protection to the city actively protected themselves from development and managed to maintain ecosystem health?

Indicator 7.3.: Reference tables

7.3.1: To what extent have ecosystems within and surrounding the city been identified and evaluated in terms of their importance in providing protective services to the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	An extensive programme to identify and evaluate ecosystems within the city has been undertaken. Ecosystems that provide important protective services to the city have been identified. Additionally, assessments have been undertaken to identify and evaluate ecosystems that lie beyond the city boundary that also provide important ecological services to the city. These protective ecosystems within and beyond the city boundaries are known and understood.	No attempt has been made to identify or evaluate important ecosystems within the city or to identify and evaluate ecosystems that lie beyond the city boundary that may also provide important ecological services to the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of natural areas within the city that have undergone ecological evaluation for their protective services (Arup, 2015)	This explores the extent of the city's ecological assets which provide protection from natural hazards. For example, natural floodplains, mangrove reefs (coastal flood protection) and green shaded spaces (heatwave protection). This might be undertaken by the city environmental department, emergency planning department, external environment agency or a combination of these and/or similar agencies.
	Supplementary Metrics	
	- Percentage of natural areas within the city that have undergone ecological evaluation (Arup, 2015)	

7.3.2: To what extent have ecosystems been considered alongside man-made infrastructure within strategies to physically protect city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a comprehensive, city-wide strategy to protect the city from physical hazards that integrates both natural and man-made protective assets. The strategy fully recognises the protective services provided by specific ecosystems within and surrounding the city, and of ecosystems generally. The strategy includes robust mechanisms to maintain and enhance the protective functions of specific ecosystems within and surrounding the city.	There are no city-wide strategies to protect the city from physical hazards. OR Strategies to protect the city from physical hazards do not recognise the protective role of specific ecosystems within, or surrounding, the city or the role of ecosystems generally. Strategies to protect the city consider man-made protective infrastructure assets only.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage green, open space increase or decrease over the past 5 years (Arup, 2015)	This includes both green spaces that are owned by the public and privately owned. Privately owned green or open spaces can only be considered if they are included as a separate land use in the city plans, for example: golf courses, agricultural land.
	Supplementary Metrics	
	Percentage of natural habitats within the city and up to 10km beyond the city boundary that are officially recognised for the protective services provided to the city / city area (Arup, 2015)	

7.3.3: To what extent are ecosystems that provide physical protection to the city actively protected themselves from development and managed to maintain ecosystem health?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to protect and maintain ecosystems that provide protective services to the city and these are actively implemented and enforced. No important protective ecosystems have been destroyed or become significantly degraded during the past 15 years. Where degraded protective ecosystems do exist, there are plans and initiatives in place enhance the health and protective functions of these ecosystems.	There are no effective mechanisms in place to protect and maintain ecosystems that provide protective services to the city. Important protective ecosystems have been destroyed or become significantly degraded during the past 15 years. There are no proposals or plans in place to enhance degraded ecosystems that provide protective services to the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city area that has been officially recognised for environmental protection (including shorelines down to low-tide mark). Adapted from World Bank	This metric examines to what extent the city has important, protected ecosystem sites within its boundaries.
	Supplementary Metrics	

Indicator 7.4.: Robust protective infrastructure

Goal:

Integrated, forward-looking and robust network of protective infrastructure that reduces vulnerability and exposure of citizens and critical assets.

Rationale:

Man-made structures in many cities play a vital role in physically protecting the city by preventing or attenuating the impacts of natural hazard events on the city. Inadequate protective infrastructure can expose a city's buildings and infrastructure to physical damage, potentially leading to loss of life. Man-made infrastructure such as levees, dams, sea walls or built drainage systems can provide protection from storm or tidal surge or floods, retaining walls can provide protection from landslides and built firebreaks can reduce wildfire risk.

Focus:

This indicator concerns the design, construction and maintenance of man-made infrastructure that provides physical protection to the city.

Qualities:

- Integrated
- Robust

Qualitative questions:

7.4.1	To what extent is the current adequacy of the city's protective infrastructure known? [NB: Protective infrastructure includes the city's stormwater drainage infrastructure.]
7.4.2	To what extent are there robust operation and maintenance regimes in place for protective infrastructure assets?
7.4.3	To what extent are the necessary upgrades carried out to ensure that the city's protective infrastructure is adequate for the future?

Indicator 7.4.: Reference tables

7.4.1: To what extent is the current adequacy of the city's protective infrastructure known? [NB: Protective infrastructure includes the city's stormwater drainage infrastructure.]		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	A full and complete register of the city's protective infrastructure assets exists. There is a formal requirement to review the adequacy of the city's protective infrastructure assets regularly (every 5 years or less) assets based on risk assessments under different disaster and long-term change scenarios. This requirement is actively enforced.	No register of the city's protective infrastructure assets exists. There are no requirements to regularly or periodically review the adequacy of the city's protective infrastructure assets based on risk assessments under different disaster and long-term change scenarios. No such review has been undertaken within the past 15 years.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since the last city-wide review of the adequacy of the city's protective infrastructure assets (Arup, 2015)	Whilst 7.3.1 examined *natural* protective assets, this metric concerns protective infrastructure more generally, *including man-made assets*. This metric is about awareness and the presence of a review process. Such review would include relevant questions such as: - What is the capacity of city flood defences, - Have they ever been breached? - Have any protective deficiencies been revealed by other recent hazards which impacted the city more than they should have done? - Are there any other infrastructure deficiencies that might be punished by any realistic increase in hazard frequency and/or severity? Such an assessment might possibly be undertaken by city planners, engineers, emergency planners or a combination of these professionals.
	Supplementary Metrics	
	• Number of assets included on the city register of protective infrastructure assets (Arup, 2015)	

7.4.2: To what extent are there robust operation and maintenance regimes in place for protective infrastructure assets?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Maintenance programmes for all the city's protective infrastructure are adequately funded and resourced. Mechanised plant is tested, maintained and verified on a frequent basis (e.g. several times per year). Responsibility for maintenance of all protective infrastructure assets is clearly defined and understood. There are procedures in place to ensure critical spare parts are accessible.	Maintenance programmes for the city's protective infrastructure are absent or severely under-funded. Staffing levels are inadequate. Mechanised plant is rarely tested, maintained and verified. Responsibility for maintenance of some/all protective infrastructure assets is unclear. There are no procedures in place to ensure critical spare parts are accessible.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years the city's stormwater (or other protective) infrastructure has been inspected (Arup, 2015)	This metric specifically focuses on maintenance of urban drainage – something that every city needs. An inspection should consider both infrastructure strength and current drainage capacity in line with recent flooding and future flood projections. This metric concerns the overall city drainage network, opposed to recent inspection of a small part of it.
	Supplementary Metrics	
	• Five year maintenance budget for city stormwater assets as a percentage of total asset value (Arup, 2015) • Trained staff per £10 million capital value of assets (Arup, 2015)	

7.4.3: To what extent are the necessary upgrades carried out to ensure that the city's protective infrastructure is adequate for the future?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are adequately funded programmes in place to upgrade the level of protection afforded by the city's man-made protective infrastructure assets based on the findings of hazard exposure assessments and predictions of future stresses.	There are no programmes in place to upgrade the level of protection afforded by the city's man-made protective infrastructure assets based on the findings of hazard exposure assessments and predictions of future stresses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of annual budget for stormwater infrastructure spent on upgrades (Arup, 2015)	This looks at what percentage of budget for stormwater infrastructure is spent on proactive upgrading opposed to responsive repair.
	Supplementary Metrics	
	• Percentage of total annual maintenance budget for city's man-made protective infrastructure assets spent on upgrades to increase the level of protection afforded by the assets • Economic loss due to infrastructure failure in last 5 years • Fatalities due to infrastructure failure in last 5 years	

Goal 8. Effective provision of critical services

Description: This results from active management and maintenance of ecosystems, and from diversity of provision, redundant capacity, and adequate maintenance of essential utility services, combined with robust contingency planning.

Rationale: Ecosystems and utilities infrastructure both provide essential services to urban populations and critical city assets (such as hospitals, government administration buildings, data centres and emergency response services). However, the quality and performance of these services are only maintained through proactive management. During times of stress, ecosystem services and effective utilities provision become central to the city functioning. Well-maintained systems are better able to accommodate abnormal demand, withstand unusual pressures and continue functioning. Well-established management practices create enhanced knowledge of system components, so that infrastructure managers are better prepared to restore disrupted services. Effective regulatory, management and enforcement frameworks are essential to protect and enhance natural habitats that provide daily ecosystem services, such as supporting livelihoods, human health and quality of life within the city.

Focus: The focus of this Goal is on ensuring essential services are provided to urban populations and critical city assets every day and during times of emergency. Essential services considered by this Goal include ecosystem services (such as support of livelihoods, health and quality of life), electricity, drinking water, wastewater disposal and treatment, and solid waste collection and disposal.

Structure: This Goal comprises six indicators, as follows:

8.1 Effective stewardship of ecosystems

8.2 Flexible infrastructure

8.3 Retained redundant capacity

8.4 Balanced supply and demand of resources

8.5 Diligent maintenance and continuity

8.6 Adequate continuity for critical assets and services

Indicator 8.1.: Effective stewardship of ecosystems

Goal:

Robust mechanisms in place to maintain and enhance the ecosystem services that benefit city residents.

Rationale:

Ecosystems provide invaluable services that would be beyond the scope of any government, business or institution or individual to reproduce. These ecosystem services support livelihoods, health and quality of life and include functions such as filtering toxins from water and air, providing natural resources for food and fuel resources and regulating climate conditions. Comprehensive identification and knowledge of the habitats that provide these services, combined with an enforced regulatory regime that provides effective preservation, protection and maintenance of valuable habitats is essential if these services are to continue benefiting the city. Additionally, ecosystems that are well-maintained and healthy are themselves better able to withstand shocks, such as extreme storms, and stresses, such as encroachment of urban areas or invasive species.

Focus:

This indicator considers the regulatory, maintenance and enforcement frameworks that exist within a city to protect and enhance valuable ecosystem services provided by natural habitats. This indicator is broader than indicator 7.3, which considers only how the physical protective services provided by certain ecosystems are valued within a city.perspective.

Qualities:

- Reflective
- Robust

Qualitative questions:

8.1.1.	To what extent are the ecosystems that provide important services to the city known and understood (e.g., supporting livelihoods, health and quality of life)?
8.1.2.	To what extent are there policies, legislation and plans in place to protect important ecosystems and natural resources?
8.1.3.	To what extent are there adequately resourced programmes for the active management and/or restoration of important ecosystems?

Indicator 8.1.: Reference tables

8.1.1: To what extent are the ecosystems that provide important services to the city known and understood (e.g., supporting livelihoods, health and quality of life)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The services provided to the city by ecosystems within the city or surrounding area are known and well understood. Specific ecosystems that provide important services to the city have been identified. There are mechanisms in place to ensure that this information is taken into account during city government policy development and decision-making.	No attempt has been made to identify or evaluate the services provided by ecosystems within the city, or beyond the city boundary.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since assessment of the city's ecosystem assets / services (Arup, 2015)	Whilst the metrics in Goal 7 examine natural infrastructure from a protective point of view, the ecosystem metrics in Goal 8 relate to service provision, for example the local environment as a source of water or food. These environmental asset assessments should examine the quality of local water sources and food sources and identify and stop contamination to major environmental assets.
	Supplementary Metrics	
	• $ spent on valuing ecosystem services within the city in the last 5 years (Arup, 2015)	

8.1.2: To what extent are there policies, legislation and plans in place to protect important ecosystems and natural resources?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are extensive policies and robust regulations in place to protect important ecosystems and natural resources and these are strictly enforced. Additionally, there is an agency or other body with clear responsibility for environmental protection and enforcement of environmental regulations. Environmental regulations are actively enforced. There are generally very low levels of pollution of natural resources (air, rivers, aquifers, soil etc.) within the city and surrounding area. There is recognition of the importance of connecting green spaces within the urban fabric at levels appropriate for the ecosystems involved and there are mechanisms in place to protect and/or strengthen connections between green spaces to allow biodiversity transfer.	There are no policies or regulations in place to protect important ecosystems and natural resources. OR There are some such policies and regulations in place but these are not enforced (e.g., due to lack of enforcing body or corruption). There is widespread degradation of important ecosystems and/or widespread pollution of natural resources (air, rivers, aquifers, soil etc.) within the city and surrounding areas. There is little or no permeability to biodiversity between ecosystems (i.e. disconnected islands of habitat/green space within the built areas of the city) and little or no movement of species between areas of natural habitat / green space. There are no mechanisms in place to strengthen connections between green spaces to allow biodiversity transfer.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	PM10 concentration (µg/m3) (ISO 37120)	
	Supplementary Metrics	
	• PM2.5 concentration (µg/m3) (ISO 37120) • NO2 concentration (µg/m3) (ISO 37120) • SO2 concentration (µg/m3) (ISO 37120) • Ozone (O3) concentration (µg/m3) (ISO 37120)	

8.1.3: To what extent are there adequately resourced programmes for the active management and/or restoration of important ecosystems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are extensive, adequately-funded programmes for the active management and/or restoration of all ecosystems identified as providing important services to the city (e.g., supporting livelihoods, health and quality of life).	There are no programmes operated by the city or any other agency for the active management and/or restoration of ecosystems that are important to the city
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage change in the number of native species ISO 37120	This is a measure of net gain or loss in local biodiversity – plants and animals.
	Supplementary Metrics	
	• Total number of threatened species (IUCN) • Percentage of habitat sites that are officially recognised for environmental protection that are also subject to active conservation management (Liverpool City Council)	

Indicator 8.2.: Flexible infrastructure

Goal:

Critical services within the city are supported by diverse and robust infrastructure, which has been appropriately planned and delivered.

Rationale:

Well-planned and delivered utility services are essential to help cities function well. Essential utility services, such as electricity, water, sanitation and solid waste collection and disposal enable residents and businesses to carry out their daily activities safely and more efficiently than without these services. Diversity and flexibility of supply and delivery is important to maintain adequate levels of service delivery, especially following disruptive events when alternative methods of supply and delivery.

Focus:

This indicator looks at the diversity and flexibility of supply and delivery of essential utility services, so that alternative solutions can be developed to respond to disruptions and longer-term changes within the city. This indicator does not consider redundant capacity and balancing supply and demand – these are considered by indicators 8.3 and 8.4.

Qualities:

- Robust
- Redundant

Qualitative questions:

8.2.1.	To what extent is there a robust strategic plan for providing electricity services to the city now and into the long-term (this may be a city, regional or national plan)?
8.2.2.	To what extent is there diversity within the city's electricity generation, transmission and distribution systems?
8.2.3.	To what extent is there a robust strategic plan for providing water to the city now and into the long-term (this may be a city, regional or national plan)?
8.2.4.	To what extent is there diversity within the city's water supply (grid), treatment & distribution systems?
8.2.5.	To what extent is there a robust strategic plan for providing sanitation to the city now and into the long-term (this may be a city, regional or national plan)?
8.2.6.	To what extent is there a robust strategic plan for providing solid waste management services to the city now and into the long-term (this may be a city, regional or national plan)?
8.2.7.	To what extent does the city have diversity across its solid waste management, collection, transport and treatment/disposal infrastructure?

Indicator 8.2.: Reference tables

8.2.1: To what extent is there a robust strategic plan for providing electricity services to the city now and into the long-term (this may be a city, regional or national plan)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Strategic, city-wide planning for the electricity infrastructure required to meet the changing needs of the city into the long-term (>15 years) has been undertaken. There is a long-term, city-wide plan for delivering the necessary infrastructure to meet the projected electricity requirements of the city, This plan is regularly reviewed (at least every 5 years) and updated. There are mechanisms in place to ensure that current and future programmes to increase capacity and/or upgrade electricity infrastructure align with this plan.	There has been no strategic, city-wide planning for the electricity infrastructure required to meet the changing needs of the city into the long-term (>15 years). Current programmes (where these exist) to increase capacity and/or upgrade electricity infrastructure are largely reactionary and ad-hoc and are not based on a long-term, city-wide plan for delivering the necessary infrastructure to meet the electricity requirements of the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	How many years ahead does the city's electricity plan look (e.g. does it analyse the city's 10 year + needs?). (Number of years) (Arup, 2015)	The looks at the degree of foresight within the city electricity plan. As well as considering current capacity versus demand, it should also consider future demand (population change, upward mobility etc.) and the ability to meet this demand. This should consider strategies to manage current and future demand (promotion of responsible usage, diversification of sustainable supply sources etc.)
	Supplementary Metrics	
	• Percentage of total annual expenditure spent on upgrades to electricity infrastructure in the last year that was spent on programmes aligned with long-term (>15 years) plans (Arup, 2015)	

8.2.2: To what extent is there diversity within the city's electricity generation, transmission and distribution systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are diverse energy generation, transmission and distribution systems serving the city, such that there are effective alternative supplies should one of these systems fail, resulting in no loss of service across the city.	There is a single or very limited number of energy generation, transmission and distribution systems serving the city, such that failure in one of these systems leads to wide-spread failure of energy supply across the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of different supply sources providing at least 5 percent of electricity generation capacity (World Bank)	This metric concerns diversity of energy supply. It concerns different generation sources which provide the city a degree of security against unexpected disruption. Diversity in the energy generation type also needs to be taken into consideration. For example, if the city is entirely dependent on one energy plant, the disruption in such facility might impact city supply. Likewise if a city id overly dependent on solar or wind energy a change in metrological conditions might have an impact. If a city receives its energy from a diverse range of sources, then disruption to overall city supply will be less severe.
	Supplementary Metrics	
	• Highest proportion of electricity from single source (Adapted from an ISET, 2014 water metric) • Percentage of energy from decentralised sources (Arup, 2015) • Percentage of energy from renewable sources (ISO 37120)	

