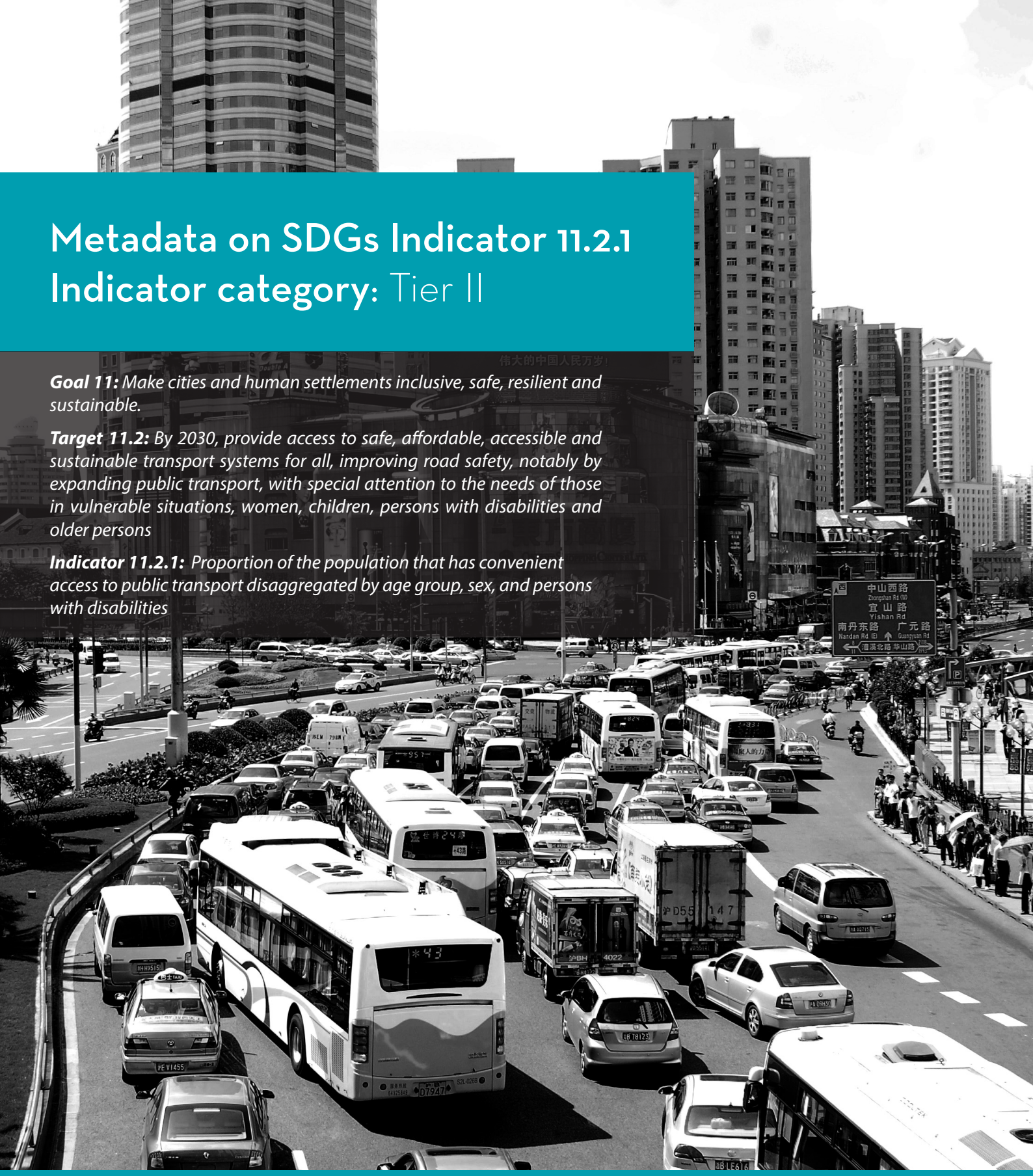
Metadata on SDGs Indicator 11.2.1
Indicator category: Tier II

Goal 11: *Make cities and human settlements inclusive, safe, resilient and sustainable.*

Target 11.2: *By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons*

Indicator 11.2.1: *Proportion of the population that has convenient access to public transport disaggregated by age group, sex, and persons with disabilities*



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1. Definition and method of computations

This indicator aims to successfully monitor the use and access of public transportation systems and move towards reducing the reliance on the private means of transportation. This includes improving the access to areas with a high proportion of transport-disadvantaged groups such as the elderly citizens, physically challenged individuals, and low-income earners - and reducing the need for mobility by decreasing the number of trips and the distances travelled. The accessibility-based urban mobility paradigm also critically needs good, high-capacity public transport systems that are well-integrated in a multi-modal arrangement with public transport access points located within comfortable walking or cycling distances from homes and jobs for all.

