# Foundations for gender-sensitive public lighting systems

Amandine Gal
Econoler
Geneva
Switzerland
agal@econoler.com

Lina Baldrich
Econoler
Quebec
Canada
lbaldrich@econoler.com

Sébastien Carreau
AFD
Paris
France
carreaus@afd.fr

Giulia D'Angiolini
Econoler
Paris
France
gdangiolini@econoler.com

Silvia Puddu
AFD
Paris
France
puddus@afd.fr

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## Abstract

Urban planning tends to reflect society's dominant values, which are typically neither inclusive nor equitable. Cities have long reflected traditional gender roles and the gendered division of labour, thus marginalising women and girls from public spaces. This is because, historically, cities have been planned and designed by men with little knowledge of or concern for how their decisions affect women. Street lighting systems (SLSs) are an extension of this marginalisation and are still planned and designed without considering gender-differentiated uses of urban spaces. These issues are exacerbated in many developing regions where cities are dimly lit due to the use of non-efficient street lighting technologies, financial challenges, deficient operation and maintenance, and limited in-country technical capacity for planning and operations, among other things.

This paper defines what a gender responsive energy efficient (EE) SLS is: "Gender responsive SLSs encompass resilient and sustainable systems that: (1) Use an intersectional gender approach to consider the gender-differentiated lighting needs of both motorised road users and pedestrians; (2) address women's and girls' urban safety needs by promoting natural surveillance and social integration; and (3) actively enable women's economic, social and political empowerment." Also, the paper identifies five pillars to ensure women's, girls', men's and boys' needs and priorities are considered when designing SLSs: Security and well-being; economic empowerment; voices and rights; gender capacity building; and sustainability including EE.

This paper summarises the main findings of a study commissioned by the French Development Agency (AFD) on the existing inequalities relating to gender and vulnerable individuals in planning and implementing SLS projects in sub-Saharan Africa (SSA). The study was financed by the European Union (EU) under the framework of the Covenant of Mayors in Sub-Saharan Africa (CoM SSA) initiative.

## Introduction

The most common approach to SLS design is focused on facilitating vehicular traffic whereby streetlights are only installed at intersections and along major traffic arteries. Design approaches demonstrate little consideration for low-traffic or pedestrian-only locations (public markets, squares, residential areas, etc.) where women congregate and travel most frequently. This lack of consideration translates into unmet streetlighting needs for non-motorised road users who are mainly women, children, youth, the elderly, and vulnerable groups such as informal workers and the disabled, thereby generating inequality in the use of public spaces as a result of lower safety perception after dark.

Streetlighting has been recognised as the most important environmental feature that influences the subjective perception of safety after dark. Light has two main impacts on the perception of safety: Natural surveillance (which encompasses someone's capacity to see around them and be seen by other people) and social integration (when positive impacts derive from community confidence that facilitate cooperation for mutual benefit, cohesion, and informal social control).

While both are essential to increase women's feeling of safety in urban settings, natural surveillance fulfils mainly practical

needs for gender equality (i.e. need for better visibility, decreased hiding places, and limited entrapment), whereas social integration fulfils strategic needs (i.e. addressing the root causes of gender-based violence and crime by strengthening community cohesion and informal social control).

In this sense, there is an urgent need for cities to design and implement inclusive SLSs that address both practical and strategic gender needs to create safer and more cohesive neighbourhoods, decrease gender-based violence and crime, promote women's social and political empowerment, enhance the relationship between the urban poor and the state while creating cost-effective and low-carbon emission energy systems that are resilient and sustainable in the long term.

This article is the second in a series and is the result of an assessment carried out for the AFD and the CoM SSA initiative. The first article was focused on a state-of-the-art review of existing literature and a selection of ongoing as well as recent streetlighting projects to analyse the correlation between gender inclusion and street and outdoor public lighting services. This second article is focused on practical aspects and proposes a methodology that streetlighting stakeholders can directly apply to help design and implement responsive EE SLSs as defined in the framework of this study. The latter encompasses resilient and sustainable systems that (1) use an intersectional gender approach to consider the gender-differentiated lighting needs of both motorised road users and pedestrians, (2) address women's and girls' urban safety needs by promoting natural surveillance and social integration, and (3) actively enable women's economic, social, and political empowerment.[1] The proposed methodology was developed by gender and energy efficient street lighting experts using diagnostics of two cities as a baseline: Kampala and Nouachkott.

The methodology presented in this paper has not yet been implemented since it was finalised in 2021 and it takes years to develop a SL project.