8.2.3: To what extent is there a robust strategic plan for providing water to the city now and into the long-term (this may be a city, regional or national plan)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Strategic, city-wide planning for the water supply infrastructure required to meet the changing needs of the city into the long-term (>15 years) has been undertaken. There is a long-term, city-wide plan for delivering the necessary infrastructure to meet the projected water supply requirements of the city. This plan is regularly reviewed (at least every 5 years) and updated. There are mechanisms in place to ensure that current and future programmes to increase capacity and/or upgrade water supply infrastructure align with this plan.	There has been no strategic, city-wide planning for the water supply infrastructure required to meet the changing needs of the city into the long-term (>15 years). Current programmes (where these exist) to increase capacity and/or upgrade water supply infrastructure are largely reactionary and ad-hoc and are not based on a long-term, city-wide plan for delivering the necessary infrastructure to meet the water supply requirements of the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	How many years ahead does the city's water plan look (e.g. does it analyse the city's 10 year + needs?). (Number of years) (Arup, 2015)	The looks at the degree of foresight within the city water plan. As well as considering current supply versus demand, it should also consider future demand (population change etc.) and the ability to meet this demand. This should consider strategies to manage current and future demand (promotion of responsible usage, diversification of sustainable supply sources etc.)
	Supplementary Metrics	
	• Percentage of total annual expenditure spent on upgrades to water supply infrastructure last year that was spent on programmes aligned with long-term (>15 years) plans (Arup, 2015)	

8.2.4: To what extent is there diversity within the city's water supply (grid), treatment & distribution systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has diverse water supply (grid), treatment and distribution systems such that there are effective alternative supplies should one of these systems fail, resulting in no loss of service across the city.	The city relies on a single or very limited number of water supply, treatment and distribution systems, such that failure in one of these systems would lead to wide-spread failure of water supply across the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of different supply sources providing at least 5 percent of water supply capacity (World Bank adapted from electricity)	This metric concerns diversity of water supply. A source should be considered separate if disruption to another source would not directly impact on the source. For example, if two tributary water supplies come from the same main river then any contamination of reduction in capacity of the main river would affect both sources. A diverse range of sources might include different rivers/tributaries, desalination plants etc. If a city receives its water from a diverse range of sources, then disruption to overall city supply will be less severe.
	Supplementary Metrics	
	• Highest proportion of water supply from single source (ISET, 2014) • Percentage of average water demand that can be delivered in the event of one unplanned and one planned outage (Arup, 2015)	

8.2.5: To what extent is there a robust strategic plan for providing sanitation to the city now and into the long-term (this may be a city, regional or national plan)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Strategic, city-wide planning for the sanitation infrastructure required to meet the changing needs of the city into the long-term (>15 years) has been undertaken. This has included the consideration of how changes to rainfall levels and flood risk could affect wastewater systems across the city. There is a long-term, city-wide plan for delivering the necessary infrastructure to meet the projected sanitation requirements of the city. This plan is regularly reviewed (at least every 5 years) and updated. There are mechanisms in place to ensure that current and future programmes to increase capacity and/or upgrade sanitation infrastructure align with this plan.	There has been no strategic, city-wide planning for the sanitation infrastructure required to meet the changing needs of the city into the long-term (>15 years). Current programmes (where these exist) to increase capacity and/or upgrade sanitation infrastructure are largely reactionary and ad-hoc and are not based on a long-term, city-wide plan for delivering the necessary infrastructure to meet the sanitation requirements of the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average $ per $10,000 of total annual expenditure of city sanitation provider(s) spent on strategic, long-term (10 years +) planning activities (Arup, 2015)	
	Supplementary Metrics	
	• Percentage of total annual expenditure spent on upgrades to sanitation infrastructure last year that was spent on programmes aligned with long-term (>15 years) plans (Arup, 2015)	

8.2.6: To what extent is there a robust strategic plan for providing solid waste management services to the city now and into the long-term (this may be a city, regional or national plan)?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Strategic, city-wide planning for the solid waste treatment and disposal infrastructure required to meet the changing needs of the city into the long-term (>15 years) has been undertaken. There is a long-term, city-wide plan for delivering the necessary infrastructure to meet the projected solid waste treatment and disposal requirements of the city, This plan is regularly reviewed (at least every 5 years) and updated. There are mechanisms in place to ensure that current and future programmes to increase capacity and/or upgrade solid waste management infrastructure align with this plan.	There has been no strategic, city-wide planning for the solid waste treatment and disposal infrastructure required to meet the changing needs of the city into the long-term (>15 years). Current programmes (where these exist) to increase capacity and/or upgrade solid waste treatment or disposal infrastructure are largely reactionary and ad-hoc and are not based on a long-term, city-wide plan for delivering the necessary infrastructure to meet the solid waste management requirements of the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of annual unsound waste disposal (as a percentage of total disposal) (Waste Atlas, 2015)	Waste disposal in which the waste has had no treatment. Includes practices such as open dumping and burning.
	Supplementary Metrics	
	• Percentage of total annual expenditure spent on upgrades to solid waste disposal infrastructure last year that was spent on programmes aligned with long-term (>15 years) plans (Arup, 2015)	

8.2.7: To what extent does the city have diversity across its solid waste management, collection, transport and treatment/disposal infrastructure?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has sufficient diversity of solid waste management, collection, transport and treatment / disposal methods for all waste streams generated within the city, such that a failure in one system will not result in loss of service across the city.	The city relies on a single or very limited number of solid waste management, collection, transport and treatment / disposal methods, such that failure in one of these systems would lead to wide-spread failure of solid waste management across the city.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of different solid waste treatment or disposal plants processing at least 5 percent solid waste generated within the city (Number of sources) (World Bank)	Unlike metrics 8.2.2 and 8.2.4 this can be the same type of processing plant. If a city has several plants / sites then it is less of a problem if one is disrupted.
	Supplementary Metrics	
	• Highest proportion of solid waste treatment/disposal undertaken at a single facility (ISET) • Percentage of waste generated within the city that is collected and transported for treatment (i.e. not uncontrolled dumping) for the following waste streams: - municipal solid waste - commercial - industrial - hazardous - clinical (Arup, 2015) • Percentage solid waste by reuse and treatment method: - reuse /remanufacturing - recycling / composting facilities - energy recovery facilities - landfills (Arup, 2015)	

Indicator 8.3.: Retained spare capacity

Goal:

Minimised demand on critical infrastructure through the resourceful and flexible use of key resources.

Rationale:

Demand management is critical in the continuity of essential utility services, ensuring that built systems are not overloaded, and can maintain sufficient redundancy to absorb surges in demand. Designing sufficient redundant capacity into new infrastructure to cope with long-term demand predictions and shorter-term demand surges is essential. Once operational, measures to maintain this redundant capacity by minimising system losses, and increasing efficiency (within the system and by end-users) are important.

Focus:

This indicator is concerned with the measures in place to ensure systems are designed with sufficient redundant capacity and that this redundant capacity is maintained through active management of supply and demand.

Qualities:

- Redundant
- Flexible
- Resourceful

Qualitative questions:

8.3.1	To what extent is there spare capacity within the city's electricity generation, transmission and distribution systems?
8.3.2	To what extent are there strategies and programmes in place to reduce demand and maintain spare capacity within the city's electricity infrastructure?
8.3.3	To what extent is there spare capacity within the city's water supply systems?
8.3.4	To what extent are there strategies and programmes in place to reduce demand and maintain spare capacity within the city's water supply infrastructure?
8.3.5	To what extent is there spare capacity within the city's sanitation systems?
8.3.6	To what extent is there spare capacity within the city's solid waste management systems?
8.3.7	To what extent are there strategies and programmes in place to demand on treatment facilities and minimise disposal to landfill facilities?

Indicator 8.3.: Reference tables

8.3.1: To what extent is there spare capacity within the city's electricity generation, transmission and distribution systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The energy generation, transmission and distribution systems operate within capacity at all times and there is sufficient redundant capacity to accommodate predicted future growth in demand or temporary demand surges for the short- to medium-term (for the next 15 years).	The energy generation, transmission and distribution systems fails to meet demand all of the time and there is no redundant capacity to accommodate future growth in demand or temporary demand surges.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	De-rated capacity margin: the amount of excess electricity supply above peak demand (expressed as a percentage) OFGEM	An annual average of this figure.
	Supplementary Metrics	
	Loss of load expectation (the average number of hours per year in which supply is expected to be lower than demand under normal operation of the system) (OFGEM, 2014)	

8.3.2: To what extent are there strategies and programmes in place to reduce demand and maintain spare capacity within the city's electricity infrastructure?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are comprehensive strategies, policies and programmes in place (at a national, regional or local level) to reduce system losses, increase efficiency (within the system and by end-users) and balance electricity supply and demand. There are initiatives in place to communicate these strategies and programmes to key stakeholders. The success of these strategies and programmes is being monitored and reported.	There are no strategies, policies or programmes in place (at a national, regional or local level) to reduce system losses, increase efficiency (within the system and by end-users) or balance electricity supply and demand.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average annual residential electrical use in kw hours per year per capita (ISO 37120)	Total residential electrical usage in kilowatt hours divided by total city population. Likely to best collected from city energy supplier.
	Supplementary Metrics	
	• Percentage change in electricity use per capita (residential) over the last 5 years for which there is data (Arup, 2015) • System losses as percentage of overall generation (US EIA) • Total electrical use (KWh/yr/capita) (ISO 37120)	

8.3.3: To what extent is there spare capacity within the city's water supply systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The water supply, treatment & distribution systems operate within capacity at all times and there is sufficient redundant capacity to accommodate predicted future growth in demand or temporary demand surges for the short- to medium-term (for the next 15 years).	The water supply, treatment and distribution systems within the city fails to meet demand all of the time and there is no redundant capacity to accommodate future growth in demand or temporary demand surges.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	City electricity supply capacity as a percentage of total demand (MWRA)	This examines how much spare capacity there is in the city energy supply. This figure should be an annual average.
	Supplementary Metrics	
	• Percentage of city population served by piped water supply (Arup, 2015) • Water capacity per capita (m3/ capita/ year) (UN Water)	

8.3.4: To what extent are there strategies and programmes in place to reduce demand and maintain spare capacity within the city's water supply infrastructure?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are comprehensive strategies, policies and programmes in place (at a national, regional or local level) to reduce system losses, increase efficiency (within the system and by end-users) and balance water supply and demand. There are initiatives in place to communicate these strategies and programmes to key stakeholders. The success of these strategies and programmes is being monitored and reported.	There are no strategies, policies or programmes in place (at a national, regional or local level) to reduce system losses, increase efficiency (within the system and by end-users) or balance water supply and demand.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Total water consumption per capita (litres/day) (ISO 37120)	Average daily use per person
	Supplementary Metrics	
	• Total annual water conserved through demand-side management, relative to demand (ISET)	

8.3.5: To what extent is there spare capacity within the city's sanitation systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The sanitation system operate within capacity at all times and there is sufficient redundant capacity to accommodate predicted future growth in demand or temporary demand surges for the short- to medium-term (for the next 15 years).	The sanitation system within the city fails to meet demand all of the time and there is no redundant capacity to accommodate future growth in demand or temporary demand surges.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of the city's wastewater that has received no treatment (ISO 37120)	Total amount of the city wastewater that has gone untreated (discharged straight into a water body) divided by the total amount of wastewater produced (multiplied by 100 and expressed as a percentage). This includes periods when wastewater volume exceeds treatment plant capacity.
	Supplementary Metrics	
	• Percentage of wastewater flows treated to national standards, by municipal and industrial source (UNSDN, 2015)	

8.3.6: To what extent is there spare capacity within the city's solid waste management systems?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The solid waste management systems (collection, transport, treatment and disposal) operate within capacity at all times and there is sufficient redundant capacity to accommodate predicted future growth in demand or temporary demand surges for the short- to medium-term (for the next 15 years).	The solid waste management systems within the city fail to meet demand all of the time. A significant proportion of the solid waste generated within the city is not collected and uncontrolled tipping of solid waste is widespread. The city's managed disposal systems (e.g., landfill sites) are at maximum capacity or beyond.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of the city population with regular solid waste collection ISO 37120	
	Supplementary Metrics	
	• Percentage of the city's solid waste that is recycled (ISO 37120) • Total collected municipal solid waste (tonnes per capita) (ISO 37120) • Percentage of the city's solid waste that is disposed of in an open dump (ISO 37120)	

8.3.7: To what extent are there strategies and programmes in place to reduce demand on treatment facilities and minimise disposal to landfill facilities?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are comprehensive strategies, policies and programmes in place (at a national, regional or local level) to encourage resource efficiency and implementation of the waste hierarchy. There are initiatives in place to communicate these strategies and programmes to key stakeholders. The success of these strategies and programmes is being monitored and reported.	There are no strategies, policies or programmes in place (at a national, regional or local level) to reduce the generation of waste and promote the Circular Economy principal (take-make-use-remake).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Waste generation rate per capita (municipal solid waste, kg per capita per year) (World Bank)	
	Supplementary Metrics	
	• Percentage of waste diverted from landfill (Arup, 2015) • Waste generation per employee (Commercial & industrial waste) in tonnes per capita (Arup, 2015) • Percentage of the city's solid waste that is recycled (ISO)	

Indicator 8.4.: Diligent maintenance and continuity

Goal:

Robust monitoring, maintenance and renewal of essential utility infrastructure, with effective contingency planning.

Rationale:

Well-established management practices create enhanced knowledge of system components, so that infrastructure managers can prevent degradation of materials, accommodate changes in demand and are better prepared to restore disrupted services. Well-maintained systems are better able to withstand unusual demand pressures such as extreme peaks and continue functioning.

Focus:

This indicator considers the on-going maintenance practices of critical infrastructure such as monitoring of condition, maintenance programmes, and employment and training practices to ensure sufficient technical expertise is available to maintain and swiftly repair critical assets when they are disrupted.

Qualities:

- Robust
- Reflective

Qualitative questions:

8.4.1	To what extent are there effective monitoring, maintenance and renewal programmes and continuity planning for energy utilities within the city?
8.4.2	To what extent are there effective monitoring, maintenance and renewal programmes as well as service continuity and emergency response plans for water utilities within the city?
8.4.3	To what extent are there effective monitoring, maintenance and renewal programmes as well as service continuity and emergency response plans for sanitation within the city?
8.4.4	To what extent are there effective monitoring, maintenance and renewal programmes and continuity planning for solid waste within the city?

Indicator 8.4.: Reference tables

8.4.1: To what extent are there effective monitoring, maintenance and renewal programmes and continuity planning for energy utilities within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Energy providers are legally bound to regularly monitor, maintain and upgrade infrastructure. Equipment is operated by skilled and knowledgeable staff who may be certified through local and national standards to manage their systems during times of crisis. There are 3rd party organisations with legal mandate to oversee the activities of the energy providers. Hazard risk assessments are undertaken on a regular basis (every 5 years of less) that consider the probability and severity of service loss during identified hazard and long-term change scenarios. Additionally, energy providers are required to develop plans for emergency response and recovery and maintaining service continuity following disruptions. This requirement is enforced and robust continuity plans exist.	There are no mechanisms in place to ensure that energy infrastructure is regularly monitored, maintained and upgraded as required. There is a shortage of skilled staff. There is no agency or organisation providing 3rd party oversight and validation of service. No hazard risk assessments have been undertaken that consider the probability and severity of service loss during identified hazard and long-term change scenarios. There is no requirement for energy providers to develop plans for emergency response and recovery and maintaining service continuity during times of disruption. There is no evidence that such continuity plans exist.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average length of electrical interruptions (hours per year per customer) (ISO 37120)	
	Supplementary Metrics	
	• Average percentage of electrical losses during distribution (Arup, 2015) • Annual expenditure on monitoring, as a percentage of total expenditure spent by energy service providers (Arup, 2015) • Annual expenditure on renewal programmes, as a percentage of total expenditure spent by energy service providers (Arup, 2015)	

8.4.2: To what extent are there effective monitoring, maintenance and renewal programmes as well as service continuity and emergency response plans for water utilities within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Water providers are legally bound to regularly monitor, maintain and upgrade infrastructure. Equipment is operated by skilled and knowledgeable staff who may be certified through local and national standards to manage their systems during times of crisis. There are 3rd party organisations with legal mandate to oversee the activities of the water providers. Hazard risk assessments are undertaken on a regular basis (every 5 years of less) that consider the probability and severity of service loss during identified hazard and long-term change scenarios. Additionally, water providers are required to develop plans for emergency response and recovery and maintaining service continuity following disruptions. This requirement is enforced and robust continuity plans exist.	There are no mechanisms in place to ensure that water supply infrastructure is regularly monitored, maintained and upgraded as required. There is a shortage of skilled staff. There is no agency or organisation providing 3rd party oversight and validation of service. No hazard risk assessments have been undertaken that consider the probability and severity of service loss during identified hazard and long-term change scenarios. There is no requirement for water providers to develop plans for emergency response and recovery and maintaining service continuity during times of disruption. There is no evidence that such continuity plans exist.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average annual hours of water service interruptions per household ISO 37120	
	Supplementary Metrics	
	• Average annual percentage of water supply lost during distribution (Arup, 2015) • Percentage of water loss (unaccounted for water) (ISO 37120) • Annual expenditure on monitoring, as a percentage of total expenditure spent by energy service providers (Arup, 2015)	

8.4.3: To what extent are there effective monitoring, maintenance and renewal programmes as well as service continuity and emergency response plans for sanitation within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Sanitation providers are legally bound to regularly monitor, maintain and upgrade infrastructure. Equipment is operated by skilled and knowledgeable staff who may be certified through local and national standards to manage their systems during times of crisis. There are 3rd party organisations with legal mandate to oversee the activities of the sanitation providers. Hazard risk assessments are undertaken on a regular basis (every 5 years of less) that consider the probability and severity of service loss during identified hazard and long-term change scenarios. Additionally, sanitation providers are required to develop plans for emergency response and recovery and maintaining service continuity following disruptions. This requirement is enforced and robust continuity plans exist.	There are no mechanisms in place to ensure that sanitation infrastructure is regularly monitored, maintained and upgraded as required. There is a shortage of skilled staff. There is no agency or organisation providing 3rd party oversight and validation of service. No hazard risk assessments have been undertaken that consider the probability and severity of service loss during identified hazard and long-term change scenarios. There is no requirement for sanitation providers to develop plans for emergency response and recovery and maintaining service continuity during times of disruption. There is no evidence that such continuity plans exist.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Annual percentage of wastewater system losses (due to storms or malfunction) prior to treatment and/or discharge to the environment (Arup, 2015)	
	Supplementary Metrics	
	• Wastewater network losses as a percentage of overall wastewater generation (Arup, 2015)	

8.4.4: To what extent are there effective monitoring, maintenance and renewal programmes and continuity planning for solid waste within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Solid waste management providers are legally bound to regularly monitor, maintain and upgrade infrastructure. Equipment is operated by skilled and knowledgeable staff who may be certified through local and national standards to manage their systems during times of crisis. There are third party organisations with legal mandate to oversee the activities of the solid waste management providers. Hazard risk assessments are undertaken on a regular basis (every 5 years of less) that consider the probability and severity of service loss during identified hazard and long-term change scenarios. Additionally, solid waste management providers are required to develop plans for emergency response and recovery and maintaining service continuity following disruptions. This requirement is enforced and robust continuity plans exist.	There are no mechanisms in place to ensure that solid waste treatment and disposal facilities are regularly monitored, maintained and upgraded as required. There is a shortage of skilled staff within the solid waste management system (collection, transport, treatment, and disposal). There is no agency or organisation providing third party oversight and validation of the service. No hazard risk assessments have been undertaken that consider the probability and severity of service loss during identified hazard and long-term change scenarios. There is no requirement for solid waste management providers to develop plans for emergency response and recovery and maintaining service continuity during times of disruption. There is no evidence that such continuity plans exist.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of defined medium- to long-term waste management service contracts e.g. Public Private Partnership and Public Private Community Partnership agreements (as a percentage of total waste service contracts) (Arup, 2015)	A medium-long term waste contract is classed as anything greater than 5 years.
	Supplementary Metrics	
	• Number times per year expected solid waste management collections have failed to be met	

Indicator 8.5.: Adequate continuity for critical assets and services

Goal:

Resourceful, reflective and flexible continuity plans to maintain utility services to critical assets during emergency situations.