Since most public transport users walk from their trip origins to public transport stops and from public transport stops to their trip destination, local spatial availability and accessibility to these stops is often evaluated in terms of pedestrian (walk) access, as opposed to cycle access, park and ride or transfers. Hence, this metadata proposes the access to public transport to be convenient when a stop is in walking distance of 0.5 km from a reference point such as a home, school, work place, market, etc. Additional criteria for defining public transport that is convenient include:

a). Public transport accessible to all special-needs customers, including those who are physically, visually, and/or hearing-impaired, as well as those with temporary disabilities, the elderly, children and other people in vulnerable situations.

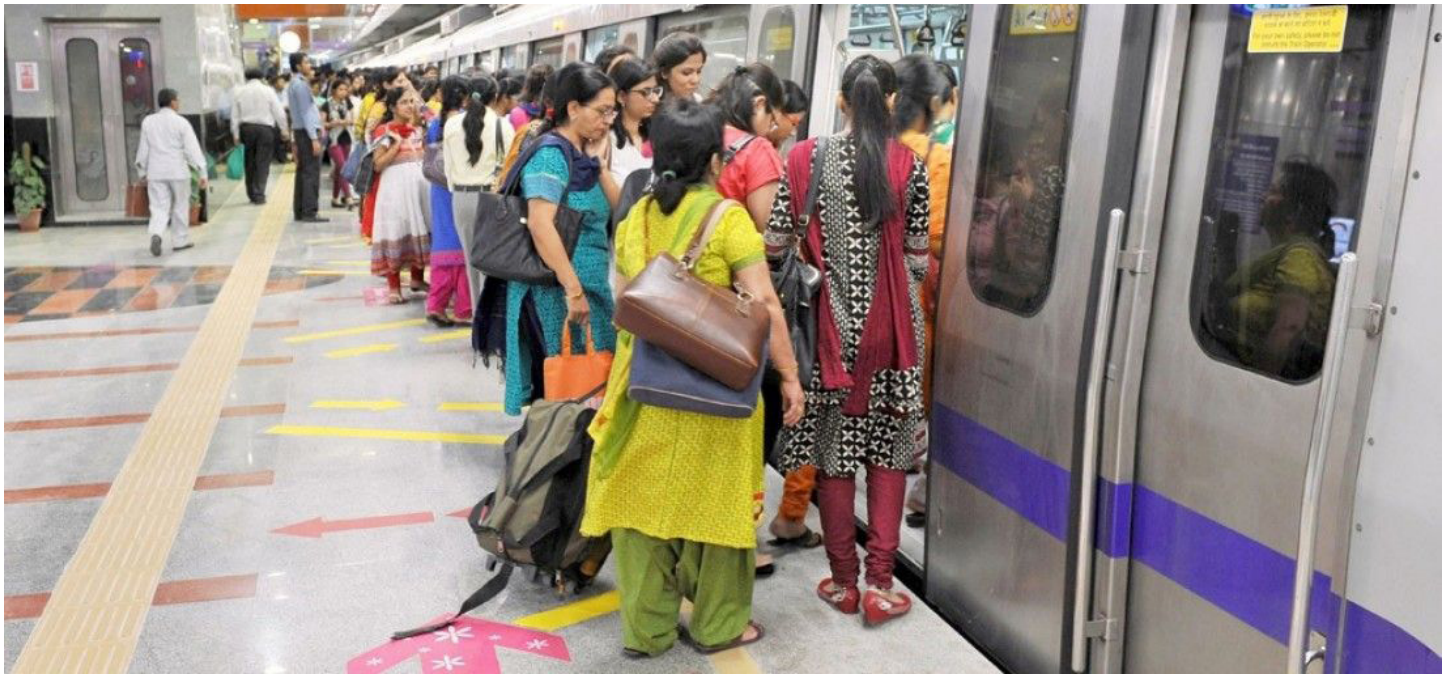
b). Public transport with frequent service during peak travel times

c). Stops present a safe and comfortable station environment

1.1 Definitions

The following definitions are required to define and measure convenient access to public transport.

Public transport is defined as a shared passenger transport service that is available to the general public and is provided for the public good. It may include cars, buses, trolleys, trams, trains, subways, and ferries that are shared by strangers without prior arrangement. It may also include informal modes of transport (para-transit) - but it is noted that these are often lacking in designated routes or stops.



Accessibility to public transport for all, Delhi, India @ indiaexpress.com.

1.2 Method of Computation

This core indicator is computed based on the following criteria.