## Diagnostics Used as Baseline

Two diagnostics were carried out in Kampala and Nouakchott, which served as the basis for the development of the methodological scheme for a gender inclusive and EE SLS. Note that there are no case studies since the methodological scheme is newly developed, but a baseline example was used to identify barriers and issues related to gender and SLS.

The diagnostics were performed as part of the socialisation of upcoming public lighting projects. Qualitative methods (document reviews, exploratory walks, focus group discussions, and key informant interviews) were used to collect field information. The main findings are presented below.

### KAMPALA

Kampala is the capital and largest city of Uganda, with 1.7 million inhabitants. There are currently 5,436 streetlights in Kampala City. Of these, 3,698 are connected to the national grid while 1,738 are solar light installations. Financed by AFD, the Kampala City Lighting and Infrastructure Improvement Project is being implemented over the 2018 to 2025 period with the objective of increasing lighting coverage from 8 % to 90 %. Community consultations were performed in Kampala in February and March 2021.

Respondents disclosed feeling safer physically, economically, and emotionally in areas that are better illuminated. It is noteworthy that 92 % of respondents, both men and women, indicated feeling unsafe at night in their neighbourhoods. Although results are not differentiated based on gender, women experience the consequences of inadequate street lighting more sorely.

The diagnostics revealed that most places identified as unsafe include pathways in informal settlements, slum areas, public transport waiting areas, marketplaces, and walkways to and from work. The importance of more ubiquitous public lighting was emphasized as key to providing enhanced safety along these commuter spaces. Areas that require street lighting include recreational and leisure sites such as city squares, centenary park, public taxi ranks, and different public commuter taxi waiting areas. Informal settlements, where much of the urban population resides, sorely lack street lighting. The provision of street lighting on both highways and access routes was highlighted as one of the issues critical to ensure safe and inclusive cities.

Robbery and theft were listed as the most prominent security concerns. These crimes were reported as being more common at night. Discussions with informal sector traders and businesswomen revealed the precarious situation of women street vendors in Kampala. Many women and girls highlighted fear of rape and other forms of sexual and physical assault and harassment in addition to the concerns of robbery, bag snatching, murder, and kidnapping. With regard to children, respondents mentioned that street lighting enables children to move safely during school time, thus helping in child protection and overall wellbeing.

In Kampala, improved street lighting enhances business and entrepreneurship opportunities for both women and men, and the various emerging business opportunities include general merchandisers, catering and eateries, as well as cloth and garments. During several focus group discussions, it was mentioned that small businesses were launched once street lights were installed, and the women's focus group discussions indicated consensus that street lighting expands economic opportunities for women by enabling them to engage in additional/initial commercial activities after the end of their other business activities, daily employment, or household and childcare duties

### NOUAKCHOTT

Nouakchott, the capital of Mauritania, is a city of 1.2 million inhabitants. Funded by the European Union, the ARENDDRE project promotes urban development in the city of Nouakchott. The project, which is being implemented from 2020 to 2023, includes a public lighting component under which a detailed diagnosis of the public lighting system was conducted. Low-consumption solar lighting fixtures will also be installed in the outlying neighbourhoods, but the locations have yet to be determined.

Currently, only the capital's main arteries, a few streets in upscale neighborhoods, the downtown area, and certain areas in outlying neighborhoods targeted by previous projects are now equipped with public lighting. Residential areas are without street lighting, particularly the central working class areas and outlying areas.

1.ECONOLER, Sustainable Street Lighting (2003, rev. 2020). Available online: https://econoler.com/wp-content/uploads/2017/10/street-lighting-2003-rev-PL_VD-ML_versionweb.pdf

The qualitative data revealed that the lack of street lighting in Nouakchott leads to a sense of insecurity, including fear for physical safety, crime, as well as harassment and sexual violence. All 19 participants in the focus groups (men and women) indicated that they sometimes felt unsafe at night in their city or neighbourhood. The perception of safety in the various neighbourhoods is illustrated in the map below, which is directly related to public lighting coverage.

The assessment of Nouakchott revealed that the lack of lighting affects everyone's social and economic life (men, women, youth, old, etc.), but that certain groups are more affected by the negative impacts. These include female informal street vendors, young women, and residents of peripheral and informal neighbourhoods.

#### DIAGNOSTICS RESULTS USAGE

The gender mainstreaming pillars for EE SLS and the scheme for implementing a gender inclusive and EE SLS were developed using the diagnostics as a baseline and reference.