Rationale:

In order to be adequately prepared for emergencies, it is important for cities to have identified those assets within the city that are critical to support the most essential city functions and emergency response and recovery efforts. Such critical city assets may include hospitals, government administrative buildings, emergency response facilities and data centres. Once identified, it is essential that mechanisms are put in place to ensure these critical assets have adequate back-up supply to continue to function adequately in the event that normal utility supplies are disrupted.

Focus:

This indicator considers if the city has identified assets which are critical to its safe functioning and ability to respond effectively to emergencies. It also considers the extent to which plans have been put in place to maintain essential utility services to these critical city assets during times of disruption. This indicator considers the on-site back-up provisions to maintain service when the usual service arrangements are disrupted. It differs from indicator 8.5 which is focussed on the plans that utility providers have in place generally to recover normal service levels following disruptions.

Qualities:

- Resourceful
- Redundant
- Flexible

Qualitative questions:

8.5.1	To what extent have critical assets been identified and probability and severity of service loss to these assets been assessed under different disaster and long-term change scenarios?
8.5.2	To what extent has emergency standby power generation been put in place for critical assets and critical services within the city?
8.5.3	To what extent have mechanisms been developed to provide back-up water supplies during emergencies for critical city assets and services?

Indicator 8.5.: Reference tables

8.5.1: To what extent have critical assets been identified and probability and severity of service loss to these assets been assessed under different disaster and long-term change scenarios?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Assets and services that are critical to the effective functioning of the city (e.g., hospitals, government administrative buildings, emergency response centres, data centres) have been identified during a process that has involved input from key stakeholders. A register of these critical assets and services exists and is regularly reviewed and updated. The register has been communicated to the city's utility providers and emergency responders.	No attempt has been made to identify, and develop a register of, assets and services that are critical to the effective functioning of the city (e.g., hospitals, government administrative buildings, emergency response centres, data centres).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since last citywide critical asset assessment (Arup, 2015)	Assets, systems and services that are essential to the functioning of a society and economy. Systems and services may operate from the local to regional scale. Examples include energy, water supply and sanitation, core transport, waste management, key information and communications technology, key food and agriculture natural and human assets, environment, industrial, key commercial, education, public health, law and order, and emergency management systems and services.
	Supplementary Metrics	
	• Number times critical city infrastructure register has been updated in last 5 years (Arup, 2015) • Total critical asset service days at risk of loss (Arup, 2015) • Number of existing hospitals certified as disaster safe (UNISDR, 2008).	

8.5.2: To what extent has emergency standby power generation been put in place for critical assets and critical services within the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Emergency standby electricity generation requirements for all the city's critical assets and services are known and assessed to be adequate. There are mechanisms in place to ensure that restoration of electricity supply to critical assets and services during times of disruption or emergency are prioritised by the utility providers.	No attempt has been made to identify critical infrastructure and critical services within the city that require emergency standby electricity generation. It is not known if these assets have adequate emergency standby generation. There are no mechanisms in place to ensure that restoration of electricity supply to critical assets and services during times of disruption or emergency are prioritised by the utility providers.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city's hospitals with back-up electricity generators (Arup, 2015)	To ensure continued functioning of key medical equipment and services in the event of power loss. This should be able to continue to run for 72 hours.
	Supplementary Metrics	
	• Designated critical asset service days at risk of loss from energy failure (Arup, 2015) • Percentage of identified critical assets which have emergency standby power generation arrangements in place (Arup, 2015) • Average length of electrical interruptions for critical assets in last 2 years (Arup, 2015)	

8.5.3: To what extent have mechanisms been developed to provide back-up water supplies during emergencies for critical city assets and services?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Robust mechanisms are in place to provide emergency alternative water supply to all the city's critical assets and services, as required. There are mechanisms in place to ensure that restoration of water supply to critical assets and services during times of disruption or emergency are prioritised by the utility providers.	There are no mechanisms in place to provide emergency alternative water supply to the city's critical assets and services. It is not known if these assets have in place mechanisms to obtain alternative water supplies during times of disruption to the normal supply or during an emergency. There are no mechanisms in place to ensure that restoration of water supply to critical assets and services during times of disruption or emergency are prioritised by the utility providers.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city's hospitals with back-up water supply to meet its needs for three days (Arup, 2015)	City hospitals should have back up arrangements to ensure continuous water supply for 72 hours during disruption. This might be back up water tanker arrangements.
	Supplementary Metrics	
	• Designated critical asset service days at risk of loss from water supply failure (Arup, 2015) • Average length of water shortages for critical assets in last 2 years (Arup, 2015)	

Goal 9. Reliable mobility and communications

Description: This is enabled by diverse and affordable multi-modal transport systems and information and communication technology (ICT) networks, and contingency planning.

Rationale: Reliable communications and mobility create daily connectivity between places, people and services. This fosters a positive environment for everyday working and living, builds social cohesion, and also supports rapid mass evacuation and widespread communication during emergencies.

Focus: The focus of this Goal is on the diversity, safety and quality of travel options across the city. It also considers the reliability and security of information and communication technology networks across the city and the ability of the city to communicate information to residents and businesses during times of emergency.

Structure: This Goal comprises four indicators, as follows:

9.1 Diverse and affordable transport networks

9.2 Effective transport operation and maintenance

9.3 Reliable communication technology

9.4 Secure technology networks

Indicator 9.1.: Diverse and affordable transport networks

Goal:

Diverse and integrated transport networks, providing flexible and affordable travel around the city for all.

Rationale:

Mobility throughout the city is crucial create an enabling environment for everyday working and living, builds and maintains social networks and bonds, and supports rapid mass evacuation during emergencies. Diversity within the city's transport networks, and integration between networks, enables people to move easily around the city to undertake personal and business activities. Diverse, integrated transport networks are also better able to continue to support mobility around the city during times of disruption by providing a range of alternative journey options. Providing affordable travel options is also essential to ensure all residents are able to move with ease around the city to pursue their livelihoods.

Focus:

This indicator considers the planning, accessibility, integration and distribution of modes of travel throughout a city daily and during emergencies. It also considers transport links to places beyond the city (e.g. other cities). Transport modes include methods such as walking, cycling, private vehicle use (e.g., car, van, motorcycle, taxi) within the city.

Qualities:

- Redundant
- Flexible
- Inclusive
- Integrated

Qualitative questions:

9.1.1	To what extent does the city provide a diverse, adequate road network?
9.1.2	To what extent does the city provide a diverse, affordable public transport system?
9.1.3	To what extent are alternative personal transport options promoted?
9.1.4	To what extent does the city provide diverse and effective transport links to other cities or regions?

Indicator 9.1.: Reference tables

9.1.1: To what extent does the city provide a diverse, adequate road network?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's road networks are adequate for demand, with drivers able to take alternative routes when disruptions occur within the network. The road network effectively supports both journeys from outer areas into the city centre as well as radial journeys around or across the city. Grid-locked traffic congestion is rare. Essential city services and facilities (e.g., schools / hospitals / employment locations) are widely distributed across the city. Information is available to users of the road network on real-time journey times and travel information.	The city's road networks heavily favour transport into the city centre, with difficult connectivity across the city or radial journeys. Grid-locked traffic congestion, causing drivers considerable delays to their journeys, occurs frequently. Essential services and facilities (e.g., schools / hospitals / employment locations) are located in clusters, causing traffic congestion issues. There is little or no information available to users of the road network on real-time journey times and travel information.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average speed of road journeys from city centre to the city boundary (km per hour) (Adapted from York City Council and City of London)	Average annual speed of a journey from the city centre to the outer boundary in kilometres per hour
	Supplementary Metrics	
	• Total / average journey time across city (i.e., circumferential journeys) (Arup, 2015) • Total / average journey time across city (i.e., radial journeys) (Arup, 2015)	

9.1.2: To what extent does the city provide a diverse, affordable public transport system?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city's public transport system is affordable and accessible across the city, providing access to relevant destinations. The city provides mechanisms that are culturally appropriate to support equitable access by vulnerable people (e.g., elderly, disabled, adults traveling with children) or demographic groups. Information is available to users on real-time journey times or notices.	The city's public transport system is not accessible or affordable for low-income users. OR The public transport system does not provide equitable access by vulnerable groups or demographic groups. The public transport network does not provide adequate access to relevant destinations.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of commuters using a travel mode other than a personal vehicle (as a percentage of total commuters) (ISO 37120)	
	Supplementary Metrics	
	• Average travel time to work using public transport (Arup) • Proportion of average monthly income of poorest 20% of the population that is spent on travel • Percentage of households located within a ½ mile walking distance of one or more modes of public transport (Arup)	

9.1.3: To what extent are alternative personal transport options promoted?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has comprehensive plans in place, and has secured investment, to promote alternative transportation options (e.g., car sharing, walking paths, cycle routes and associated infrastructure). These plans engage the private sector and/or civil society and integrate with overall city planning. The city has evaluated the adequacy and effectiveness of alternative travel planning initiatives. Plans reflect up to date data and are regularly revised and updated to address the city's needs.	The city has no plans or initiatives to promote alternative transportation options (e.g., car sharing, walking paths, cycle routes and associated infrastructure).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of journeys undertaken by walking or cycling (Arup, 2015)	
	Supplementary Metrics	
	• Percentage of city covered by safe walking surface (Arup, 2015) • Kilometres of bicycle paths / urban area (Arup, 2015) • Kilometres of bicycle paths / 100,000 (Arup, 2015) • Kilometres of shared transport lanes (e.g. carpool, bus) per 100 000 population (Arup, 2015)	

9.1.4: To what extent does the city provide diverse and effective transport links to other cities or regions?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has identified the commuting catchment and has up-to-date data on commuting time and cost by mode. The city has strong regional transport connectivity through a range of accessible transport modes. The city has undertaken a strategic assessment of transport links with other cities and regions. The city has contingency plans in place to enable movement of people and goods into / out of the city should one or more major external transport links fail (e.g., airport, rail, and road). The city has reviewed intra-city/regional transport links in the context of emergency scenario planning.	The city has not identified the commuting catchment. The city has poor transport links to other cities or regions. The city has not undertaken a strategic assessment of transport links with other cities. OR The city has not developed contingency plans to ensure movement of people and goods into / out of the city should one or more major external transport links fail (e.g., airport, rail, and road).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of other cities to which this city has daily connections by bus (Liverpool City Council)	
	Supplementary Metrics	
	• Average cost of fares for commuting catchment by bus (Arup, 2015) • Average journey time (minutes) for commuting catchment by bus (Arup, 2015) • Commercial air connectivity (number of non-stop commercial air destinations) (ISO 37120)	

Indicator 9.2.: Effective transport operation and maintenance

Goal:

Effective management of the city's transport network to provide quality, safe transport.

Rationale:

Effective management of the city's transport networks is important to maintain a reliable and safe service. Adequate public transport options for city citizens provide accessible mobility for people who may be unable to access private means of transport, particularly the most vulnerable residents of the city, such as the poor and the elderly. Public transport also encourages community connection and reduces pollution and road congestion.

Focus:

This indicator considers the adequacy of transport safety laws, operation and maintenance regimes across the transport network and planning to maintain continuity during emergency events.

Qualities:

- Resourceful
- Redundant
- Integrated

Qualitative questions:

9.2.1	To what extent are adequate resources available for safe operation and essential maintenance and upgrade programmes?
9.2.2	To what extent are safety laws and regulations enforced across the transport network?
9.2.3	To what extent are there effective planning and programmes across the transport network for emergency response and recovery following a major event?

Indicator 9.2.: Reference tables

9.2.1: To what extent are adequate resources available for safe operation and essential maintenance and upgrade programmes?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has a comprehensive plan with a protected budget for long-term maintenance and renewal of core transport infrastructure (e.g., roads, rail, and bridges) with clear roles and responsibilities. The city employs a progressive user fee system or tax to manage road congestion and cover maintenance / operation fees. Funds are dedicated to reinvestment in transport infrastructure.	The city has no / an insufficient plan for long-term maintenance and renewal of core transport infrastructure (e.g., roads, rail, and bridges). OR The city has a plan but insufficient funding available for implementation.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Average percentage of the city's transport budget spent on maintenance and upgrade over the past 5 years (Arup, 2015)	This measures whether the city transport infrastructure is kept in good operational condition.
	Supplementary Metrics	
	• Presence of capital infrastructure program, updated on a consistent (typically 5 or 10 year) basis. (this is more of a yes/no) (Arup, 2015) • Maintenance budget for network, per kilometre of rail and kilometre of road (Arup, 2015) • Average age of public transport stock (Arup, 2015) • Average delay in hours, per year, for each kilometre of the city's transport network by rail and road	

9.2.2: To what extent are safety laws and regulations enforced across the transport network?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has appropriate design and safety regulatory standards in place across the transport network within the city. Mechanisms are in place to review and update standards. The city requires drivers of all motorised vehicle types to pass a proficiency examination prior to operating vehicles on public roadways. The city has a respect and safety campaign or initiatives for all public transport users.	The city has inconsistent or absent standards for appropriate design and safety regulatory standards across the city's transport network. The city has no / unenforced requirement for drivers of motorised vehicles to pass a proficiency examination prior to operating vehicles on public roadways. The city has no / unenforced safety campaigns / initiatives for all public transport users.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Transportation fatalities per 100 000 population (ISO 37120)	Annual figure
	Supplementary Metrics	
	• Number of crimes reported on public transport (Arup, 2015) • Number of pedestrian accidents (Arup, 2015) • Number of cyclist accidents (Arup, 2015) • Percentage coverage of major roadways with road crossings (e.g., surface, below ground, above ground) (Arup, 2015)	

<table>
<tr><th colspan="3">9.2.3: To what extent are there effective planning and programmes across the transport network for emergency response and recovery following a major event?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td>Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td>The city has comprehensive plans in place to provide continuity of transport services during and following an emergency. The plans reflect relevant shocks and are based on current data or modelled hazard and demographic projections. The city regularly tests the operational adequacy of the plans (e.g., through theoretical modelling or real-life practice and drills). The city has in place robust mutual assistance agreements between transport providers to ensure continuity of transport services. The city has a comprehensive mechanism to identify and sign-post emergency access routes that is effectively communicated across the city.</td><td>The city no / inadequate plans to provide continuity of transport services during and following an emergency. OR The city has plans in place but they may be untested, based on out of date data, or do not encompass all relevant shocks. The city does not have a mechanism to identify and sign-post emergency access routes OR The city has sign posted emergency access routes but information has been ineffectively communicated across the city.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td>Metric Guidance</td></tr>
<tr><td>Number of years since the city evacuation plan was updated
(Arup, 2015)</td><td>A city evacuation plan should outline arrangements for the evacuation of all, or parts of the city centre. It should:
- Outline multiagency roles and responsibilities.
- Outline pre-determined evacuation points for public transport and arrangements for increasing capacity.
- Ensure that the needs of residents and visitors are met.
- Provide analysis of estimated evacuation time and potential congestion points along core routes with alternative solutions (this can be achieved using computer modelling).</td></tr>
<tr><td colspan="2">Supplementary Metrics</td></tr>
<tr><td colspan="2">• Capacity of evacuation routes out of city (cars per hour) (Arup, 2015)
• Dedicated routes for emergency services & response time (Arup, 2015)
• Number of major roads out of the city (Arup, 2015)</td></tr>
</table>

Indicator 9.3.: Reliable communications technology

Goal:

Effective and reliable communication systems that are accessible by all.