The identification of service areas is typically achieved using the buffering operation (in GIS) by constructing lines of equal proximity around each public transport stop. However, the metadata proposes to identify the size of the coverage area by the network distance of 500 meters – instead of using a mere buffer of 500 meters (equal proximity) around the transport stop.

Hence, for the core indicator, public transport is considered "convenient" for those living within a 0.5 km (or 500 m) walkable distance of the nearest stop. Using network distance (that is, the walking distance computed using the street network to reach a public transport feature) will help to realistically reflect the configuration of the street network and to recognize the presence of any barriers preventing direct access to public transport features.

In addition to using the above-mentioned distance measures, others have suggested the use of travel time to public transport as a measure of proximity to places of opportunity. Using travel time has the advantage of potentially accounting for pedestrian-unfriendly factors such as steep terrains. However, because of the additional data requirements and the amount of processing effort involved, travel time measures are more difficult to use in practice. For this core indicator, we will therefore use network distance to the public transport stop to develop the service area – but provide the option to consider travel time as a sub-indicator.

The identification of the population served Once a service area is constructed, the next step is to overlay the area onto other polygons, such as census tracts, for which population data is available. This may be inferred from data on dwelling types and likely occupancy rates, although the best measures also provide socio-demographic details of the inhabitants (such as economic figures, presence of disabled persons, gender distribution etc.) We will refer to these polygons as the analysis zones. Typically, a service area (denoted as *i*) intersects, either fully or partially, with more than one analysis zone *j (j=1…..n)*. The population served by the public transport service in area *i*, *Pi*, is thus equal to the sum of the population in each of the intersecting areas, *Pij* . Hence:

$$P_i = \sum_{j=1}^{n} P_{ij}$$

Where,

P_{ij} is estimated based on the amount of interaction between service area $_i$ and analysis zone $_j$.

In estimating P_{ij} we will assume that the population is uniformly distributed within the analysis zones.

Finally, the population with access to public transport out of the entire city population will be computed as:

$$\text{\% with access to Public transport} = \left[\frac{\text{Population with convenient access to Public transport}}{\text{City Population}}\right] 100$$

Additional methodological comments:

The method to estimate the proportion of the population that has convenient access to public transport is based on four steps (core indicator):

a). Spatial analysis to delimit the built-up area of the urban agglomeration;

b). Inventory of the public transport stops in the city or the service area;

c). Street network analysis to measure walkable distance of 500 meters to nearest transport stop;

d). Estimation of population within the walkable distance to public transport;

e). Estimation of the proportion of the population with convenient access out of the total population of the city.

a) **Spatial analysis to delimit the built-up area of the urban agglomeration.** Delimit the built-up area of the urban agglomeration and calculate the total area (square kilometers). Area of delimitation should be aligned with census enumeration areas to match with demographic data.

b) **Inventory of public transport stops.** Information can be obtained from city administration or service providers. In some cases where this information is lacking, incomplete or outdated, open sources, community-based maps, or innovative technologies to map public transport - which are increasingly recognized as a valid source of information - can be a viable alternative. When information is available, characteristics of the quality, universal accessibility for people with disabilities, safety, and frequency of the service can be 'assigned' to the public transport stops' inventory for detailed analysis and further disaggregation according to the statistical capacities of countries and cities.

c) **Street network analysis to measure walkable distance of 500 meters to nearest transport stop.** To calculate the walking distance of 500 meters, data on a well-defined street network (by city or Open Source e.g. Open Streets Map) is required with corresponding attributes (such as junctions, intersections, turns, elevation etc.).

d) **Estimation of urban area with access to Public Transport.** To calculate the indicator, it is necessary to use a map with the inventory of officially-recognized public transport stops and create a polygon area of 500 m walking distance for each stop – based on the street network. Merge and clip with boundary of the boundary built-up area of the urban agglomeration.

e) **Estimation of the proportion of the population with convenient access to public transport out of the total population of the city.** Overlay GIS demographic data on the number of dwellings within the area with access to public transport stop. Calculate the population within those dwellings. Estimate the proportion of population out of the total population of the city.

1.3 "Second Tier" or sub-indicators

Complementary to the above, other potential indicators of "convenient access" may provide a useful complement to the core indicator of distance to stations. Several are identified here, but there may be others. These all represent potential extensions or more detailed modifications of the core indicator that could improve it, but that require more data and, in some cases, may compromise the comparability of the indicator across jurisdictions, since collection techniques may vary. Yet, any of these may be usefully applied as secondary indicators when data is available:

Traffic congestion in shanghai, China © Julius Mwelu / UN-Habitat.