## Gender Mainstreaming Pillars for Energy Efficient Streetlighting Systems

As previously stated, the gender equality outcome is to have SLSs that are responsive to women's, girls', men's, and boys' needs and priorities (not just drivers) and that are accessible, affordable, safe, and sustainable.

To achieve a gender-responsive and EE SLS, five interconnected and equally important pillars of gender mainstreaming in the streetlighting project cycle should be considered, all five of which are outlined below.

#### SECURITY AND WELL-BEING

Streetlighting reassures people as well as enhances urban safety and the well-being of the community. SLSs enhance natural surveillance (i.e. visibility) by decreasing hiding places for potential offenders and providing a better overview of someone's surroundings. Also, improved SLSs send a positive message on investment in a community and a sense of belonging, which in turn enhance social integration (i.e. informal social controls derived from a community's confidence and social trust).

In this sense, this pillar refers to increasing safety, convenience, and well-being in public places, including informal settlements and low-income areas, to provide services that meet the needs of women, girls, men, and boys on an equitable basis. It is worth noting that while improving urban safety is a universal need, it is especially important for women and girls who are the primary victims of gender-based violence.

#### ECONOMIC EMPOWERMENT

SLSs can yield significant economic benefits. Diagnostics performed in SSA cities indicated evidence that improved streetlighting provided extended trading hours and improved commercial elements, thus not only benefiting many women working at night in the informal sector and as street vendors, but also enhancing women's economic empowerment.

Hence, improved SLSs in commercial areas can provide safe and productive environments for women and men vendors, as well as shoppers and children. They also increase employment and income generation while providing entrepreneurial opportunities and improving working environments conducive to women's employment.

Furthermore, gender-responsive SLSs should improve employment and leadership opportunities for women in the municipal workforce in which they are currently underrepresented.

#### VOICES AND RIGHTS

There is an opportunity to build collective ownership and buy-in from the population toward SLSs by conducting gender equal and socially inclusive consultations and raising civil society advocacy. This will in turn foster social integration, improve the sustainability of the systems (by improving maintenance mechanisms and reducing vandalism), and promote women's social and political empowerment.

Thus, this pillar is intended to ensure that women and men participate equally in decision-making on urban planning and infrastructure, including SLSs. This serves to strengthen the capacity of women's civil society organisations (CSOs) to hold service providers accountable as well as empowers women to play a greater role in the management of local markets/business areas and take a leadership role in local governance structures.

#### GENDER CAPACITY BUILDING

Traditional urban design leads to three main exclusion patterns of women and girls, which are based on spatial planning as well as economic and social factors.[2] The marginalisation of women and girls from public spaces and urban areas is reinforced in cities that are dimly lit since a lack of adequate SLSs exacerbates their feelings of insecurity or limits their economic empowerment.

As a result, it is necessary to strengthen service providers' capacity to ensure that women and men benefit equally from public spaces, including inhabitants of informal settlements and low-income areas, by increasing the capacity to consult with women and men to respond to their priorities and develop greater stakeholder understanding of gender issues and needs in urban development and SLSs.

#### SUSTAINABILITY

The widespread adoption of light-emitting diodes (LEDs) has demonstrated that they provide clear economic and environmental performance advantages over traditional high-intensity discharge (HID) lamps.[i] City administrations, however, tend to overuse LEDs and over-illuminate areas.[3] Over-illumination is the inappropriate or excessive use of artificial light. It can take many forms including glare (or excessive brightness), sky glow, and light trespass (when light falls where it is not needed). Over-illumination is not a solution to producing safer urban spaces and may even have undesirable impacts on crime rates and women's and girls' feeling of safety.[4] Consequently, only

2. D'Angiolini, Giulia, My Ton, Amandine Gal, Silvia Puddu, and Sébastien Carreau (2021). "Lighting the way to gender equality." Available online: https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2021/4-monitoring-and-evaluation-for-a-wise-just-and-inclusive-transition/lighting-the-way-to-gender-equality/

3. Generally, this is due to the perception that it is necessary to match or increase the lumen output of individual luminaires instead of ensuring the average light levels are appropriate for the application. Econoler, (2003, rev. 2020), loc cit.

4. YANG, Hoa et al. (2019), Making Cities Safer for Girls and Women, Arup Research Institute, Plan International and XYX Labs. Available online: https://research.arup.io/story/cities-for-girls

carefully designed, EE SLSs increase urban safety while limiting other detrimental impacts.