Rationale:

Robust ICT services, with sufficient capacity to meet demand surges, enable safe communication and access to information and are critical for a city's connectivity. The availability of reliable and inclusive forms of communication is critical to disseminate information during emergencies – particularly to the most vulnerable residents of a city, such as the poor and the elderly. Effective and appropriate information dissemination can save lives and assets during emergencies and help avoid panic or inaction.

Focus:

This indicator considers the planning, accessibility, integration and distribution of a diverse range of information and communication technologies for the city's residential, public and business use and the delivery of relevant, accessible, timely, and reliable information during emergencies. Technologies include radio networks, internet and mobile phone services, as well as specific channels such as social media. Emergency communication is also considered. In this instance, it is the capacity and capability of the technology with which we are primarily concerned.

Qualities:

- Robust
- Redundant
- Inclusive

Qualitative questions:

9.3.1	To what extent is there access to diverse, reliable communication networks across the city?
9.3.2	To what extent do emergency information systems alert the public, provide information updates, maintain calm and reunite family members following a shock?
9.3.3	To what extent does emergency communications infrastructure enable key responders to communicate during / following a shock event?

Indicator 9.3.: Reference tables

9.3.1: To what extent is there access to diverse, reliable communication networks across the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Households and businesses across the city have access to a diverse range of communication technologies that enable reliable, affordable connectivity (e.g., fixed telecom, wireless / mobile, radio). Wireless technology offers fast connection at affordable prices. The city promotes free, open use of social media technology.	Households and businesses have no / inconsistent access to communications technology across the city. Pockets of connectivity may exist, but broadly, access is unreliable or unavailable. Access may be technically limited, or unaffordable. OR Households and businesses may have good access, but are reliant on one primary technology that may be vulnerable to disruption.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Internet users (per 100 people) (Arup, 2015)	What percentage of the population has reasonable access to the internet on a regular basis? This might be through a home connection, mobile technology or a local library. Reliable, affordable connectivity is key.
	Supplementary Metrics	
	• Number of telephone connections (landlines and cell phones) per 100,000 population (ISO 37120) • Percentage of city population with access to TV or radio (Arup, 2015)	

9.3.2: To what extent do emergency information systems alert the public, provide information updates, maintain calm and reunite family members following a shock?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Plans, strategies and mechanisms exist for warning businesses and households of emerging hazards and suggested responses. Warnings systems are regularly tested with clear roles and responsibilities. The city has appropriate and robust communication plans to warn and assist people at risk of impact by a crisis - especially the most vulnerable people. The city has a clear understanding that warning systems and notices are understood by the public. Emergency information systems are accessible throughout the city with complete coverage of residents, businesses, etc.	There is no comprehensive warning system for businesses and households of emerging hazards and/or suggested responses. OR There is a system but it is out of date, untested or does not adequately reach people at risk of impact.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of media types used to alert people in an emergency (Arup, 2015)	This metric examines diversity of emergency communications assessing whether people will be able to access emergency messages through one or more mediums. Types of media used to communicate may include (but not be limited to) radio, TV, social media, telephone, text message, matrix boards and speakerphone announcements and door to door visits in affected neighbourhoods by emergency services.
	Supplementary Metrics	

9.3.3: To what extent does emergency communications infrastructure enable key responders to communicate during / following a shock event?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is adequate communications infrastructure across the city to enable coordination between key responders to prepare for and respond to emergency events. There is sufficient diversity and capacity within the communications infrastructure such that information can still be effectively communicated during demand surges following an emergency event. The emergency communication infrastructure is appropriate for the key hazards facing the city. Operational procedures for emergency communication systems have clear roles and responsibilities, technology is are understood and regularly tested. The city has identified sites for Command and Control centres (or equivalent). Required communication technology is regularly tested.	The city has no / insufficient communications technology to enable emergency responders to reliably communicate during / following an emergency event. OR The city has communications technology in place but it is untested and/or unreliable to withstand potential impacts of relevant hazards.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of emergency responders with arrangements which enable them to communicate in an emergency (e.g., MTPAS (UK), satellite phones, airwaves etc.) (Arup, 2015)	Key emergency responders should have priority communication arrangements in the event of an emergency (as communications networks are likely to be exceptionally busy). In the UK there are agreements where by emergency responders can be registered (with mobile phone network providers) for network priority access and therefore have a higher chance of being able to connect and make calls in an emergency. Other arrangements include emergency responders having access to satellite phones or airwave radios, in the event that all mobile networks are disrupted. These and other types of special arrangements should be considered when answering this question. Regular mobile phone access is not considered to be a sufficient solution.
	Supplementary Metrics	
	• Percentage of emergency responders which have undertaken an emergency communication exercise in the last 5 years (Arup, 2015)	

Indicator 9.4.: Secure technology networks

Goal:

Robust, effective mechanisms in place to protect the information and operational technology systems on which the city is dependent.

Rationale:

Secure technology systems help protect information technology (IT) and operational technology (OT) systems and services from attack. This considers detection, prevention and response to potential disruptive events, helping to prevent fraudulent or abusive use of data or disruption of communication and information service provision. The security of IT and OT networks is becoming more critical in the day-to-day operation of cities as ICT becomes an integral tool for daily life and more services are becoming mechanised or automated.

Focus:

This indicator considers mechanisms to protect IT and OT networks day-to-day as well as during and following an emergency to enable the on-going functioning of city services. This also considers the storage, protection and accessibility of data records and communication networks following a shock event.

Qualities:

- Reflective
- Robust

Qualitative questions:

9.4.1	To what extent are mechanisms in place for safe and efficient storage, back-up and access of data critical to the functioning of the city government?
9.4.2	To what extent does the city have in place Information Technology (IT) security and continuity arrangements?
9.4.3	To what extent does the city have in place Operational Technology (OT) security and continuity arrangements?

Indicator 9.4.: Reference tables

9.4.1: To what extent are mechanisms in place for safe and efficient storage, back-up and access of data critical to the functioning of the city government?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city government has robust plans, strategies and mechanisms in place for the safe, long-term storage, back up and access of city government data and records critical to the functioning of the city. These plans reflect the city's vulnerabilities to risks, and are regularly updated and tested. Roles and responsibilities are clearly defined. There are mechanisms in place to protect the security and privacy of sensitive data collected and stored by the city government.	The city government does not have plans, strategies or mechanisms for the safe, long-term storage, back-up and access of city government data and records. OR The city government may have plans in place, but they are untested, out of date, or do not reflect the city's vulnerability to risks.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city government data with secure back-up remote storage (See Tier standard of backup) (Arup, 2015)	All important data held by government should be backed up at a secure secondary data centre in the event of disruption and/or damage to primary storage. The data centre used for back-up storage should be meeting criteria outlined in Tier standard level IV – http://www.gpxglobal.net/wp-content/uploads/2012/08/tierstandardtopology.pdf
	Supplementary Metrics	
	• Number checks to back up options (Arup, 2015) • Number attacks detected per year (Arup, 2015) • Number disruptive events to government services per year (disruptive event = functionality below Service Level Agreement) (Arup, 2015)	

9.4.2: To what extent does the city have in place Information Technology (IT) security and continuity arrangements?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has sophisticated, state-of-the-art IT security (the latest antivirus, firewalls etc.) and measures in place to prevent hacking of critical city systems. There are also rigorous arrangements for the continuity of city services and businesses in the event of IT disruption/failure. These arrangements ensure that public services and key businesses are able to continue to function and that disruption is kept to a minimum. The city government and key businesses have specialised teams which can respond immediately to any IT disruption.	There are severe vulnerabilities in IT infrastructure supporting key city services and economic sectors. There is a lack of appropriately sophisticated security (antivirus, firewalls etc.) and insufficient arrangements in terms of the continuity of services and businesses in the event of IT disruption/failure.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of government databases protected by a dynamic proactive I.T. security system (Arup, 2015)	Dynamic I.T security systems automatically install the latest software updates and dynamically scan and block threats to I.T infrastructure. All government databases should be protected by top-level security, including the latest firewalls, antivirus and malware scanning programs.
	Supplementary Metrics	
	• Number of days of I.T. disruption in year (Arup, 2015) • $ spent on Information Technology (IT) security and continuity arrangements / year (Arup, 2015) • Number attacks on Information Technology (IT) security) in last year (Arup, 2015) • Total cost of I.T. disruption to the city last year? (Arup, 2015)	

9.4.3: To what extent does the city have in place Operational Technology (OT) security and continuity arrangements?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are comprehensive mechanisms in place to ensure the cyber security of public or privately managed wirelessly linked infrastructure. Mechanisms are in place to detect vulnerabilities, threats and risks for the security of OT infrastructure and to provide timely input into the development and enforcement of policies and standards to protect specific technologies. The city government and key stakeholders, including public, private, civic, and industry groups collaborate to address current and future security challenges. There are mechanisms in place to coordinate a response in the event that OT infrastructure systems are compromised.	The city government has not considered the risk to essential city functions from a cyber-attack on critical OT infrastructure. No assessment of these risks has been undertaken. There is potential for major weaknesses in the cyber security of OT infrastructure supporting key city services and economic sectors (e.g., traffic lights, transport operations, power networks, gas or water pipelines). No initiatives have been implemented to ensure that public or privately managed OT infrastructure systems are adequately protected from cyber-attacks.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of infrastructure which relies on operational technology protected by a dynamic proactive I.T. security system (Arup, 2015)	Dynamic I.T security systems automatically install the latest software updates and dynamically scan and block threats to I.T infrastructure. All city operational technology should be protected by top-level security, including the latest firewalls, antivirus and malware scanning programs. Operational technology includes any city infrastructure which relies on I.T. technology. This may include (but not be limited to) traffic lights and other transport infrastructure, energy infrastructure (e.g. automatic cooling systems etc.) and water systems (e.g. automated supply components).
	Supplementary Metrics	
	• Economic value of I.T. disruption to the city last year? (Arup, 2015) • US$ spent on Operational Technology (OT) security and continuity arrangements / year (Arup, 2015) • Number attacks on Operational Technology (OT) security) in last year (Dell) • Number of days of disruption in year due to Operational Technology (OT) issues? (Arup, 2015)	


[090] M1/M50 Roundabout
[093] M50 / M1 Slip
[094] M50 / M1
[110] M1 - J2 Airport Roundabout
[113] M1 - J4 Lissenhall
[138] M1 / Toll Bridge Drogheda
[089] M50 - J4 Ballymun
[148] M50 - Between M1 & Port Tunl
[095] M50 / Coolock Lane
[111] M1 - J3 Drinan
[112] M1 - Estuary Road Malahide
[109] M1 - J6 Balbriggan
[077] M50 - J11 N81Tallaght
[075] M50 - J12 Firhouse
[118] M50 - J14 Sandyford
[116] M50 - J15 Carrickmines
[081] M50 - J11 N81 Tallaght Slip
13 Dundrum (N)
[115] M50 - J14 Sandyford Slip Lane
[119] M50 - J17 M11
Control Center Client
M50 - J11 N81 Tallaght Slip
[096] M50 - J4
[084] M50 - J6 N3 Blanch Slip
[074] M50 - J

Leadership and strategy

This dimension is underpinned by **knowledge**. A resilient city learns from the past and takes appropriate action based on evidence. This means a city must have effective leadership and urban management, characterised by inclusive governance involving the government, business and civil society, and evidence-based decision-making. A city must also empower its stakeholders by providing access to information and education, so that individuals and organisations can take appropriate action. It is equally important to ensure that the city develops in an integrated way that aligns the city's vision with sectoral strategies and plans and individual projects.

Structure:

This dimension of the City Resilience Index comprises three Goals, as follows:

10 Effective leadership and management

11 Empowered stakeholders

12 Integrated development planning

(Image Opposite)

Dublin Port Tunnel Facilities

Goal 10. Effective leadership and management

Description: This is enabled by trusted individuals, multi-stakeholder consultation, evidence-based decision-making and disaster risk reduction activities.

Rationale: Clear and purposeful leadership promotes trust, unity and a shared understanding of a city's trajectory. Leadership is a key ingredient in encouraging individuals and communities to take action during challenging times. A committed city government that takes decisions on the basis of sound evidence enables a city to thrive from day to day, and to respond to shocks and stresses.

Focus: The focus of this Goal is on leadership provided by the city government and its supporting agencies, with a particular focus on preparation and planning for emergency situations.

Structure: This Goal comprises five indicators, as follows:

10.1 Appropriate government decision-making

10.2 Effective coordination with other government bodies

10.3 Proactive multi-stakeholder collaboration

10.4 Comprehensive hazard monitoring and risk assessment

10.5 Comprehensive emergency management

Indicator 10.1.: Appropriate government decision-making

Goal:

Transparent, inclusive and integrated government decision-making and leadership.

Rationale:

A committed city government that takes decisions on the basis of sound evidence enables a city to thrive from day to day, and to respond to shocks and stresses. Cross-sector collaboration that challenges 'siloed' approaches in government operations is critical to effective decision-making, as is using knowledge based on learnings from past experiences and exchanges with other cities and agencies. Openness and transparency can help strengthen trust in the city's leadership - a key ingredient in encouraging individuals and communities to take action during challenging times.

Focus:

This indicator is about city government decision-making, in particular sound decision-making based on solid evidence. It considers transparency, continual learning and knowledge exchange.

Qualities:

- Inclusive
- Reflective

Qualitative questions:

10.1.1	To what extent is continual learning and knowledge sharing promoted at all levels within city?
10.1.2	To what extent is there transparency within policy-making and decision-making by the city government?

Indicator 10.1.: Reference tables

10.1.1: To what extent is continual learning and knowledge sharing promoted at all levels within city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city is active within networks and programmes to share knowledge and best practices between cities with an aim to enhance long-term resilience (e.g., C40, ACCCRN, 100 Resilient Cities). The city government often supports, and participates in, events to share best practice knowledge with other relevant organisations or agencies. There is considerable dialogue to share knowledge across district, city, regional and national government levels. There are robust systems in place to ensure that information on hazards and long-term stresses is shared with all city departments, relevant external agencies, businesses and civic society. For cities that have experienced disasters and major emergency events, robust reviews have been undertaken after the event to learn from the recovery and reconstruction process and identify how similar disasters could be prevented or mitigated in future. The findings of these reviews have been widely disseminated across city departments and externally.	The city government is not active within any networks or programmes to share knowledge and best practices between cities. The city government rarely supports, or participates in, events to share best practice knowledge with other relevant organisations or agencies. There is little or no sharing of knowledge across district, city, regional and national government levels. There are no systems in place to ensure that information on hazards and long-term stresses is shared with all city departments, relevant external agencies, businesses and civic society. For cities that have experienced disasters and major emergency events, very few or no post-event reviews have been undertaken to learn from the recovery and reconstruction process or to identify how similar disasters could be prevented or mitigated in future.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of training and knowledge sharing agreements with international networks (Arup, 2015)	International knowledge sharing networks allow cities to share best practice and help each other work towards common objectives. Examples include 100 Resilient Cities and C40.
	Supplementary Metrics	

10.1.2: To what extent is there transparency within policy-making and decision-making by the city government?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are procedures and requirements for public consultation during development of city policies and plans. The findings of these consultations are made publically available. Citizens have the right to access data, documents and proceedings of the city government. The city government and other publically-funding city agencies publish information on their activities in a timely manner, in open data formats and without restrictions on reuse. Transparency mechanisms that are in place include the disclosure of information in response to requests from the public and proactive publication by public bodies. The city government publishes data sets showing how public money has been spent and how the city government is doing against its objectives and targets. There is a requirement to publish public contracts and tenders and a clear selection process by which contracts are awarded.	There are no procedures or requirements for public consultation during development of city policies and plans. Citizens do not have the right to access data, documents and proceedings of the city government. There is no right to disclosure of information in response to requests from the public. The city government does not publish data sets showing how public money has been spent or how the city government is doing against its objectives and targets. There are no requirements to publish public contracts and tenders and there is not a clearly defined selection process by which contracts are awarded.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of non-sensitive city government documentation and data sets that are publically available (Arup, 2015)	This is any government data that is non-sensitive in the respect that it its release does not pose a security risk or breach the privacy of individuals by publishing personal details such as private addresses and telephone numbers. Non-sensitive data should be publically available to ensure transparency with respect to how the government is running the city.
	Supplementary Metrics	

Indicator 10.2.: Effective coordination with other government bodies

Goal:

Integrated and flexible communication and collaboration between city, state and national government, both daily and during times of shock or stress.

Rationale:

Effective collaboration with actors at all levels of government is critical to develop integrated, co-ordinated strategies that make best use of the resources available. Isolated decision makers are less effective and efficient than collaborative groups, and may act in conflict of goals broader than their specific interest. This could lead to conflicts within the city government and with other levels of government (e.g. regional, national). With long-term stresses, and during shock events, this could create environments that exacerbate social unrest or economic loss as direction is unclear or in opposition to other plans or actions.

Focus:

This indicator considers whether the city government coordinates effectively both with other local departments (horizontally) and with state / regional / national governments (vertically). This indicator does not consider co-ordination and collaboration with non-governmental stakeholders as this is included under indicator 10.3.

Qualities:

- Integrated
- Resourceful

Qualitative questions:

10.2.1	To what extent is there effective communication and collaboration between city, state/ regional and national governments?
10.2.2	To what extent is there effective communication and collaboration across city departments?