- **Alternative definitions of "convenient access":** As mentioned in the definition of "convenient access" above, additional metrics of access to transit may include a longer distance for reaching faster transit modes (e.g. metros or bus rapid transit) such as 1km, or for cycling access, such as 2km.
- **Obstacles to reaching stations:** Distance to stations may be adjusted by considering factors that create obstacles or otherwise make traveling the route difficult, at least for some travelers. An obvious example is the need to take stairs or steep ramps to reach a station, making it difficult for some elderly or disabled persons to gain access. Alternative routes would need to be identified, or stations indicated as not providing convenient access for some groups.
- **Transit system performance:** The methodology described above covers public transport service solely based on spatial access to stops and does not address the performance of the system, such as frequency of service, capacity, safety/security, comfort, etc. We note that performance aspects of public transport are important because a service within walking distance is not necessarily considered as available if waiting times are high or if conditions are unsafe/insecure. These are not included in our core indicator, but countries are encouraged to collect and report this information as a secondary indicator.
- **Affordability:** this can be used to adjust "convenient access" since access is only convenient for those who can afford the services. Affordability is often measured as the percentage of household income of lowest quintile of population spent on transport. This can be obtained from surveys. The poorest quintile should not spend more than 5% on transport. This may need to be translated into limits on per-trip transit fares or monthly pass prices for the service to be included under convenient access.
- **Safety/security:** This parameter may be difficult to measure but could be captured in part from accident and crime statistics near stations and on the transit systems themselves.
- **Convenience/comfort:** apart from journey times, convenience may include the presence of information systems such as real-time electronic schedule displays or other user information systems (e.g. apps), while comfort may relate to features on the system and typical crowding or load factor levels.
- **Modal shift to sustainable transport:** this is also expressed in Modal share (cars, Non-Motorized Transport -NMT, Public Transport-PT), Passenger kilometers travelled on Electric Vehicles (EV) as percentage of total passenger kilometers travelled in urban areas from city mobility surveys. This parameter is also important due to transport's contribution to carbon emissions and air quality issues in cities.

Public transport motorcyclist popularly known as Okada in Lagos, Nigeria © Julius Mwelu / UN-Habitat.jpg

1.4 Achieving a higher level of "convenient access" – Access to opportunities

Beyond the secondary indicators for measuring access to "convenient transit" lies a completely different approach to measuring convenience: "convenient access". This is based on the idea that we do not wish to access transit stations, we wish to access destinations, and even access non-physical objectives such as "opportunities".

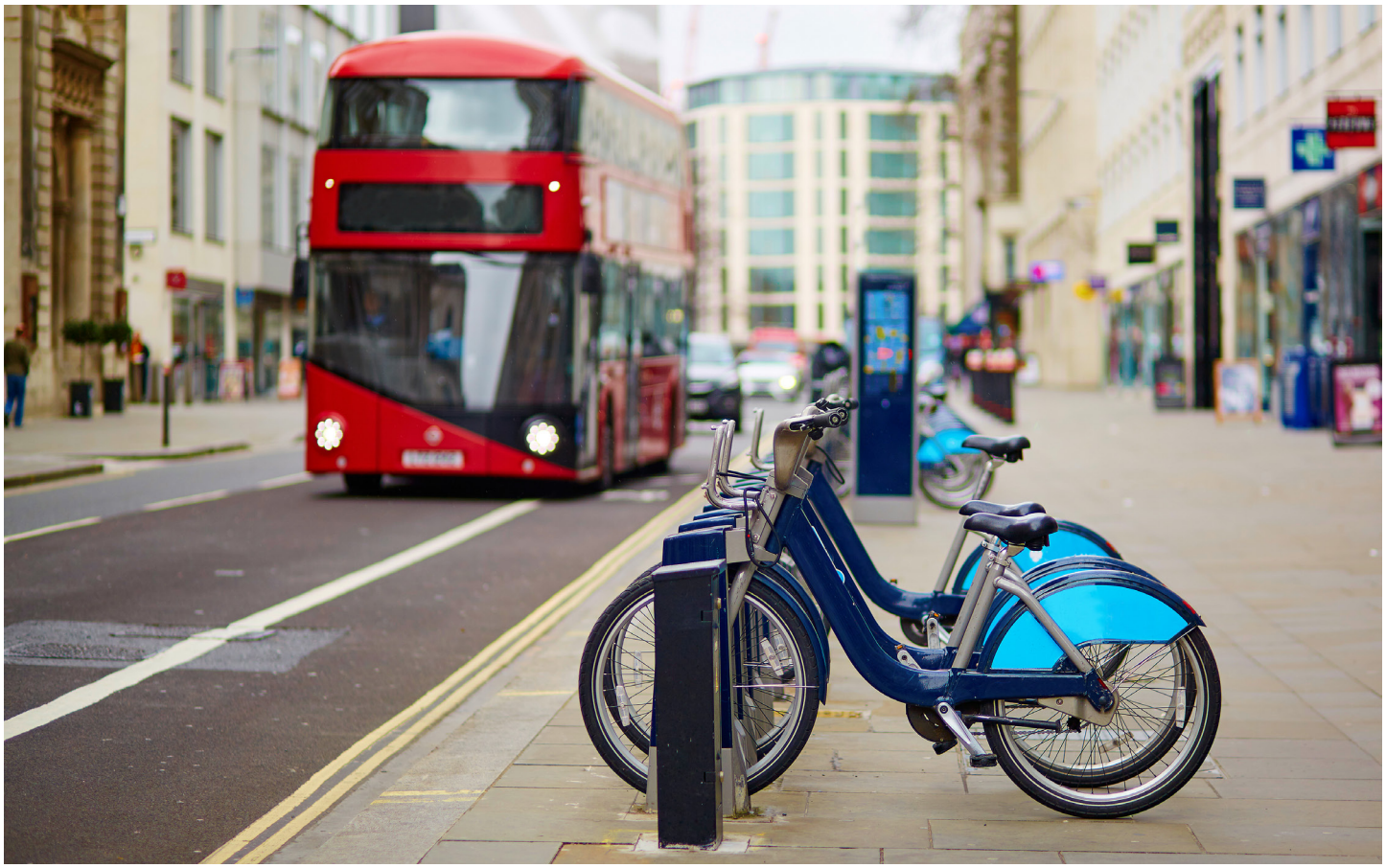
Operationally, access to "opportunities" means the ability of individuals to reach desired final destinations in a reasonable amount of time, for a reasonable cost, with adequate safety/security/comfort, etc. For example, this may be measured as a maximum one-hour travel time between any origins and destinations within a city, or at least those O-D combinations used (or desired to be used) by individuals.