In this sense, this pillar refers to increasing the energy efficiency of existing and new SLSs as well as increasing the use of renewable energy where relevant to the country's energy mix and technological context. Those actions serve to create cost-effective and low-carbon emission SLSs that are resilient and sustainable in the long term.

## How to Design Gender Sensitive SLSs

To guide public lighting stakeholders to design and implement EE SLSs, this section highlights the general steps to mainstream gender equality and social inclusion (GESI) across each step of the project cycle, which are summarised in Figure 1.

Recommendations are outlined below on every project step and are connected to the five gender mainstreaming pillars presented above.

### PROJECT ORGANISATION AND PREPARATION

#### Involvement of Relevant Stakeholders/Decision-Makers

Relevant stakeholders and decision-makers need to be involved throughout the data-collection process. Project initiators must seek buy-in from all key stakeholders involved in streetlighting and raise their awareness about EE and GESI aspects as of project onset (organisation in charge of SLSs, designers, women, and inhabitant associations, etc.).

It is also relevant to ensure that decision-makers follow national policy and regulatory frameworks for streetlighting and, if these do not exist, include best practices based on international standards.

#### Team Set-Up and Training

Before the project kick-off phase, an initial gender responsive measure should serve to ensure that women are included on the project team and in decision-making power positions. Recruiting a local gender expert to the team would add value since the local expert can best advise on local gender understanding and realities on the ground if that expert has influence on the project team.

Training team members on basic concepts in gender, gender responsive streetlighting, and how to use gender mainstreaming tools and guidelines is also essential to ensure that gender is systematically integrated by the project team throughout project development and implementation and in all project follow-up and sustainability efforts.

#### Project financial requirements

Gender must be integrated into project budgets, either in a specific component or in existing budget items.[5] Integrating gender in budgets has several advantages including raising project implementer awareness about the importance of mainstreaming gender throughout project implementation, collaboratively identifying gender targets, and deciding on strategies and actions to achieve them.

5. SAÏDI-SHAROUZ, Mina and LAHMANI-SAADA, Sarah (2016), Boite à outils Genre : Développement urbain, Agence française de développement, Available online: https://www.afd.fr/fr/boite-outils-genre-developpement-urbain

### PLANNING AND DESIGN

#### Establishing an Inclusive and Gender-Balanced Stakeholder Consultation Process

This approach must be used at the very onset of project planning to collect quantitative and qualitative data on gender-differentiated lighting needs. Having only women on a project team does not mean that women's perceptions are automatically incorporated into a project since women are not a homogeneous group and many women are not habituated to vocalise their own needs, especially in strongly patriarchal societies wherein norms prohibit women them doing this. Therefore, intersectionality must underpin the consultation process to include individuals with varied social and political identities (e.g. sexual orientation, disability, race, socio-economic status, age, religion, etc.) since they may have different lighting needs.

It is also essential to identify recipients of the lighting "message" to enable social integration within the targeted neighbourhood.[6] Residents of an area should be a priority target, but not the only ones since people working there or using the area for any other function are also relevant potential recipients.[7]

It is important to mention that social participation in the design process does not mean abiding by the exact design people want. We must listen to people, take their opinion into consideration, and give them the opportunity to influence the design process, but it does not mean that we must blindly follow them.[v] Interactive city mapping, surveying, focus group discussions, and collaboration with civil society are all relevant data-collection methods for public consultations. It is also imperative that efforts to form inclusive consultation processes not risk tokenism or essentialisation of any particular group of women.

#### Technology Selection and Infrastructure Design

Lighting programs intended to address gender and social issues have wider planning scopes, thereby covering more urban areas with more emphasis on lighting designs for different urban areas (implementation zones) rather than simply focusing on urban roads. The design must also ensure that SLSs are energy and cost efficient, emit low carbon emissions, and limit detrimental impacts on safety, health, and the environment. Results from the consultation process must be included directly in the infrastructure design and technology selection. Strategic long-term programs must have a gender perspective to allow streetlighting infrastructure to be planned, prioritised, delivered, and managed in consideration of women's and girls' lighting needs and their connection with other objectives. Moreover, including a gender perspective in the strategic planning process helps outgrow political and short-term arguments to allocate resources in a gender-biased manner (such as political cycles and social dynamics). The presence of women in leadership and decision-making positions at all levels of government is a key factor in achieving this goal.[8]

6. DASTGHEIB, Seyedehfatemeh (2018), "Light and perception of safety in-between buildings", M.S. Thesis KTH Royal Institute of Technology.