Indicator 10.2.: Reference tables

10.2.1: To what extent is there effective communication and collaboration between city, state/regional and national governments?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are formal city forums and initiatives that facilitate collaboration with state / regional government and with national government. Multiple tiers of government are involved in major city policy discussions. There are formal mechanisms in place that ensure city policies are aligned with related regional and/or national policies. Emergency strategies for the city have been developed in alignment with regional and national emergency strategies.	There are no formal city forums or initiatives that facilitate collaboration with state / regional government and with national government. The city government makes major city policy decisions without consultation with national or state / regional government. There are no formal mechanisms in place that ensure city policies are aligned with related regional and/or national policies. Emergency strategies for the city do not align with regional and national emergency strategies.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of major policy / regulatory decisions made within the last year that were the product of city-upwards, downwards (regional, national) government consultation (Arup, 2015)	This explores how coordinated national and city governments are in making key decisions which directly affect the city population. For example housing support policy.
	Supplementary Metrics	
	• Number of interdepartmental meetings / year (Arup, 2015) • Number of multi-stakeholder projects in last 5 years (Arup, 2015)	

10.2.2: To what extent is there effective communication and collaboration across city departments?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place to ensure effective collaboration and communication between departments. Staff have no working relationship with counterparts in other departments are routinely are excluded or omitted from pertinent information exchange.	There are no mechanisms in place to ensure effective collaboration and communication between departments. Departments have in place effective means to coordinate and share relevant information with clear objectives, processes, roles and responsibilities. Staff demonstrate working relationships with relevant counterparts, and feel both a willingness to share information from their own departments and trust that relevant information from other departments is shared with them.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of major policy / regulatory decisions made within the last year that were that are the product of cross-departmental government consultation (Arup, 2015)	This examines how coordinated city government is across its departments. For example when a new planning policy is formed is appropriate consultation undertaken with the environment department, emergency planning, transport and any other departments affected by this decision?
	Supplementary Metrics	

Indicator 10.3.: Proactive multi-stakeholder collaboration

Goal:

Inclusive and constructive collaboration between all actors involved in city decision-making.

Rationale:

Engaging multiple stakeholders in city decision-making builds cross-sector relationships, helps align different perspectives and goals to a common end, and leverages knowledge that universities, businesses, institutions and civic society can contribute to help understand and solve city problems. By forging relationships across sectors and interests, cities are better understand the broad needs and assets across their communities, are better able to coordinate people and access private resources and support during times of need, and avoid creating unintentional disadvantages or disincentives.

Focus:

This indicator considers the engagement and consultation undertaken by the city government and its agencies during decision-making with other organisations, institutions and with civic society. This indicator does not consider co-ordination and collaboration between government departments and with other levels of government as this is considered by indicator 10.2.

Qualities:

- Reflective
- Inclusive

Qualitative questions:

10.3.1	To what extent does the city government seek participation from the business sector in policy-making and decision-making?
10.3.2	To what extent does the city government seek participation from key civil society stakeholders in policy-making and decision-making?

Indicator 10.3.: Reference tables

10.3.1: To what extent does the city government seek participation from the business sector in policy-making and decision-making?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is appropriate consultation with local businesses before projects are initiated which may affect them. There is an agency or organisation that represents the views of businesses (e.g. a chamber of commerce) and works to ensure that the views and activities of the private sector within the city are represented. There are mechanisms in place to ensure the views and interests of the private sector are taken into account during city government decision-making processes.	There are no mechanisms in place to ensure collaboration between the private sector and stakeholders involved in city decision-making. Decisions are undertaken without consultation, which may adversely affect local business.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of major projects within the last year which included private sector consultation (Arup, 2015)	All projects with an estimated cost in excess of £500,000 (USD 750,000) shall be deemed major projects regardless of complexity. Projects less than this shall be deemed minor unless there is a clear economic focus or the undertaking or completion of the project is likely to have an impact on the private sector. (Adapted from http://www.plymouth.gov.uk/pms_define_project.doc)
	Supplementary Metrics	

10.3.2: To what extent does the government seek participation from key civil society stakeholders in policy-making and decision-making?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are policies in place that clearly identify when consultation with key civil society stakeholders (e.g. representing community level interests and the interests of minority groups) and the general public must be undertaken by the city government during its decision-making processes. There are mechanisms in place to ensure that these policies are consistently applied across all city government departments. Public consultation exercises are undertaken during the planning stages of significant projects. The public can engage directly in the consideration of policy options and decision making, and can contribute ideas and evidence that lead to policies, laws, and decisions which best serve society and broad democratic interests. Mechanisms exist which permit the public to participate at their own initiative and to trigger policy debates on matters of concern. [Citation from www.opengovstandards.org). The city government actively seeks to mobilise citizens to engage in public debate.	Consultation with key civil society stakeholders (e.g., representing community level interests and the interests of minority groups) and the general public is rarely, if ever, undertaken. There are no mechanisms in place to enable the public to engage directly in city government policy-making and decision-making. The general public are discouraged from public debate of city government decisions and activities.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of city government major policy and plan changes within the past year sent out to public consultation (Arup, 2015)	This is defined as any plan or policy deemed to have a significant impact on the lives of citizens. Best practice suggests these changes shall be subject to public consultation.
	Supplementary Metrics	
	-	

Indicator 10.4.: Comprehensive hazard monitoring and risk assessment

Goal:

Effective systems to monitor potential hazards and assess risk.

Rationale:

Timely and integrated monitoring of the hazards it faces enables a city to anticipate exposures, identify vulnerabilities and prepare for risks. Hazards may include chronic stresses (such as ageing infrastructure, changing demographics, crime or environmental degradation) or short-term shocks (such as extreme weather events, transport accidents, public protest or terrorism). The foundation of emergency planning is understanding the hazards the city faces and effectively communicating this information to emergency management stakeholders in a timely fashion so they can act upon this information. Emergency planning and co-ordination efforts are more likely to be inadequate or ineffective if based on incomplete hazard and risk assessment information.

Focus:

This indicator considers the technical capacity to understand and effectively monitor hazards that pose a risk to the city. It considers if there are early warning systems for hazard monitoring agencies to alert city emergency management agencies and the general population to imminent threats. Finally, it considers whether this information is used by emergency management agencies to collectively assess the risk of different hazards to the city and its population.

Qualities:

- Robust
- Reflective

Qualitative questions:

10.4.1	To what extent is there hazard research and data accessible for city emergency planning?
10.4.2	To what extent are there effective early warning centres serving the city?
10.4.3	To what extent does the city assess risk collectively, considering current and future hazards, local exposure and underlying vulnerability?

Indicator 10.4.: Reference tables

10.4.1: To what extent is there hazard research and data available for city emergency planning?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city monitors, or has access to, reliable, specific, up to date hazard data, appropriate to is hazard profile. The city has the research capacity, or access to such expertise, in the field of hazard monitoring. A mechanism exists to ensure that city emergency management stakeholders have access to hazard data and hazard experts to ensure data is explained and understood.	The city does not monitor, or have access to, reliable hazard data, appropriate to its hazard profile. The city has no expertise, or access to such expertise, in the field of hazard monitoring.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since city hazard maps have been updated (Arup, 2015)	City hazard mappings should present exposure of different city areas to local risks. Hazards might include flooding, earthquakes, landslides etc. This work may combine several departments and stakeholders, for example G.I.S departments, emergency planners and research institutions.
	Supplementary Metrics	
	• Frequency to which scientific updates on local hazard profile are provided (Arup, 2015) • Historical record available of hazards and their impacts, climate change and climate variability (catalogues, inventories). (UNISDR, 2008) • Quantity of accurate documentation and databases on disasters. (UNISDR, 2008) • Number of universities / NGOs / institutions (e.g. weather agency) involved in undertaking DRR or resilience research related to the city (Arup, 2015)	

10.4.2: To what extent are there effective early warning centres serving the city?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	An early warning mechanism / arrangements between hazard monitoring agencies (e.g., weather office, seismology centre) and local emergency responders. Alerts are based upon timely, accurate information and there is an appropriate and well-understood system outlining different levels of severity. The mechanism is tested regularly.	There is no early warning mechanism / arrangements between hazard monitoring agencies (e.g., weather office, seismology centre) and local emergency responders.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of local severe weather warnings issued by national metrological agency which are received in a timely fashion by city emergency responders (Adapted from UNISDR, 2008)	This explores how effective the communication is between the national or regional meteorological offices and local city emergency planning. There should be a mechanism to ensure that city responders receive weather alerts in sufficient time to implement emergency plans and warn citizens. There should also be the opportunity for emergency responders to communicate with meteorological office representatives in order to ask any questions and obtain more in-depth information.
	Supplementary Metrics	
	• Number of times the city emergency responders have communicated with agencies responsible for scientific monitoring of hazards in the last month (Arup, 2015) • Percentage of the city's top 5 natural hazards which have specific scientific monitoring and alert mechanisms (Arup, 2015)	

10.4.3. To what extent does the city assess risk collectively, considering current and future hazards, local exposure and underlying vulnerability?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	A multi-stakeholder (key emergency responders) risk assessment mechanism exists which ensures that findings are integrated into key city decision-making. Risk assessments are based on up-to-date information on the city's hazard profile and consider local exposure and underlying vulnerability including cross-sectoral issues such as economic, social and environmental vulnerabilities which can impact upon the impact of various hazards. Mechanisms exist to disseminate hazard-risk information up and down, between the national government, city and local community.	There are no mechanisms in place to assess risk collectively, such as across key emergency responders (government, police, fire, ambulance, health), city government departments, research institutes, or community-based organisations. responders
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	The number of times the 5 most significant hazards identified in the city's local risk profile have been assessed by multi-stakeholders in the last 5 years? (Arup, 2015)	A risk assessment should follow the equation: *Risk = Hazard x Exposure x Vulnerability* It should consider the likelihood of the **hazard** occurring (frequency) and how severe this might be (intensity). It should then consider what parts of the city (people and infrastructure assets) are **exposed** to this hazard should it occur. Finally it should consider the **vulnerability** of exposed populations, assets and services, considering what capacities they have to manage impact (e.g. financial protection, resilience plans, protective infrastructure etc.). Risk assessments often consider all of these aspects from a social, environmental, economic and health perspective. The combination of these considerations should allow assessors to make an assessment regarding the risk of that particular hazard to the city. Scientific information should be provided (often by national government) as to the likelihood and intensity of hazard occurrence. The other aspects of the risk assessment should be considered by key representatives from all emergency responders (local government, police, fire, health) as well as environmental representatives.
	Supplementary Metrics	
	• Coverage by type and objective of trans-boundary hazard assessments. (UNISDR, 2008) • Number of (multi-stakeholder) hazard risk assessments in last 2 years (Arup, 2015)	

Indicator 10.5.: Comprehensive emergency management

Goal:

City leadership that has sufficient capacity and flexibility to effectively manage emergencies.

Rationale:

Comprehensive emergency planning is important because it helps a city to implement a more effective and efficient response during an emergency to save more lives, protect more assets, and enable a city to recover faster after an event. By identifying the relevant actors and establishing clear roles, responsibilities and actions cities will be able to quickly put plans into action, respond to emerging needs, and make better use of resources. Cities without robust, integrated and flexible emergency response and coordination plans could experience greater loss of life or physical damage leading to longer-term social and economic disruption or breakdown.

Focus:

This indicator concerns the capacity and capability of the city's emergency management agencies to collectively manage emergencies. They need clear strategies and plans to ensure both the continuity of their own departments and minimisation of disruption to citizens. This includes comprehensive planning and actions to mitigate, prepare, respond and recover from local shocks. The focus here is overall multi-stakeholder emergency management. Specific elements are considered in more detail elsewhere within the index: Operational emergency response capability is considered within indicator 3.4, budgeting is considered within 6.1, technology within 9.4 and community awareness and preparedness within 11.2.

Qualities:

- Robust
- Integrated
- Reflective

Qualitative questions:

10.5.1	To what extent are there mechanisms in place to ensure government functions adequately continue during an emergency?
10.5.2	To what extent does the city have sufficient powers and capability to effectively facilitate emergency planning?
10.5.3	To what extent does the city plan for specific emergency scenarios?
10.5.4	To what extent does the city have a platform or mechanism which enables responders to work effectively and collaboratively to prepare for and manage emergencies?
10.5.5	To what extent does the city have emergency response centres to process and coordinate emergency activity

Indicator 10.5.: Reference tables

10.5.1: To what extent are there mechanisms in place to ensure government functions adequately continue during an emergency?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The council has a comprehensive business continuity strategy and department-specific business continuity plans. Training exercises testing the emergency response of government departments to different scenarios are undertaken on a frequent basis (at least once per year). Specific departments have business continuity exercises. The city has established procedures for remote working / alternative working for times of emergency.	There are no mechanisms in place to ensure government functions continue adequately during an emergency OR The city has a plan in place but it is incomplete (e.g., addressing relevant shocks / stresses, coordination with private sector or other governmental authorities) or out of date. No training exercises testing the emergency response of government departments to different scenarios have been undertaken in the past 5 years. There are no procedures in place for remote working / alternative working of city government staff during times of emergency.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of government departments that have tested their own continuity arrangements in the last 2 years (Arup, 2015)	Each government department should regularly test its ability to continue to function in the face of disruption. This should consider: • Back up I.T. and communications arrangements; • Alternative staffing arrangements, alternative premises and minimum staffing requirements; • Emergency evacuation scenarios (e.g. meeting points and contact numbers + who to contact outside of the department etc.); • Office first aid capability; • Fielding any enquiries the department might face (e.g. public and/or media); and • Maintaining an event log that records actions from impact to end of recovery.
	Supplementary Metrics	
	• Percentage of government employees familiar with emergency procedures (Arup, 2015) • Government departmental hours lost due to disruption in last 5 years (Arup, 2015) • Percentage of departments which have passed business continuity assessments in last 2 years (Arup, 2015)	

10.5.2: To what extent does the city have sufficient powers and capability to effectively facilitate emergency planning?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city (local government and emergency responders) has full powers to effectively facilitate emergency planning. The city government and other emergency agencies have sufficient capacity to meet expectations of preserving life and protecting the local built / natural environment. Responsibilities for emergency planning are clearly defined and understood. This includes: • Emergency preparation (e.g., scenario planning, warning and informing), • Emergency response (at the scene and away from the scene) • Recovery (including critical city infrastructure and short/ long-term economic and social recovery). Individual agencies have their own specific strategies and these feed into the overall multi-agency strategy. Plans are tested (at least) annually and updated regularly (at least every 2 years), to reflect changes to the city's risk profile and emergency management best practice.	The city has no powers to facilitate effective emergency planning. No strategy exists with regard to how the local government will manage an emergency scenario. Arrangements for supporting the general public are not outlined and no preparatory action is undertaken. The disaster management cycle (mitigation, preparation, response, recovery) is not followed. The city has made no attempt to develop an emergency management strategy that outlines multi-agency roles and responsibilities. There are no multi-agency emergency plans specific to the city's risk profile. The city government (and other emergency responders)do not have agency-specific plans which define roles, requirements and responsibilities during an emergency
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of times the city's multi-stakeholder emergency management strategy has been tested in the last 5 years (Adapted from UNISDR, 2008)	Exercises should test roles and responsibilities of different emergency responders in responding to an incident, as outlined in the city multi-stakeholder emergency management strategy. Exercises should also examine: • Alerting and mobilising procedures; • Facilities and equipment available, and their locations; • How additional resources may be obtained, if required; • Individual staff roles and how to support and protect personnel and the general public. Exercises should look to test different high risk hazards the city faces.
	Supplementary Metrics	
	• Percentage score of the city's last major incident exercise? (Arup, 2015) • Percentage of population within a 2 mile radius of an appropriately sized, designated rest centre/emergency shelter (Arup, 2015)	

10.5.3: To what extent does the city plan for specific emergency scenarios?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has detailed multi-agency emergency plans outlining actions (mitigation, preparation, response, recovery) for specific city hazards. These plans are informed by specific city hazard data and the city's risk profile. Specific agency plans in relation to the city's risk profile also exist where appropriate and complement multi-agency plans outline agency arrangements in greater detail. Plans are reviewed and updated on a regular basis and a review cycle is maintained. There are multi-stakeholder emergency specific hazard scenario exercises on a regular basis (once a year minimum, testing high city risks regularly as priority). These exercises test the adequacy of both plans and overall arrangements for local hazards.	Emergency plans are missing or incomplete for hazards specific to the city. Gaps exist and arrangements are not properly outlined regarding how specific hazard risks are managed. Hazard plans / arrangements are not properly tested / exercised.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	The number of times the 5 most significant hazards identified in the city's local risk profile have been exercised in the last 5 years. (Add up total and divide by 5) (Arup, 2015)	This metric examines how often the top five risks within the city (see 10.4.3) have been assessed by an emergency scenario exercise (see 10.5.2). It is calculated by adding up the total number of times that the top five have been tested and then dividing this number by 5).
	Supplementary Metrics	
	• Number of times the top 5 city risks have had their plans updated in last 5 years (Arup, 2015) • Coverage by type and objective of risk specific management policies, planning and programming into sector activities. (UNISDR 2008)	

10.5.4: To what extent does the city have a platform or mechanism which enables responders to work effectively and collaboratively to prepare for and manage emergencies?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city has multi-agency emergency management committees at both operational and strategic levels. They meet on a regular basis (at least four times per year). These committees include representation from all key stakeholders and also from civil society. These committees ensure that local hazard emergency plans, risk assessments, community awareness activities and emergency exercises are undertaken in a collaborative fashion.	The city does not have a multi-agency emergency management strategic committee or a multi-agency emergency management operational committee. There is no single body with responsibility for developing and operationalizing city-wide emergency strategies and plans. There is no formal mechanism to bring together multi-agency emergency stakeholders on a regular basis for planning and joint scenario exercises.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of times multi-stakeholder emergency responders meet and undertake joint activities (e.g. exercises, risk assessment, plan reviews) per year (Arup, 2015)	Key emergency responders should meet to undertake joint activities such as risk assessment, emergency planning, and emergency exercises. This metric examines how often they convene to undertake these and other joint initiatives.
	Supplementary Metrics	

10.5.5. To what extent does the city have emergency response centres to process and coordinate emergency activity		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Robust plans to mobilise critical non-financial resources exist and incorporate the full scope of relevant actors. Roles and responsibilities are clearly defined. Plans may focus on a full range of identified relevant scenarios and consider immediate to medium term needs. Arrangements exist for a multi-stakeholder emergency operations centre. This includes activation, premises, attendees and responsibilities. The centre is sufficiently resourced with communications infrastructure and all other emergency equipment.	No emergency response centre or multi-stakeholder arrangements exist in the event of an emergency. No back-up or paraprofessional staff available to process emergency information.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of times the emergency response centre capability has been tested (and successfully passed) in the last 5 years (for real or scenario) (Arup, 2015)	An emergency response centre should have all the necessary communications, I.T and emergency response equipment required to coordinate an effective emergency response. It is the place where representatives of key emergency stakeholders can coordinate their joint response to a major incident based on the latest emergency information (e.g. weather information, GIS data). The capability of all equipment within this centre should be regularly tested.
	Supplementary Metrics	
	• The number of times emergency response centre capacity / capability has been exceeded in last 10 years (Arup, 2015)	

Goal 11. Empowered stakeholders

Description: This is underpinned by education for all, and relies on access to up-to-date information and knowledge to enable people and organisations to take action.