While measuring access to opportunities is superior to measuring access to transit stations, it is more difficult and data intensive, so is not proposed as the core indicator. Though as data systems improve and cities become more able to collect the needed data, it may eventually make sense to shift to this as a core indicator. We note here that there are three basic types of data needed to construct this indicator:

- Data on the residential locations of individuals
- Data on the desired destinations of individuals (such as job, shopping, school, hospital locations)
- Data on the available travel options and travel times linking the origins to the destinations

In fact, the first and third of these are very similar to what is needed to construct the core indicator, since residential locations and transit data are needed. The main additional data requirement is on the destinations, and there may be some additional complexities in putting the three types of data together.

Overall while there is considerable effort ongoing to try to operationalize this approach and help cities beginning to collect the needed data, it appears to be too complex to consider as the core indicator at this time.



Green Mobility Zone project in London © diariodotransporte.com.

2. Rationale and interpretation

Equity and inclusivity are at the heart of Universal Access. This objective accounts for distributional considerations and places a minimum value on everyone's travel needs, providing all, including the vulnerable, women, young, old, and disabled, in both urban and rural areas, with at least some basic level of access through transport services and leaving "no one behind." The ability of all individuals to access markets, employment opportunities, and service centers such as schools and hospitals is critical to urban economic development.

To achieve the goal of "convenient access" for all, urban transport systems and services need to be upgraded—and in some cases planned from scratch—in an integrated way, that ensures the balanced access of urban residents regardless of income, mode of travel, gender, or disability status. Urban mobility should foster and enable cities to flourish, without creating over-dependence on any particular mode of travel. The concept of convenient accessibility to jobs, services and markets also allows policymakers, citizens and businesses to discuss the state of the transport system in a comprehensible, goal-oriented way.

Thus the "convenient access" SDG indicator addresses a significant gap that was never addressed by the MDGs: directly addressing transport as a critical enabler of economic activities and social inclusion. By focusing on access to transit, this can also be aligned with sustainability goals such as reducing greenhouse gas emissions, pollutant emissions, and road fatalities and injuries since (as shown in SUM4ALL document), increased use of transit aligns with these goals. Broadening the basic access concept to reaching destinations (with associated services, goods, social, education, health and other opportunities associated with these destinations) for all as the ultimate goal, the full value can be achieved, though measuring this "opportunity access" is difficult, as described above. In any case, adopting a goal of convenient access tends to align with a broad objective of making cities more compact, with shorter trips and greater focus on transit, cycling and walking through better planning and the integration of land-use planning with transport planning.