7. MALAGONI, Benedetta (2019), Social urban lighting in the creation of social capital.

8. OECD Council on SDGs (2019), "Gender Equality and Sustainable Infrastructure". Available online: http://www.oecd.org/gov/gender-mainstreaming/gender-equality-and-sustainable-infrastructure-7-march-2019.pdf

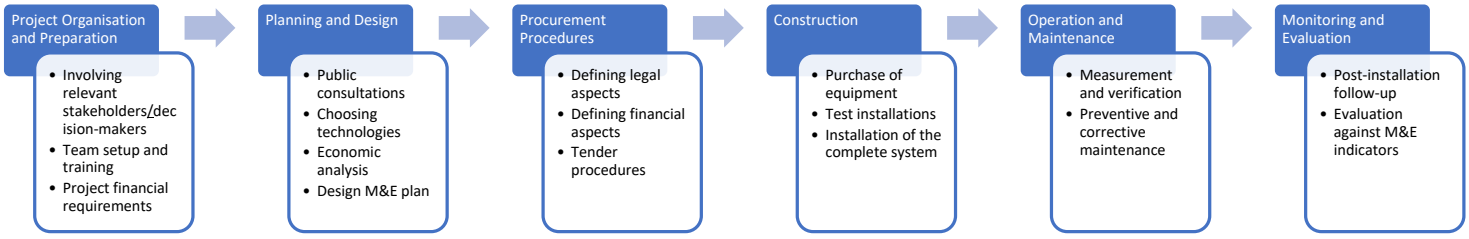



*Figure 1. Main Steps of an EE Streetlighting Project.*

#### Designing a Gender Responsive Monitoring and Evaluation (M&E) Plan

An M&E plan that includes gender sensitive indicators as well as activities for data collection and reporting must be developed at the planning stage. The data collected during public consultations are used to establish a baseline. The project team should have a clear roadmap for collecting social data disaggregated by gender, age, and other intersectional identities (sexual orientation, disability, race, income, age, religion, etc.) to properly qualify and quantify safety improvements and well-being benefits promoted by a given project. In addition, a measurement and verification (M&V) plan should identify technical data to be monitored (energy savings and GHG emission reductions) to ensure that projects comply with technical and economic expectations.

### PROCUREMENT PROCEDURES

#### Establishing Gender Responsive Procurement Protocols

The criteria defining gender responsive streetlighting include involving women and girls as active stakeholders in planning and designing systems and that SLSs increase women's income-generating opportunities. Establishing gender responsive procurement processes[9] s an important tool to fulfil these criteria by encouraging women-led businesses to take part in the design, construction, and/or maintenance of SLSs. Revised procurement protocols ensure that women-owned businesses are considered along all aspects of the procurement chain and that local supplier businesses that are women-owned or have a strong representation of women in senior leadership roles are favourably considered. Projects can also advocate for stronger women's representation at higher levels by encouraging female representation on the boards and in the senior management positions of the relevant service providers such as electricity companies and national providers.

### CONSTRUCTION

#### Test Installation

LED lighting technology has been identified as the key to improving energy efficiency and improved lighting services for many municipalities. This is a generic finding, however, and the applications of LEDs without any localised adjustments may result in unfavourable results or unintended consequences such as glare or light pollution. Test installations are therefore essential to ensure that technologies and infrastructure are suitable and ready to be scaled up to the full scope of a given project.

They also allow for gender equality and social inclusion considerations to be examined and monitored.

### OPERATION AND MAINTENANCE

#### Measurement and Verification (M&V)

Ensuring the proper operation of installed LED streetlights requires the verification and measurement of their energy and emission savings as well as their lighting performance. Typically, the implementation plan includes an M&V plan to be carried out as part of the commissioning process. Such a plan requires energy performance to be measured using internationally accepted protocols such as the International Performance Measurement and Verification Protocol (IPMVP), especially if the SLS is installed under a guaranteed savings scheme. In addition to energy measurements, lighting performance needs to be verified to ensure that the illumination levels and uniformity ratios comply with established standards and any other criteria established during the design and procurement process.

#### Fostering Social Integration Through Ongoing Collaboration with Beneficiaries

Social integration is a key positive impact of streetlighting and contributes to addressing the root causes of crime and gender-based violence. Improved streetlighting sends a positive message to inhabitants about the community's investment in the area, which thereby can serve to increase community pride, cohesion, and informal social control. However, social integration does not occur automatically. It is encouraged through the participation of targeted beneficiaries in various stages and levels during the project development and implementation phases, such as during public consultations, collaborative project management and decision-making, information campaigns, etc. Keeping beneficiaries informed on the investments being made in their neighbourhood and the anticipated impacts on gender equality, safety, and well-being is a good practice to promote social integration.