Rationale: Individuals and communities that know what to do during unexpected events are invaluable assets to a city. The provision of early warnings and access to education, information and knowledge empowers citizens and gives them the tools to take appropriate decisions in the face of shocks and stresses. As a consequence, urban stakeholders are better positioned to act, learn, and adapt.

Focus: The focus of this Goal is on the ability of individuals and communities to understand the hazards and risks they face and to adequately prepare themselves for emergency situations. This encompasses short-term, rapid action in response to early warning notifications, as well as longer-term access to education, information and knowledge to empower residents with the tools to take appropriate decisions in the face of shocks and stresses. It differs from Goal 4, which is focused on the social networks within communities that provide day to day support, in addition to support during emergencies, and also considers how actively civic society participates in city affairs.

Structure: This Goal comprises three indicators, as follows:

11.1 Adequate education for all

11.2 Widespread community awareness and preparedness

11.3 Effective mechanisms for communities to engage with the city government

Indicator 11.1.: Adequate education for all

Goal:

Affordable, quality education for all.

Rationale:

Education is a fundamental building block for human development. Basic skills (literacy, numeracy) can directly help citizens to adapt to changes and cope in shock situations (understanding warnings, assessing recovery etc.). Education also facilitates a greater range and quality of livelihood opportunities, helping citizens to manage local stresses (poverty, unemployment etc.) and build their own resources to adapt to long-term changes and recover from shock events.

Focus:

This indicator concerns formal education. Primary education (basic literacy / numeracy) is a minimum requirement and comprehensive access to secondary and further education further empowers individuals. Educational opportunities for adults are also examined. However, this indicator does not consider vocational skills and training, which is instead considered by Goal 2.

Qualities:

- Inclusive
- Resourceful

Qualitative questions:

11.1.1	To what extent is quality education accessible and affordable to all?
11.1.2	To what extent is there an educated workforce within the city?

Indicator 11.1.: Reference tables

11.1.1: To what extent is quality education accessible and affordable to all?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The mainstream education system provides free and compulsory primary and secondary education for all children. Affordable, further education options are available for young adults (16-18 years old), regardless of ethnicity, gender, religion or income. There are no gender disparities in educational attainment. Literacy rates across all population groups is 100 percent.	Primary education is not compulsory. Financial contributions from parents/carers is required. The education system is largely inaccessible to children from the most marginalised population groups. There are large gender disparities in educational attainment within both the primary and secondary education systems. Literacy rates within some population groups are very low (<60%).
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage primary education completion rates (Adapted from World Bank)	
	Supplementary Metrics	
	• Percentage female secondary education completion rates (OECD BLI) • Average duration of education in which a 5 year old child can expect to enrol during his/her lifetime until the age of 39 (OECD BLI) • Student/teacher ratio (ISO 37120)	

11.1.2: To what extent has the city's adult population attained a high level of education?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Levels of educational attainment within the working age population are very high, with almost all having completed secondary education at least. University education is accessible and affordable to all. A large pool of the working age population has also attained a degree or diploma from a higher education institution. There are accessible opportunities for adult literacy and education for citizens to continue to develop new skills and knowledge.	Levels of educational attainment within the working age population are very low. A majority of the working age population has not completed primary education.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Adult literacy rate (as a percentage) (World Bank)	
	Supplementary Metrics	
	• Number of adults aged 25 to 64 holding at least an upper secondary degree over the population of the same age (University of Buffalo Regional Institute) • Educational Attainment using RCI calculation method (% of the population age 25+ with a bachelor's degree or higher divided by the percentage of population age 25+ without a high school diploma or GED). (University of Buffalo Regional Institute) • Higher Education Degrees per 100,000 (ISO 37120)	

Indicator 11.2.: Widespread community awareness and preparedness

Goal:

Inclusive efforts to build public awareness of risks.

Rationale:

Community awareness and preparedness activities are essential to ensure that individuals and communities understand and are prepared to manage local hazards. An individual's or community's ability to safeguard their home and assets, receive and understand emergency alerts and know what to do and where to go in an emergency, can reduce the physical and social impacts of disasters on communities.

Focus:

This indicator considers how aware local communities are of hazard risks and what level of preparation they have undertaken.

Qualities:

- Inclusive
- Resourceful

Qualitative questions:

11.2.1	To what extent is the general public aware of risks and how to safeguard themselves and their assets?
11.2.2	To what extent are communities adequately prepared for emergency events?
11.2.3	To what extent is there an effective and robust alarm system to warn communities of imminent hazards?

Indicator 11.2.: Reference tables

11.2.1: To what extent is the general public aware of risks and how to safeguard themselves and their assets?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There a regular disaster risk reduction awareness programmes which along with the citywide population, specifically seek to reach school children, communities in exposed areas and minority and marginalised groups (cultural, language, disability). There is a risks communication plan in place and the city government regularly communicates information on local hazard trends and risk reduction measures. There is publically available, up-to-date and free disaster management advice for city residents and businesses. City emergency management stakeholders provide programmes to educate households on how to safeguard homes and personal property from high risk hazards.	The city is exposed to one or more high risk hazards. AND No attempts have been made to raise awareness of these risks amongst communities in exposed areas or to educate the general public on how to safeguard themselves and their assets. There is no strategy or plan in place to communicate to the general public information regarding hazards and risk reduction measures. There is no guidance, advice or other support available to provide disaster management advice for businesses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of households that have a smoke alarm (Arup, 2015)	
	Supplementary Metrics	
	• Percentage of school children educated in DRR (UNISDR, 2008) • Percentage of education and training available in all languages spoken in the city (UNISDR Scorecard) • Proportion of households with an emergency plan (Arup, 2015) • Percentage of households that have incorporated safeguard measures into their home (UNISDR, 2008)	

11.2.2: To what extent are communities adequately prepared for emergency events?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a formal network of trained community level volunteers and groups that can be engaged in emergency preparation, response and recovery efforts. There are mechanisms in place to ensure communities and neighbourhoods are adequately prepared for emergencies. Finance is provided to local community groups to undertake DRR activities. Regular disaster preparedness drills and simulations are carried out within the community, including the most vulnerable and disadvantaged communities, in partnership with the city's emergency response services. These activities ensure that all citizens can be evacuated and sufficiently supported in the full range of emergency scenarios that the city may face.	The city is exposed to one or more high risk hazards. AND There are very few trained volunteers at the community level or groups that can be engaged in emergency preparation, response and recovery efforts. There are no mechanisms in place to ensure communities and neighbourhoods are adequately prepared for emergencies. Insufficient community DRR outreach activities.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of population that have made a household or a community resilience plan (Arup, 2015)	A household or community resilience plan should outline steps that local people can take in preparation and response to, and recovery from an emergency. A sample template is available here: http://gov.wales/docs/resilience/publications/120601houseemergencyplanen.pdf
	Supplementary Metrics	
	• Red Cross/Red Crescent volunteers within the city per capita (Arup, 2015) • Coverage by type and objective of hazard-specific vulnerability and capacity assessments at the community level. (UNISDR, 2008) • Funding for community DRR as a proportion of overall city budget (Arup, 2015) • Percentage of population with (last 5 years) first aid or similar certification (EJM Harvard)	

11.2.3: To what extent is there an effective and robust alarm system to warn communities of imminent hazards?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Warnings exist for all relevant hazards and allow for reaction time. More than one systems are in place to extend these warnings to minority and marginalised groups. The warning systems are regularly tested. Warnings are transmitted via a wide range of media (e.g., website; radio; TV; Twitter; Facebook; Online forums; Word of mouth). There are effective mechanisms to ensure people clearly understand alarm warnings and how to respond.	The city is exposed to one or more high risk hazards. AND Warnings do not exist for all relevant hazards and do not allow for reaction time. There are no systems in place to extend these warnings to minority and marginalised groups. There are no efforts to ensure people understand the alarm warnings and how to respond.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of citizens intended to be evacuated, which were successfully evacuated in the last disaster drill or disaster event in the last 5 years (Arup, 2015)	
	Supplementary Metrics	
	• Number of hazard alarm tests in last 5 years (Arup, 2015) • Percentage responses to alerts? (Arup, 2015) • Coverage by type and objective of community vulnerability EWS (Early Warning System) (UNISDR, 2008). • Percentage of population that receives hazard warnings via 2+ systems when given/required (Arup, 2015)	

Indicator 11.3.: Effective mechanisms for communities to engage with the city government

Goal:

Inclusive, integrated and transparent mechanisms for communication and coordination between the city government and citizens.

Rationale:

Fundamentally, cities are made up of people. Strong communication links between citizens and the government is crucial for creating a common sense of community and identity, building trust, and empowerment. Multiple, inclusive and well-used channels of communication help to make this process effective. Supporting dual-direction communication between government and citizens facilitate grassroots-up and government-down coordination and collaboration. This helps to ensure that all stakeholders are engaged in the city, have a stake in the collective future of their communities, and are able to take make effective decisions and take action in their lives. In addition, resilient cities ensure that information shared with their citizens can be understood, with messages presented in appropriate cultural and language contexts and media that is accessible for all.

Focus:

This indicator considers the robustness of a two-way dialogue between citizens and the city government. This includes the ability of citizens to talk and engage with the city government and the extent to which their feedback is appropriately responded to, and vice-versa, as well as mutual trust and respect.

Qualities:

- Inclusive
- Integrated
- Resourceful
- Reflective

Qualitative questions:

11.3.1	To what extent are there inclusive, integrated and transparent mechanisms for communication between the city government and citizens?

Indicator 11.3.: Reference tables

11.3.1: To what extent are there inclusive, integrated and transparent mechanisms for communication between the city government and citizens?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are programmes or strategies in place to maintain diverse mechanisms for communication and coordination between local government and the general public (e.g., website; radio; TV; Twitter; Facebook; Online forums; Word of mouth). Communication is also provided in minority languages spoken within the city and in braille. The effectiveness of communications between local government and citizens (in terms of both the content and delivery mechanisms used) are monitored.	There are no programmes or strategies in place to maintain effective and diverse mechanisms for communication and coordination between the city government and the general public. Communication is rarely, if ever, provided in minority languages spoken within the city or in braille.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of major city plans published in the last year that incorporate consultation with communities (Arup, 2015)	Major city plans are those deemed to have a direct impact on the city population across more than one community or city borough. There should be a robust consultation process which allows members of the general public to provide there feedback on proposed plans before they are finalised.
	Supplementary Metrics	
	• Number of twitter (or equivalent) followers to local council page (Arup, 2015) • Number hits per website / day customer rating of information on pages (Arup, 2015) • Percentage of government communication that is delivered in top two minority languages (Adapted from ISET)	

Goal 12. Integrated development planning

Description: This is indicated by the presence of a vision, an integrated development strategy, and plans that are regularly reviewed and updated by cross-departmental groups.

Rationale: A resilient city fosters integrated development planning that ensures sectoral plans and individual projects are aligned with the city's vision, integrated and appropriate to address the city's needs. This includes city monitoring and data, strategies and plans, and land use and development.

Focus: The focus of this Goal is on coordinating long-term development plans for the city to ensure that individual projects and programmes are aligned and sufficiently address opportunities and challenges the city faces. The development of a shared and integrated city vision requires understanding of and alignment between the motivations of different stakeholders involved in designing and implementing projects in the city. Specific indicators that underpin this Goal area include: comprehensive city monitoring and data management, a consultative planning process, appropriate land use and zoning, and a robust planning approval process.

Structure: This Goal comprises four indicators, as follows:

12.1 Comprehensive city monitoring and data management

12.2 Consultative planning process

12.3 Appropriate land use and zoning

12.4 Robust planning approval process

Indicator 12.1.: Comprehensive city monitoring and data management

Goal:

Regular monitoring and analysis of relevant data undertaken to inform city planning and strategies.

Rationale:

Access to comprehensive, reliable data is crucial to inform the development of effective, appropriate city planning and strategies; as the old adage says, you can't manage what you don't measure. Regular monitoring and analysis of city data can inform strategic long-term planning, as well as identify emerging opportunities and challenges to prioritise short-term action or intervention. Incomplete or unreliable data can result in misapplication or wasted use of resources, and may aggravate chronic stresses or prevent a city form responding appropriately to emergency or shock events.

Focus:

This indicator considers mechanisms by which the city government collects, analyses and responds to data about city characteristics, trends, functions and processes within the planning process. Issues associated with hazard monitoring are covered elsewhere in the CRI, in particular in Goals 7 and 10, while issues relating to data safety and security are covered in particular in Goals 8 and 9.

Qualities:

- Reflective
- Resourceful

Qualitative questions:

12.1.1	To what extent are existing datasets comprehensive and up-to-date? Does the city have access to the right data for planning?
12.1.2	To what extent are projections of future trends undertaken?
12.1.3	To what extent do planning policies and key documents seek to address high risks uncovered by assessments of hazards and long-term change scenarios?

Indicator 12.1.: Reference tables

12.1.1: To what extent are existing datasets comprehensive and up-to-date? Does the city have access to the right data for planning?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The city planners and policy-makers have ready access to up-to-date (from <5 years) city-level data and analyses of current city needs related to the following: • Land use • Housing • Deprivation • Health inequalities • Employment • Health of environment and ecosystems • Infrastructure demand and capacity levels (energy, potable water, wastewater, stormwater, solid waste, ICT, Transportation) • Hazard risks Additionally, there are robust systems and procedures in place to ensure the city's plans, strategies and policies respond to the most up-to-date data.	The city planners and policy-makers have scarce and/or out-dated (>10 years old) city-level data and analyses of current city needs related to the following: • Land use • Housing • Deprivation • Health inequalities • Employment • Health of environment and ecosystems • Infrastructure demand and capacity levels (energy, potable water, wastewater, stormwater, solid waste, ICT) • Hazard risks There are no systems and procedures in place to ensure the city's plans, strategies and policies respond to the most up-to-date data.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of census data available for planning (Arup, 2015)	This asks how much census level data (e.g. population size, gender etc.) is available to assist in city planning.
	Supplementary Metrics	

<table>
<tr><th colspan="4">12.1.2: To what extent are projections of future trends undertaken?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td colspan="2">Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td colspan="2">Trend analyses are regularly undertaken (by city/regional/national government or its agencies) (at least 5 year frequency) to forecast future city needs in relation to:
• Land use
• Housing
• Demographic projections
• Deprivation
• Health inequalities
• Employment
• Environment and ecosystems
• Infrastructure demand and capacity levels (energy, potable water, wastewater, stormwater, solid waste, ICT)
• Hazard risks and long-term change scenarios

Additionally, there are robust systems and procedures in place to ensure the city’s plans, strategies and policies respond to the most up-to-date data.</td><td>No trend analyses are undertaken to forecast future city needs in relation to:
• Land use
• Housing
• Demographic projections
• Deprivation
• Health inequalities
• Employment
• Environment and ecosystems
• Infrastructure demand and capacity levels (energy, potable water, wastewater, stormwater, solid waste, ICT)
• Hazard risks and long-term change scenarios

There are no systems and procedures in place to ensure the city’s plans, strategies and policies respond to the most up-to-date data.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td></td><td>Metric Guidance</td></tr>
<tr><td colspan="2">Number of years validity of population projections
(Arup, 2015)</td><td>How many years ahead has the city (or national) data departments made population size projections for?</td></tr>
<tr><td colspan="3">Supplementary Metrics</td></tr>
<tr><td colspan="3">• Number of qualified staff involved in research & intelligence informing city planning (Arup, 2015)</td></tr>
</table>

12.1.3: To what extent do planning policies and key documents seek to address high risks uncovered by assessments of hazards and long-term change scenarios?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	The development of all relevant and current planning policies and key planning documents has occurred with reference to the findings of up to date (<5 years old) and comprehensive assessments of risks associated with hazards and long-term change scenarios. There are no residential populations located within areas that have been assessed as high risk from hazards OR There are small residential populations located in areas that have been assessed as high risk from hazards and there are comprehensive plans in place to appropriately re-locate vulnerable populations to safer areas.	The development of planning policies and key planning documents over the past 10 years has occurred without reference to the findings of up to date (<5 years old) assessments of risks associated with hazards and long-term change scenarios. There are large residential populations located within areas that have been assessed as high risk from hazards and there are no policies or plans in place to re-locate vulnerable populations to safer areas.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of residential dwellings within the city that are situated within high risk areas (which could be addressed by zonation and relocation?) (Arup, 2015)	This examines the effectiveness of hazard mapping, zonation and zonation enforcement within the city. It does not include city-wide hazards e.g. if the whole city is within a seismic zone, but does include properties within high risk zones which could be mitigated against by appropriate relocation e.g. zones prone to heavy flooding, storm surges, landslides and sinkholes.
	Supplementary Metrics	
	• Percentage of current planning policies and land use/zoning plans that have been developed with reference to a relevant hazard risk assessment (Arup, 2015) • Percentage urban development within the city that are situated within high risk areas (Arup, 2015)	

Indicator 12.2.: Consultative planning process

Goal:

Transparent and inclusive process to develop planning policies and strategies.