3. Disaggregation

In principle, the core indicator of access to transit stations, and the various secondary indicators can be disaggregated by various characteristics of groups within the population, to track whether all such groups have good access. Information can be disaggregated by age and gender, by indicators of vulnerability and disability, and by various other characteristics. But in all cases such disaggregation requires detailed data that breaks out variables of interest across the groups of interest. Obtaining such data typically requires major efforts and often changes in mainstream mechanisms of data collection. Typical types of disaggregation include:

- By location (intra-urban)
- By income group
- By age group
- By gender (head of household)
- By race (head of household)
- Disaggregation by mode to reach public transport or by type/quality of public transport
- Disaggregation by transport quality (travel time, safety, universal access, security, affordability, comfort and user information)

Quantifiable Derivatives:

- Proportion of urban population that has convenient access to public transport.
- Proportion of population that has convenient access to public transport stop with accessibility rating for various demographic disaggregation dimensions.
- Proportion of population with access to bus vs. train, high speed vs. low speed modes, access by walking vs. biking, etc.
- Proportion of population broken out by location (e.g. urban central vs. suburban area) that has convenient access to public transport.

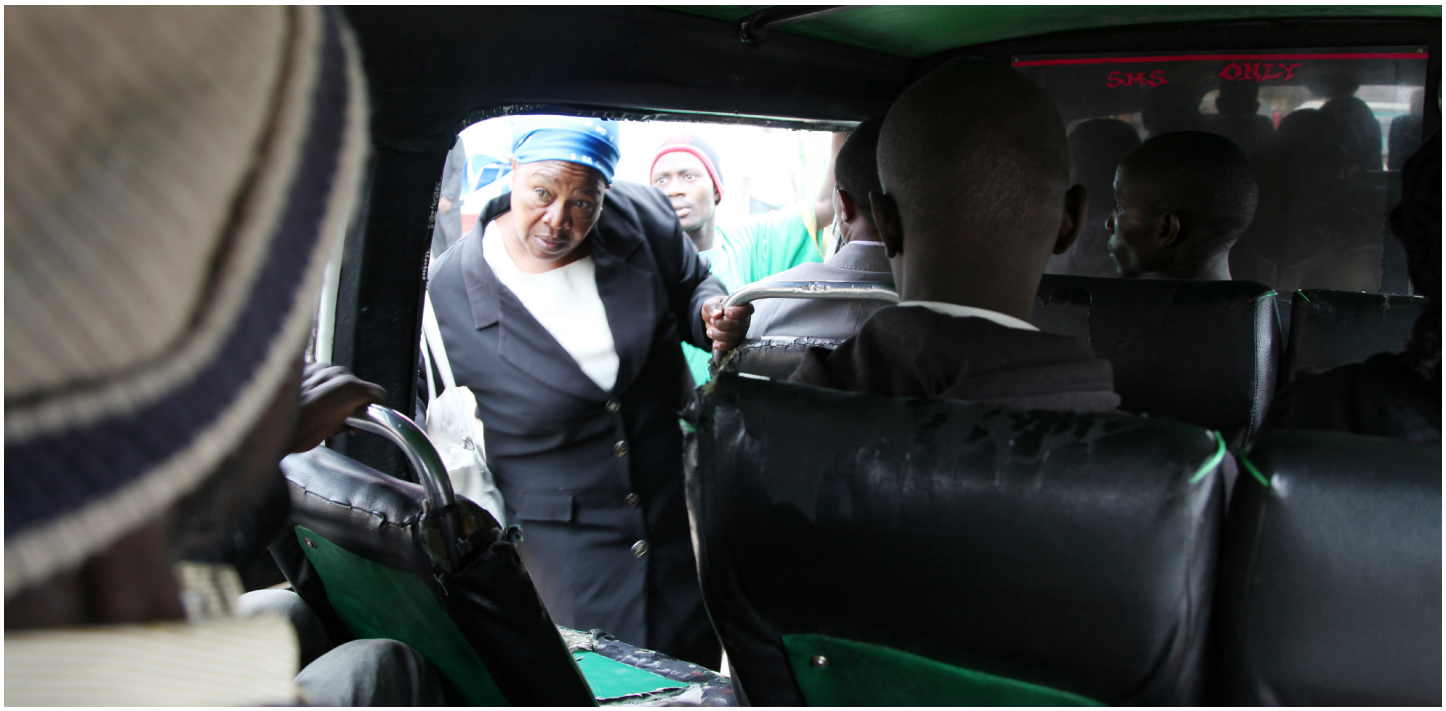
4. Sources and data collection processes

The actual and recommended data sources for the core indicator are the following:

- Data on location of public transport stops in city: Typically available from city administration or service providers, or from GIS data such as Open Street Map
- Dwelling units within 500m of public transport stops, typically from Census or other geographic surveys,
- Typical number of residents per dwellings unit, Census/household survey
- Demographic data for disaggregation: Typically obtained from household surveys that collect information both on household/individual characteristics and travel patterns. Must also provide information on the location of the respondent. These surveys could also be used to collect information about the perceived quality of the service, such as time to reach taking into account obstacles, typical wait ties, etc.
- Note that such household surveys are often not easily available and rarely updated on a frequent (e.g. every 2-3 years) basis.
- Due to its spatial nature, the use of the urban agglomeration is a precondition for the measurement and comparability of this indicator.