#### Build Local Technical Capacity for Ongoing Maintenance

Maintenance is often the weakest link of streetlighting projects in SSA.[10] SLS resiliency and sustainability being a key criterion for gender responsive streetlighting, projects must build local technical capacity for ongoing system maintenance. Maintenance

9. UN Women (2017) "The power of procurement: how to source from women-owned businesses", https://www.unwomen.org/en/digital-library/publications/2017/3/the-power-of-procurement.

10. Econoler (2020) Interviews with streetlighting project representatives, AFD project on Gender Mainstreaming in the Development of Streetlighting Projects, November.

responsibilities depend on the EE SLS contractual scheme (managed directly by a municipality, public entity, PPP, etc.). Beyond good design and implementation, the quality and consistency of s streetlight service depend on how well lights are operated and maintained. In certain locations, streetlighting system maintenance does not tend to be adequately budgeted or considered.

Poorly operated lights can result in lighting service gaps. For example, if the lighting system or a particular circuit remains off when it should be on, this results in poor, unavailable, or unreliable service even if the lights are functional; conversely, lights that remain on beyond their scheduled operational period result in additional electricity costs to municipalities. Similarly, poorly maintained lights can result in low-quality lighting services. For example, luminaires that are not cleaned or serviced according to a set schedule or if shading vegetation is not cleared deliver lower or uneven light levels, thus reducing drivers' and pedestrians' ability to see. Non-functional lights that are not identified or replaced create dark spots and uneven light, which visually impairs drivers and pedestrians.

LED technology has many advantages over older streetlighting technologies, including superior lifetime, which can also require adjustments to the typical maintenance regime, one of which is ongoing system cleaning and inspection. For some municipalities that use HID technology, the maintenance and cleaning of luminaires as well as trimming of vegetation occur when light bulbs fail – which occurs between 18 and 33 months (6 000–24 000 hours) after HID bulb is installed. Since LEDs last much longer, maintenance may not occur on a regular basis unless it is required as part of a rigorous maintenance scheme. Thus, municipalities switching to LEDs need to have additional training on maintenance needs and required practices for this technology.

Furthermore, certain municipalities do not conduct regular inspections or do not have a reporting system in place. These municipalities will need to institute such a system to be able to identify or receive reports on failures and replace failed lights in a timely manner.

#### MONITORING AND EVALUATION

The final project evaluation serves to assess results against the indicators defined in the M&E plan. Examples of target values[iv] are presented below. These should be systematically sex-disaggregated and include information on other intersectional identities.

- Number of beneficiaries of enhanced new streetlighting infrastructure.
- Number of street vendors and other businesses located in lit public places and markets.
- Reduction of crime and gender-based violence (to be evaluated separately from general crime).
- Number of project beneficiaries involved in or consulted (project consultations, collaborative project management, information campaigns, etc.).

The M&E results not only support the design of future gender responsive SLS initiatives, but also inform relevant stakeholders such as decision-makers, police forces, and community leaders to develop policies and procedures to address urban gender-based violence.

## Conclusion

The traditional urban approach to SLS design is focused on facilitating vehicular traffic with little consideration for low-traffic or pedestrian-only locations where women congregate and travel most frequently. This lack of consideration translates into unmet streetlighting needs for non-motorised road users who are mainly women, children, youth, the elderly, and vulnerable groups such as informal workers and the disabled, thereby generating inequality in the use of public spaces. In this sense, there is an urgent need for cities to design and implement inclusive SLSs that address women's, girls', men's, and boys' needs and priorities equally.

The above recommendations advocate for more inclusive systems, procedures, and staffing at the institutional level as well as more consultative and participatory design and planning procedures that will hopefully be mutually reinforcing. The work for fostering public buy-in and ownership of streetlighting projects as a public good will help reinforce not only a community's collective benefits, but also the individuals' benefits. Increased overall well-being among residents and improved security and commerce will lead to benefits at all levels (individual residents, the community, institutional, and municipal). Integrating energy efficiency and gender-equality concerns into streetlighting projects will help ensure the sustainability of projects and turn them into a useful lever for creating positive socio-economic benefits as well as safer and more inclusive cities for all citizens.

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