Rationale:

A transparent, integrated and inclusive process to include a wide range of stakeholders will help capture multiple perspectives of the city's needs, opportunities and assets to inform more comprehensive, appropriate plans and strategies. This in turn will help shape a development and planning vision for the city's future. An engagement process that includes representatives from three the key groups of city stakeholders – the government (including regional government if relevant), the private sector, and civil society (including vulnerable groups or commuters) – who can inform and will experience the effects. Excluding relevant stakeholders from a consultative planning process, intentionally or not, may mean that city plans and strategies do not accurately address the city's needs, potentially exposing the city to chronic stresses or vulnerability to risks of greater impact or loss from emergency events.

Focus:

This indicator is concerned with assessing the process that the city government undertakes to create city development plans. This encompasses transparent consultation with relevant stakeholders for input and buy-in of development plans, considering the city's short, medium and long-term needs. Issues such as the scope, approval, implementation and enforcement of development plans are covered elsewhere in the CRI, in particular elsewhere in Goal 12 and Goal 8.

Qualities:

- Reflective
- Integrated

Qualitative questions:

12.2.1	To what extent is the process to develop planning strategies inclusive and transparent?
12.2.2	To what extent are there mechanisms in place to ensure that planning strategies and development plans are fully aligned with the long-term strategies of utility providers and transport agencies?
12.2.3	To what extent have (or would) long-term recovery and reconstruction programmes adopt an inclusive and reflective process?

Indicator 12.2.: Reference tables

12.2.1: To what extent is the process to develop planning strategies inclusive and transparent?			
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**	
	There are requirements to consult with key stakeholders (including emergency services and other DRR agencies) and the general public during the development of key planning strategies and plans. Specific efforts are made to ensure the full involvement of minority groups and low income households in the consultation process. The findings of these consultations are made publically available. All current land use and zoning plans were created following this inclusive process.	There are no formal requirements to consult with key stakeholders (including emergency services and other DRR agencies) and the general public during the development of key planning strategies and plans. Plans and strategies are always developed without consultation with key stakeholders and the general public.	
Quantitative metrics	**Preferred metric**	**Metric Guidance**	
	Percentage of current land use and zoning plans that have been subject to a formal consultation process (Arup, 2015)	This metric examines whether there is a consultation process with key stakeholders before land use is designated or changed within the city	
	Supplementary metric(s)		

12.2.2: To what extent are there mechanisms in place to ensure that planning strategies and development plans are fully aligned with the long-term strategies of utility providers and transport agencies?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are formal requirements to consult with providers of essential utility services (e.g., electricity, water, sanitation) and transport agencies during the development of key planning strategies and plans. All current planning strategies and development plans are known to be well-aligned with the current and long-term strategies of essential utility services and transport providers.	There are no formal requirements to consult with providers of essential utility services (e.g., electricity, water, sanitation) and transport agencies during the development of key planning strategies and plans. Current planning strategies and development plans are known to be in conflict with the current and long-term strategies of essential utility services and transport providers.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of current land use and zoning plans that have been subject to a formal consultation process with utility providers and transport agencies (Arup, 2015)	Land use and zonation should configure appropriately with transport provision and this metric examines whether this is achieved with effective collaboration. For example, if the city planning department decide to free up some new land for residential usage, they need to ensure that there will be effective transport corridors connecting residents to key urban services.
	Supplementary Metrics	

12.2.3: To what extent have (or would) long-term recovery and reconstruction programmes adopt an inclusive and reflective process?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place to promote an inclusive and reflective process for long-term recovery and reconstruction. Specific efforts have been made to ensure the full involvement of minority groups and low income households in the reconstruction planning process.	There are no mechanisms in place to promote an inclusive and reflective process for long-term recovery and reconstruction. Long-term recovery and reconstruction has been undertaken largely without involvement from minority groups and low income households.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of current land use and zoning plans that have been subject to a formal consultation process with minority communities affected by the development (Arup, 2015)	This metric examines whether land use changes and urban development plans are an inclusive process, consulting with all affected communities. Comprehensive consultation ensures that development is not just motivated by economic gain, but also by the needs of all city residents.
	Supplementary Metrics	

Indicator 12.3.: Appropriate land use and zoning

Goal:

Integrated and flexible land use and zoning plans that ensure appropriate development of the city.

Rationale:

Development plans and land use or zoning regulations are instruments that cities use to coordinate and control urban development and guide future investments. The creation and implementation of plans and regulations ensures that individual projects and programmes are aligned with the long-term vision of the city's opportunities and needs and sufficiently accommodate uncertainty. Informing plans and regulations with up-to-date and relevant city data and a consultative process helps ensure these are appropriate to the city's needs today as well as anticipating and accommodating future change.

Focus:

This indicator considers the appropriateness of land use plans and zoning plans in relation to the hazards the city faces and changes in long-term trends. Issues such as the identification of the city's vulnerability to hazards are covered elsewhere in the CRI, in particular in Goal 7. The development and enforcement of codes and standards that shape man-made and natural assets within land use or zoned areas are covered in Goal 7 while the maintenance of these assets is covered in Goal 8.

Qualities:

- Reflective
- Integrated

Qualitative questions:

12.3.1	To what extent does the city have in place clear, integrated land use and zoning plans designed to provide physical connectivity of communities to essential infrastructure, jobs and services that account for long-term projections and trend analyses?
12.3.2	To what extent are there mechanisms in place that specify the land uses and building typologies that are safe and appropriate for different areas of the city, according to vulnerability assessments and hazard risk assessments?
12.3.3	To what extent are there mechanisms in place that proactively aim to deliver zoning and planning policies and infrastructure to meet needs of business?
12.3.4	To what extent are development planning strategies and plans updated on a regular basis, using the latest trend projections?

Indicator 12.3.: Reference tables

<table>
<tr><th colspan="3">12.3.1: To what extent does the city have in place clear, integrated land use and zoning plans designed to provide physical connectivity of communities to essential infrastructure, jobs and services that account for long-term projections and trend analyses?</th></tr>
<tr><td rowspan="2">Basis of Measurement</td><td>Best Case Scenario (Score = 5)</td><td>Worst Case Scenario (Score = 1)</td></tr>
<tr><td>The city has land use plans based on current data (< 5 years old) that delineate development zones and these plans:
• Cover the full extent of the city
• Specify appropriate density for different zones
• Protect and enhance ecosystems across the city
• Preserve green spaces for public use
• Encourage use of public transport & active travel modes
The city's land use and zoning plans have been developed to account for predicted future changes in:
• spatial development
• economic development
• growth projections
• demographic change (e.g., age, health, culture groups)
• employment projections
• hazard exposure and vulnerability
• housing needs
• transportation needs, utilities needs
• informal settlements
• social spaces and services
• essential utility services capacity requirements
• environment and ecosystems
• availability of funding</td><td>The city has no land use plans in place that delineate development zones or the type of development that is appropriate within different areas of the city.</td></tr>
<tr><td rowspan="3">Quantitative metrics</td><td>Preferred metric</td><td>Metric Guidance</td></tr>
<tr><td>Areal size of informal settlements as a percentage of city area (ISO 37120)</td><td>Informal settlements are:
1. Areas where groups of housing units have been constructed on land that the occupants have no legal claim to, or occupy illegally;
2. Unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing).
(Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, UN, New York, 1997)</td></tr>
<tr><td colspan="2">Supplementary Metrics
• Green area (hectares) per 100 000 population (ISO 37120)
• Jobs/housing ratio (ISO 37120)</td></tr>
</table>

12.3.2: To what extent are there mechanisms in place that specify the land uses and building typologies that are safe and appropriate for different areas of the city, according to vulnerability assessments and hazard risk assessments?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are mechanisms in place (e.g., policies and land use plans) based on current data (< 10 years old) that specify the land uses and building typologies that will be accepted by the city planners for different areas of the city, according to vulnerability assessments and hazard risk assessments. Additionally, there are robust processes in place to ensure that these mechanisms are regularly updated (frequency of 10 years or less), taking into account the latest vulnerability and hazard risk assessments.	There are no mechanisms in place that specify the land uses and building typologies that are safe and acceptable for different areas of the city, according to vulnerability assessments and hazard risk assessments.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of high risk areas within the city where development is restricted or prohibited under planning guidelines. (Arup, 2015)	Whilst 12.1.3 concerns relocation, 12.3.2 is about appropriate construction in high risk zones. For example, buildings within seismic zones should have earthquake resistant construction and not exceed specified heights.
	Supplementary Metrics	
	• Coverage by hazard type and objective of incorporation of disaster risk reduction management elements into physical planning and infrastructure development procedures. (UNISDR, 2008) • Percentage of construction or building projects in floodplains and other mapped hazard-prone areas. (UNISDR, 2008)	

12.3.3: To what extent are there mechanisms in place that proactively aim to deliver zoning and planning policies and infrastructure to meet needs of business?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	Zoning and planning activities include mechanisms to specifically consider the needs of businesses today and into the long-term (>15 years). Planning and zoning activities engage with local business stakeholders to consider business needs to enhance growth, productivity and competitiveness.	There are no mechanisms within zoning or planning activities to consider meeting the needs of businesses.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Amount spent on transport in the last 5 years as percentage of overall city budget (Arup, 2015)	Average spend on transport over 5 years / average total city budget over last 5 years x 100.
	Supplementary Metrics	
	Foreign direct investment as a percentage of GDP (World Bank)	

12.3.4: To what extent are development planning strategies and plans updated on a regular basis, using the latest trend projections?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are robust mechanisms in place to ensure that development planning strategies and plans are regularly updated (frequency of 10 years or less), taking into account the latest city trend projections and vulnerability exposure assessments.	Key development planning strategies and plans are out-dated (> 10 years old). There are no mechanisms in place to ensure that strategies and plans are regularly updated and take account of the latest city trend projections and vulnerability exposure assessments. Plans and strategies are generally developed without consultation with key stakeholders and the general public.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Number of years since the city plan was updated (Arup, 2015)	This is the overall strategic plan for the city, outlining how they city intends to meet local priorities, and respond to future challenges. It should outline broad locations, scale and types of development needed together with the supporting infrastructure. Example documents for the city of Brighton are available here - http://www.brighton-hove.gov.uk/content/planning/planning-policy/city-plan
	Supplementary Metrics	
	• Existence of clear consultation guidelines on the plan making process, including different ways of public engagement and involvement of technical experts (Arup, 2015) • Number of years since the oldest current development plan still in use within the city was last updated (Arup, 2015)	

Indicator 12.4.: Robust planning approval process

Goal:

Transparent, robust planning approval mechanisms, consistent with planning policy and strategy.

Rationale:

A robust planning process that includes a transparent, effective approval process reduces the risks of bias, corruption, or negligence and helps ensure development and investment aligns with city plans and regulations. The approval process should be inclusive, incorporating consultations with residents and others affected by proposals, with transparent, timely response to concerns.

Focus:

This indicator is concerned with assessing the process by which the city government approves proposals for development. This encompasses transparent evaluation of proposed development against clear, robust criteria consistent with planning policy and strategy. Issues such as the scope, development, implementation and enforcement of development plans are covered elsewhere in the CRI, in particular elsewhere in Goal 12 and Goal 8.

Qualities:

- Robust
- Reflective

Qualitative questions:

12.4.1	To what extent is there a transparent approval process to ensure new development is appropriate and in accordance with planning policies and strategies?
12.4.2	To what extent are city emergency services and agencies that enforce the implementation of building codes involved during the planning process for major new development and infrastructure projects?

Indicator 12.4.: Reference tables

12.4.1: To what extent is there a transparent approval process to ensure new development is appropriate and in accordance with planning policies and strategies?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There is a formal, transparent approval process for new development that is aligned with current planning policies and strategies. The planning approval process includes a requirement for formal consultation of the general public for major new development projects.	No formal planning approval process for new development exists. Or, a planning approval process does exist but it is widely ignored and/or is subject to widespread corruption.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of buildings [or new development] constructed within the city in the past 10 years that were approved or otherwise authorised by the relevant city planning authorities (Arup, 2015)	
	Supplementary Metrics	
	• Percentage of buildings with occupancy certificate (Arup, 2015)	

12.4.2: To what extent are city emergency services and agencies that enforce the implementation of building codes involved during the planning process for major new development and infrastructure projects?		
Basis of Measurement	**Best Case Scenario (Score = 5)**	**Worst Case Scenario (Score = 1)**
	There are formal requirements to consult with city emergency services and agencies that enforce the implementation of building codes during the planning approval process. These consultation requirements are actively implemented on a consistent basis according to clearly defined criteria for when this consultation should occur.	There are no formal requirements to consult with city emergency services and/or agencies that enforce the implementation of building codes during the planning approval process and this is rarely, if ever, undertaken on an informal basis.
Quantitative metrics	**Preferred metric**	**Metric Guidance**
	Percentage of planning applications submitted to the city during the past 5 years on which emergency services agencies have been consulted (Arup, 2015)	Emergency services should be consulted on new city developments to ensure that developments are structurally safe, considering issues such as fire safety and any impacts on emergency service access routes.
	Supplementary Metrics	
	• Percentage of planning applications submitted to the city during the past 5 years on which agencies that enforce the implementation of building codes have been consulted (Arup, 2015).	

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Appendix A
Glossary

A1. General Terms

Term	Definition
Mechanisms	An established process by which something takes place or is brought about ((Adapted) Oxford Online Dictionary, 2015).
Plan	A detailed proposal for doing or achieving something (Oxford Online Dictionary, 2015)
Policy / Policies	A set of ideas or a plan of what to do in particular situations that has been agreed officially by a group of people, a business organization, a government, or a political party (Cambridge Online Dictionary, 2015).
Programme	A set of related measures or activities with a particular long-term aim (Oxford Online Dictionary, 2015).
Strategy	A plan of action designed to achieve a long-term or overall aim (Oxford Online Dictionary, 2015).
Stakeholders	A person such as an employee, customer, or citizen who is involved with an organization, society, etc. and therefore has responsibilities towards it and an interest in its success
Civil Society	Society considered as a community of citizens linked by common interests and collective activity (Oxford Online Dictionary, 2015).
Private Sector	Businesses and industries that are not owned or controlled by the government (Cambridge Online Dictionary, 2015).
Youth	The UN, for statistical consistency across regions, defines 'youth', as those persons between the ages of 15 and 24 years, without prejudice to other definitions by Member States. http://www.unesco.org/new/en/social-and-human-sciences/themes/youth/youth-definition/

A2. Disaster Risk Reduction Terminology

Term	Definition
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Comment (UNISDR): Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. (UNISDR, 2007)
Disaster Risk Management	The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster. (UNISDR, 2009) Comment (UNISDR): This term is an extension of the more general term “risk management” to address the specific issue of disaster risks. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness.
Disaster Risk Reduction (DRR)	The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. (UNISDR, 2009)
Emergency	A crisis or emergency is a threatening condition that requires urgent action. Effective emergency action can avoid the escalation of an event into a disaster. (UNISDR, 2009)
Emergency Management	The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps. (UNISDR, 2009) Comment (UNISDR): Emergency management involves plans and institutional arrangements to engage and guide the efforts of government, non-government, voluntary and private agencies in comprehensive and coordinated ways to respond to the entire spectrum of emergency needs. The expression “disaster management” is sometimes used instead of emergency management.
Emergency Response	The reaction from the emergency management services to helping the public in an emergency situation. This could be a widescale disaster involving specialist agencies or the everyday duties of traditional emergency response services (police, fire ambulance).
Exposure	People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. (Arup, 2015) Comment (UNISDR): Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest (UNISDR, 2009)
Hazard	A dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. UNISDR, 2007.
Impact	Effects on natural and human systems. Comment (IPCC): In this report, the term ‘impact’ is used primarily to refer to the effects of extreme weather and climate events on natural and human systems. Impacts generally refer to effects on lives, livelihoods, health status, ecosystems, economic, social, and cultural assets, services (including environmental), and infrastructure due to the interaction of climate changes or hazards occurring within a specific time period and the vulnerability of an exposed society or system. (IPCC, 2014.)