5. Current data availability/ indicator tier

This indicator is categorized under **Tier II** of which the indicator is conceptually clear and an established methodology exists but data is not easily available. In addition, global/local on urban transport systems do not exist. Moreover, data is not harmonized and comparable at the global level. Obtaining this data will require collecting it at the municipal/city level with the possibility of experiencing serious deficiencies in some areas where such data on mass transit and on transport infrastructure are not available. In addition, an open-source software platform for measuring accessibility, the Open Trip Planner Analyst (OTPA) accessibility tool, will be available to government officials and all urban transport practitioners. The World Bank in conjunction with Conveyal (http://conveyal.com) developed this tool, which leverages the power of the OTPA engine and open standardized data to model block-level accessibility. The advantage of the tool (free and user friendly) is its ability to easily calculate the accessibility of various opportunities and transportation scenarios.



Matatu vehicles serve as public transportation in Nairobi Kenya © Julius Mwelu / UN-Habita.

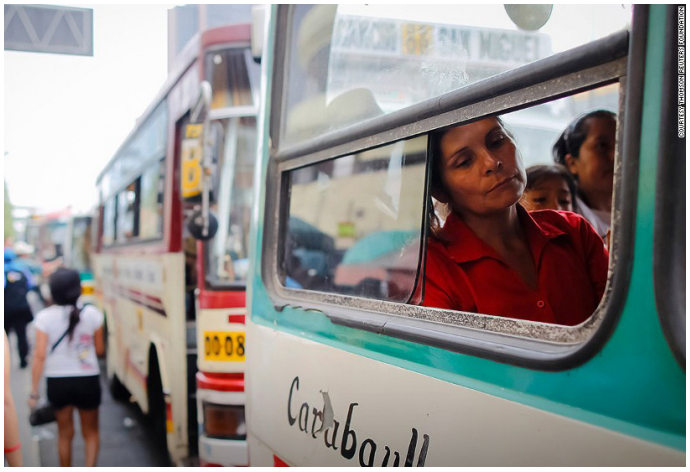
6. Responsible entities

National Focal points as designated by respective Governments underpins the governance framework for monitoring the Transport Target. Such focal points could be the ministries themselves, NSOs, academic or research institutions, Civil Society Organizations, operators or a combination of these working under an agreement facilitated by the National Government. A secretariat or resource center, comprising UN-Habitat and its partner organizations will work with the National Focal Points, providing capacity building and quality assurance support.

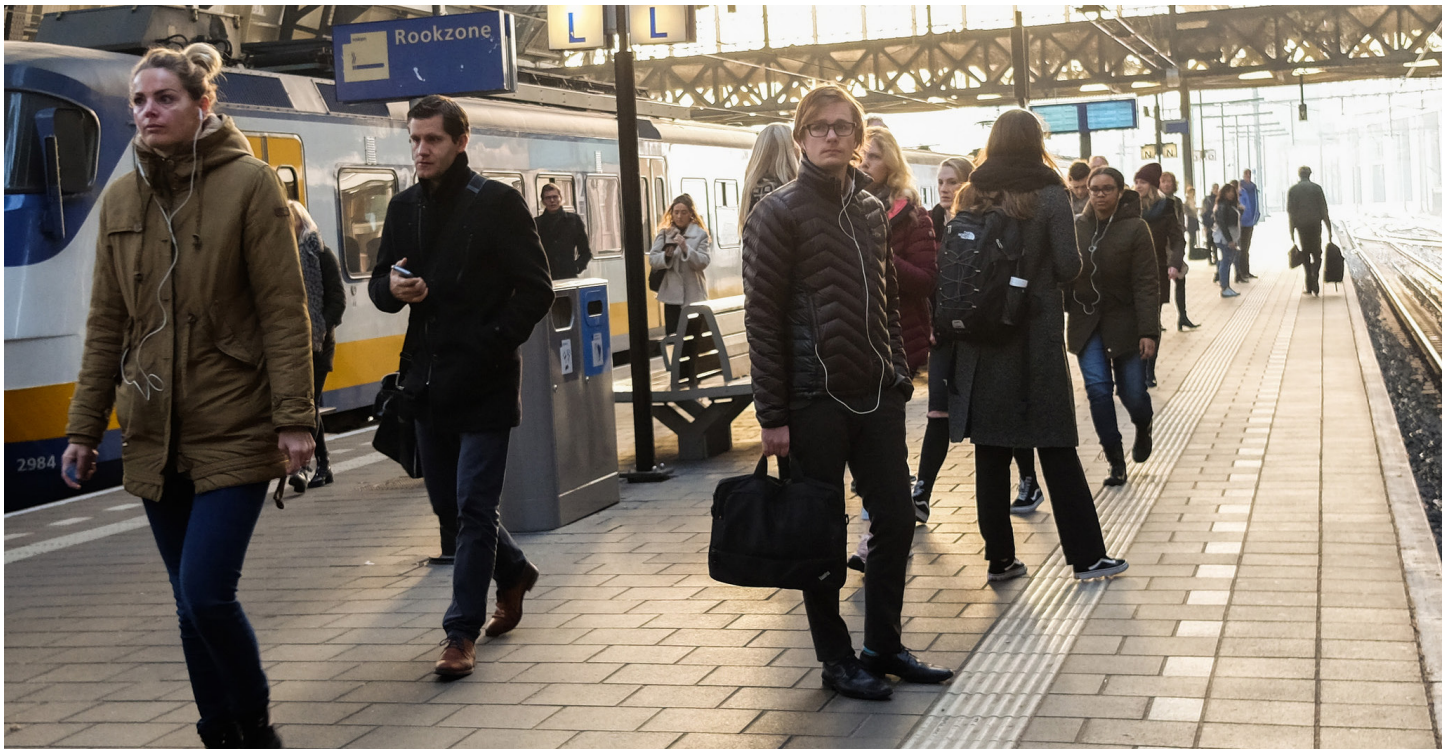
The resource center will also ensure the exchange of knowledge and experience between participating countries. Specific agreements will be drawn up with respective countries and cities for collaboration in the monitoring. The monitoring framework will be disseminated in UITP and other transport events. A dedicated team combining UN-Habitat and the International Association of Public Transport (UITP) staff will be set up and these will lead the annual monitoring and reporting. Comprehensive reporting will be undertaken on a biennial basis. Reports will be published in the public domain with data available in the UN-Habitat global databases.

7. Data collection and data release calendar

The monitoring of the "distance to transit stop" indicator can be conducted fairly frequently, with updates of transit maps and spatial information on presence of dwellings. These would not be expected to change much each year, so perhaps a 3-year reporting cycle would be adequate. Monitoring at such time intervals will allow us to determine whether the proportion of the population with convenient public transport is increasing significantly over time, as well as monitor what is the share of the global urban population with convenient access to public transport.



Women safety in public transport © CNN.com



Public transport © Franklin Heijnen / Flickr.

8. Treatment of missing values

Missing data are anticipated in the first few years of collection of data for this indicator, and this will be largely because of the slow adoption of the proposed methodology, and associated data collection efforts and development of needed statistical systems by national and local governments. The spatial nature of the indicator and the variations in the definitions of what is public transport by countries, as well as attempts to measure secondary indicators, will lead to differences in methods and comparability of data and metrics. Hence, missing data or "inferior" measurement efforts for selected countries will be scored incrementally based review of the approach and data quality. The existence of "formal" vs informal public transit systems will also matter, and if no formal public transit system is in place, this may lead to using a modelled level of availability instead of reporting zero.

9. Sources of differences between global and national figures

For this indicator, national data built up from a "national sample of cities approach[1]", complemented with internationally available spatial data sources, will be used to derive final estimates for reporting at national and global figures. As national agencies are responsible for data collection, and data will be built up from cities to a national and then to a global level, no differences between the city-produced data/indicators or country/global produced indicators are expected to arise. Where such discrepancies exist, these will be resolved through planned technical meetings and capacity development workshops.

1 The National Sample of Cities (NSC) is a carefully constructed sample of cities that considers sub-regional and city specific characteristics and variances to monitor the dominant pattern in the country's cities in an aggregated manner in a given country. The NSC is one of the mechanisms that will create conditions to monitor and report on a consistent set of cities that can enable them to produce time series analysis to measure national progress in a more systematic and scientific manner. The sample of cities will be drawn using sound statistical and scientific methodologies based on a number of relevant city-specific criteria/characteristics that capture the specific contexts of countries, ensuring that the sample is consistent, and representative of a given country's territory, geography, size, history, etc.

10. Regional and global estimates and data collection for global monitoring

Based on the global SDG monitoring framework, national statistical agencies/national governments will be primarily responsible for data compilation at the national level, and they will manage and resolve the differences observed at that level. At the global level, UN-Habitat and the selected partners will be in charge of data compilation for international consumption and comparison. They will also explore several capacity building options to ensure that all countries and regions apply uniform standards for generation, reporting and analyzing data for this indicator.

11. References

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