Likelihood	The chance that something will happen (Cambridge, 2015)
Major incident	A major incident is any emergency that requires the implementation of special arrangements by one or more of the emergency services and will generally include the involvement, either directly or indirectly, of large numbers of people. LESLEP, 2012
Mitigation	The lessening or limitation of the adverse impacts of hazards and related disasters. Comment (UNISDR): The adverse impacts of hazards often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness. It should be noted that in climate change policy, “mitigation” is defined differently, being the term used for the reduction of greenhouse gas emissions that are the source of climate change.
Preparedness / Preparation	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions. (UNISDR, 2007) Comment (UNISDR): Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response through to sustained recovery. Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. The related term “readiness” describes the ability to quickly and appropriately respond when required
Recovery	The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. (UNISDR, 2007) Comment (UNISDR): The recovery task of rehabilitation and reconstruction begins soon after the emergency phase has ended, and should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action and enable public participation. Recovery programmes, coupled with the heightened public awareness and engagement after a disaster, afford a valuable opportunity to develop and implement disaster risk reduction measures and to apply the “build back better” principle.
(City) Resilience	City resilience describes the capacity of cities to function, so that the people living and working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter ((Arup, 2015), 2014).
Risk	Disaster risk signifies the possibility of adverse effects in the future. Risk is determined not only by the hazards but also by the exposure and vulnerability to these hazards. (IPCC, 2014)
Shocks	Single, unpredictable events (such as a disaster) ((Arup, 2015), 2014)
Stresses	On-going hardships which a community experiences continuously ((Arup, 2015), 2014).
Vulnerability	Physical, social, economic, and environmental factors which increase the susceptibility to be impacted by hazards. (UNISDR, 2007)

A3. Specific Indicator Terms

Indicator reference	Word / Phrase	Definition
1.4, 3.2, 9.1, 9.3, 11.1	Access / Accessible	Able to be easily obtained or used (Oxford Online Dictionary, 2015). Comment: Whether someone is able to access something could be influenced by geographic distance, accessibility to those less mobile, the issue of affordability
1.1, 1.2, 1.5, 3.2, 3.3, 3.4, 6.1, 7.4, 9.1	Adequate / Adequately	Enough or satisfactory for a particular purpose (Cambridge Online Dictionary, 2015).
1.1, 1.2, 1.5, 9.1, 9.3, 11.1	Affordable	Realistically within range of all income groups (Arup, 2015). Comment: Not excessively costly for any income group. This is about inclusivity, in the sense that all citizens should be able to access an appropriate standard of housing.
3.1, 9.2, 10.1	Appropriate	Correct or suitable for a particular time, situation, or purpose (Longman, 2015)
11.3	Braille	A system of writing for the blind consisting of raised dots that can be interpreted by touch, each dot or group of dots representing a letter, numeral, or punctuation mark (Collins Online Dictionary, 2015).
3.2, 3.4, 8.2, 9.3, 10.5	Capacity	The total amount that can be contained or produced, or (especially of a person or organization) the ability to do a particular thing (Cambridge Online Dictionary, 2015).
8.3	Circular Economy	A circular economy aims to decouple economic growth from the use of natural resources and ecosystems by using those resources more effectively. By definition it is a driver for innovation in the areas of material-, component- and product reuse, as well as new business models such as solutions and services. In a circular economy, the more effective use of materials enables to create more value, both by cost savings and by developing new markets or growing existing ones (Philips, 2013).
7.2	Codes	A conventionalized set of principles, rules, or expectations (Collins Online Dictionary, 2015).
11.3	Communication	The successful conveying or sharing of ideas and feelings (Oxford Online Dictionary, 2015).
9.1	Commuting catchment	Areas from which people travel from, to work in the city on a daily basis (Arup, 2015).
6.2, 6.4	Comprehensive	Complete and including everything that is necessary (Cambridge Online Dictionary, 2015).
7.1	Comprehensive assessment	An assessment which deals fully with all elements or aspects of the subject ((Adapted) Oxford Online Dictionary, 2015).
10.2, 12.2	Consultation	The action or process of formally consulting or discussing (Oxford Online Dictionary, 2015).
1.2, 1.3, 1.4, 1.5, 6.2, 9.1, 9.4	Contingency Continuity Plan	A plan to be carried out if a more likely or desired outcome does not happen (Collins Online Dictionary, 2015). Comment: Business Continuity (BC) is defined as the capability of the organization to continue delivery of products or services at acceptable predefined levels following a disruptive incident (ISO 22301)

1.4, 3.2, 9.1, 9.3, 11.1	Access / Accessible	Able to be easily obtained or used (Oxford Online Dictionary, 2015). Comment: Whether someone is able to access something could be influenced by geographic distance, accessibility to those less mobile, the issue of affordability
11.3	Coordination	Organizing the activities of two or more groups so that they work together efficiently and know what the others are doing (Collins Online Dictionary, 2015).
5.1	Crime Prevention Through Environmental Design (CPTED)	The idea that the proper design and effective use of the built environment can lead to a reduction in the incidence and fear of crime, and an improvement in the quality of life. In other words, if a site is laid out well, the likelihood of it being targeted for a crime may be reduced (City of Virginia Beach).
6.2	Critical	Something that is critical is very important because what happens in the future depends on it (Longman Online, 2015).
8.1, 8.5	Critical assets	Those assets that are critical to the running of the city and lives of its inhabitants (Arup, 2015).
8.1, 8.2, 8.5	Critical services	Those services that are critical to the running of the city and lives of its inhabitants (Arup, 2015).
8.2, 8.3	Critical infrastructure	Infrastructure that is deemed critical to the running of the city and its inhabitants (Arup, 2015).
8.3	Critical utilities	Those services that are critical to the running of the city and lives of its inhabitants (Arup, 2015). Comment: Predominately electricity, gas, water, wastewater, solid waste management, ICT, transportation
3.1, 4.2	Disadvantaged	Socially or economically deprived or discriminated against (Collins Online Dictionary, 2015).
6.3, 6.4, 8.2, 9.1, 9.3	Diverse / Diversity	Showing a great deal of variety and having many different ways of delivery (adapted Oxford Online Dictionary, 2015).
9.3, 10.4	Early Warning Mechanism / System	System to alert city responders and the general public to an upcoming hazard ((Arup, 2015), 2014).
11.1	Educational Attainment	Educational attainment refers to the highest level of education that an individual has completed. This is distinct from the level of schooling that an individual is attending (US Census Bureau, 2015).
5.2, 7.3, 9.1	Effective	Successful in producing a desired or intended result (Oxford Online Dictionary, 2015).
7.3	Ecosystem services	The benefits of nature such as food, fuel, natural hazard protection, pollination, and spiritual sustenance (WRI, 2008)
10.5	Emergency Responder	Stakeholders responsible for managing emergencies within the city (Arup, 2015), 2015).
11.3	Engage	To interest someone in something and keep them thinking about it (Cambridge Online Dictionary, 2015).
3.2	Epidemic	The occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy. The community or region and the period in which the cases occur are specified precisely. The number of cases indicating the presence of an epidemic varies according to the agent, size, and type of population exposed, previous experience or lack of exposure to the disease, and time and place of occurrence (WHO, 2008).
2.1	Fair	Free from discrimination, dishonesty, etc.; just; impartial (Collins Online Dictionary, 2015).

6.1	Fiscal Policy / Management	The ways in which a government controls its expenditures and taxation (World Bank, 2014).
3.2	Free at the point of service	All medical treatment including in and outpatient visits, surgery, medications (and related treatment), tests, vaccinations, mental health services etc. are free. This is financed through general taxation and not a specific tax (Arup, 2015).
3.3	Formal	Having a conventionally recognized form, structure, or set of rules (Oxford Online Dictionary, 2015).
10.2	Forum	A situation or meeting in which people can talk about a problem or matter especially of public interest (Cambridge Online Dictionary, 2015).
4.1	Gated communities	An area of houses and sometimes shops that is surrounded by a wall or fence and has an entrance that is guarded (Collins Online Dictionary, 2015).
4.4	Grassroots	Relating to the ordinary people as distinct from the active leadership of a party or organization (Collins Online Dictionary, 2015).
12.3	Growth Projections	Informed predictions as to how the city's population will grow in coming years (Arup, 2015).
9.1	Grid-locked	(Of urban traffic) obstructed by queues of vehicles forming across junctions and causing further queues to form in the intersecting streets (Collins Online Dictionary, 2015).
7.4	Hazard Exposure Assessment	Assessment of the type and nature of hazards an area or asset is exposed to/might potentially face (Arup, 2015).
10.4	Hazard Profile	The full range of hazards which the city may face (Arup, 2015).
10.4	Hazard Monitoring	Monitoring the different hazards facing the city/region providing warning of when, where and how a hazard might occur (Arup, 2015).
3.1	Health risk	Something that could cause harm to people's health (Collins Online Dictionary, 2015).
7.1	High risk	Denoting a group, part, etc., that is particularly subject or exposed to a danger (Collins Online Dictionary, 2015). Comment: This may be due to likelihood of occurrence, potential intensity of impact, underlying vulnerability which may exacerbate impact or a combination of these factors.
1.1	Homeless	Absolute homelessness refers to those without any physical shelter, for example, those living outside, in parks, in doorways, in parked vehicles, or parking garages, as well as those in emergency shelters or in transition houses (ISO, 2014 (UN Habitat)).
5.3	Indigent	So poor as to lack even necessities (Collins Online Dictionary, 2015).
10.2	Initiative	An act or strategy intended to resolve a difficulty or improve a situation; a fresh approach to something (Oxford Online Dictionary, 2015).
2.2	Informal Sector / Economies	The informal sector is broadly characterised as consisting of units engaged in the production of goods or services with the primary objective of generating employment and incomes to the persons concerned (OECD). Comment: those that are not registered under specific forms of national legislation

2.1, 5.4	Inclusive	Tries to include many different types of people and treat them all fairly and equally (Cambridge Online Dictionary, 2015).
2.1	International Labor Organisation	UN agency - The main aims of the ILO are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue on work-related issues. (ILO, 2015)
1.1	Informal Settlement	Informal Settlements are human settlements which do not provide their inhabitants the opportunity for enjoying their rights to an adequate standard of living. (UN-Habitat, 2007) Comment: An Informal Settlement is characterised as one which: - is unplanned, - has an informal or insecure property tenure, - has an inadequate or non-participation in government, resulting in lack of basic services, registration and infrastructure, - has a vulnerability of discrimination for the residents.
5.2	Justice system	The system of law enforcement that is directly involved in apprehending, prosecuting, defending, sentencing, and punishing those who are suspected or convicted of criminal offenses (Oxford Online Dictionary, 2015).
12.2	Key Stakeholders	The main people, communities, organisations, groups who are affected on can affect an activity (Arup, 2015).
	Literacy and Numeracy	The ability to read, write and use numeracy, to handle information, to express ideas and opinions, to make decisions and solve problems, as family members, workers, citizens and lifelong learners (Scottish Government, 2001).
2.2, 2.4	Livelihood	A means of securing the necessities of life (Oxford Online Dictionary, 2015).
2.2	Livelihood cooperatives	Group of workers or companies which offer mutual support and knowledge exchange (Arup, 2015).
10.5	Major Incident Plan	Local government plan which outlines how it will continue to function and support the local population during an emergency (Arup, 2015).
11.1, 11.2	Marginalised	To relegate to the fringes, out of the mainstream; make seem unimportant (Collins Online Dictionary, 2015).
2.4	Micro-finance	Microfinance is the provision of financial services to low-income people (CGAP). Comment: In the 1970s, social innovators from the Global South introduced the concept that small amounts of short-term capital (microcredit) can help poor people in the informal economy engage in productive activities and grow their way out of poverty. Over the past few decades, we learned that poor households need access to the full range of financial services to generate income, build assets, smooth consumption, and manage risks—financial services that a more limited microcredit model cannot provide. Now the term “microfinance” generally refers to a broad set of financial services tailored to fit the needs of poor individuals.
2.3, 3.2, 4.2, 10.3, 11.2, 12.2	Minority	A group that is different racially, politically, etc., from a larger group of which it is a part (Collins Online Dictionary, 2015).
1.1	Multi-person household	A group of two or more persons living together who make common provision for food or other essentials for living (UN, 2013).

4.1	Networks	A group or system of interconnected people or things (Oxford Online Dictionary, 2015).
3.2	Non Communicable Diseases (NCDs)	Non-communicable diseases (NCDs), also known as chronic diseases, are not passed from person to person. They are of long duration and generally slow progression. The 4 main types of non-communicable diseases are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes (WHO, 2015).
1.1	One person household	An arrangement in which one person makes provision for his or her food or other essentials for living without combining with any other person to form part of a multi-person household (UN, 2013).
9.4	Operational Technology	Operational technology (OT) is hardware and software that detects or causes a change through the direct monitoring and/or control of physical devices, processes and events (Gartner, 2013). Comment: e.g. traffic lights, transport operations, power networks, gas or water pipelines etc.
10.6	Paraprofessional	A person who is not fully qualified in a profession, but who helps qualified professionals with their work (Collins Online Dictionary, 2015).
5.1	Preventative	Intended to stop something before it happens (Cambridge Online Dictionary, 2015).
9.2	Proficiency test / examination	An exam which test how proficient or skilled someone is in a particular activity, field of study, language, etc. (Collins Online Dictionary, 2015).
7.1, 7.3, 7.4	Protective infrastructure assets	Infrastructure or assets which help reduce the impact of shocks and/or stresses upon the city (Arup, 2015).
2.2	Public Aid / Welfare	Financial and other assistance given to people in need (Collins Online Dictionary, 2015).
3.1	Public Health	The activities and services that are designed to improve the standard of health of the general population (Collins Online Dictionary, 2015).
12.1	Projection	A prediction based on known evidence and observations (Collins Online Dictionary, 2015).
9.1	Radial (journeys)	(Of a road or route) running directly from a town or city centre to an outlying district (Oxford Online Dictionary, 2015).
8.3	Redundant Capacity	Designed to ensure that there is additional / extra / spare capacity (Arup, 2015).
1.2, 1.3, 1.4, 9.3	Reliable	Consistently good in quality or performance; able to be trusted (Oxford Online Dictionary, 2015).
7.2, 8.4, 10.5	Risk Assessment	Formal assessment of the likelihood and potential impact of local hazards upon the city (and surrounding region) in relation to exposure and vulnerability ((Arup, 2015), 2014). Comment: Impacts may be environmental, social, economic or physical (Arup, 2015).
1.1	Safe Housing	Sound with regard to structural safety and secure with regard to personal safety (Arup, 2015)

1.3	Safe / Potable Water	Potable water shall refer to water that is treated or confirmed safe for human consumption. A potable water supply service shall refer to a service that delivers potable water through a pipe or similar duct that is connected to a network, the supply of which is relatively continuous given that it includes a deposit built for its storage. If a group of houses has a mother pipe connected either provisionally or permanently; it shall be considered to have access to potable water. (ISO)
3.1	Screening	The process of examining people for the presence of a disease (Collins Online Dictionary, 2015).
5.1	Secured by Design	Design and security for new & refurbished homes, commercial premises and car parks as well as the acknowledgement of quality security products and crime prevention projects. (SBD).
1.1	Security of Tenure	The right of a tenant to continue to occupy a dwelling or site (Collins Online Dictionary, 2015).
4.4	Society	The totality of social relationships among organized groups of human beings (Collins Online Dictionary, 2015).
2.1, 7.1, 9.2	Standard	A level of excellence or quality (Collins Online Dictionary, 2015).
Many, notably within Goal 1	Sufficient	As much as is needed for a particular purpose (Longman, 2015).
3.2, 3.3, 3.4, 9.3	Surge	A sudden large increase, typically a temporary one (Oxford Online Dictionary, 2015).
3.2	Timely	Done or happening at exactly the right time (Longman, 2015).
4.3	Transient	Working or staying somewhere for only a short time (Longman, 2015).
5.2, 5.4, 6.1, 10.1	Transparent / Transparency	Open and honest, without secrets (Cambridge Online Dictionary, 2015).
5.2	Trustworthy	Able to be relied on as honest or truthful (Oxford Online Dictionary, 2015).
3.4, 4.4, 11.2	Volunteer	A person who freely offers to take part in an enterprise or undertake a task (Oxford Online Dictionary, 2015). Comment: In relation to 3.4 and 11.2 this requires a degree of formality and training (Arup, 2015).
2.5, 3.1, 3.2, 4.2, 4.4, 6.2, 9.1	Vulnerable Persons / Populations / Groups	A person, or group more susceptible to the impact of a shock or stress than the average person. (KB (Arup, 2015)) or A population's or sub-population's ability to mitigate risk. It is neither static nor uni-directional. A population which is highly vulnerable to one risk may be less vulnerable to another, depending upon its resources, perception of risk, and agency (Johnson, 2006). Comment. This reasons for this could be varied. Issues in terms of physical, social and/or economic mobility are but to name a few. (Arup, 2015). Social vulnerability itself is not static. Changes in the political economy, natural environment, and social fabric will create change in the vulnerabilities of sub-populations.
8.3	Waste Hierarchy	Steps for dealing with waste, ranked according to environmental impact: Prevention, which offers the best outcomes for the environment, is at the top of the priority order; followed by preparing for re-use, recycling, other recovery and disposal, in descending order of environmental preference (DOE, 2008).

11.1	Working-age Population	Members of the city population of legal age to work (Arup, 2015) Comment: ILO Basic Minimum Age: The minimum age for work should not be below the age for finishing compulsory schooling, and in any case not less than 15 (ILO, 2014).
12.2, 12.3	Zoning	To divide into zones, as for different use, jurisdiction, activities, etc. (Collins Online Dictionary, 2015).

A4. Qualities of resilient systems

Integrated	Integration and alignment between city systems promotes consistency in decision making and ensures that all investments are mutually supportive to a common outcome. Integration is evident within and between resilient systems, and across different scales of their operation. Exchange of information between systems enables them to function collectively and respond rapidly through shorter feedback loops throughout the city.
Inclusive	Inclusion emphasises the need for broad consultation and engagement of communities, including the most vulnerable groups. Addressing the shocks or stresses faced by one sector, location, or community in isolation of others is an anathema to the notion of resilience. An inclusive approach contributes to a sense of shared ownership or a joint vision to build city resilience.
Reflective	Reflective systems are accepting of the inherent and ever-increasing uncertainty and change in today's world. They have mechanisms to continuously evolve, and will modify standards or norms based on emerging evidence, rather than seeking permanent solutions based on the status quo. As a result, people and institutions examine and systematically learn from their past experiences, and leverage this learning to inform future decision-making.
Resourceful	Resourcefulness implies that people and institutions are able to rapidly find different ways to achieve their goals or meet their needs during a shock or when under stress. This may include investing in capacity to anticipate future conditions, set priorities, and respond, for example, by mobilising and coordinating wider human, financial and physical resources. Resourcefulness is instrumental to a city's ability to restore functionality of critical systems, potentially under severely constrained conditions.
Robust	Robust systems include well-conceived, constructed and managed physical assets, so that they can withstand the impacts of hazard events without significant damage or loss of function. Robust design anticipates potential failures in systems, making provision to ensure failure is predictable, safe, and not disproportionate to the cause. Over-reliance on a single asset, cascading failure and design thresholds that might lead to catastrophic collapse if exceeded are actively avoided.
Redundant	Redundancy refers to spare capacity purposely created within systems so that they can accommodate disruption, extreme pressures or surges in demand. It includes diversity: the presence of multiple ways to achieve a given need or fulfil a particular function. Examples include distributed infrastructure networks and resource reserves. Redundancies should be intentional, cost-effective and prioritised at a city-wide scale, and should not be an externality of inefficient design.
Flexible	Flexibility implies that systems can change, evolve and adapt in response to changing circumstances. This may favour decentralised and modular approaches to infrastructure or ecosystem management. Flexibility can be achieved through the introduction of new knowledge and technologies, as needed. It also means considering and incorporating indigenous or traditional knowledge and practices in new ways.

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