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JUST AND SUSTAINABLE MOBILITY TRANSITION IN THE TRANSPORT SECTOR: A CONCEPTUAL FRAMEWORK AND GENDER-MAINSTREAMING CASE STUDIES

Developed through the USAID-NREL Partnership's Electric Mobility and Sustainable Transport Pillar

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- Eliseo Esparza, Researcher I, Transportation Deployment Analysis Group, Center for Integrated Mobility Sciences, National Renewable Energy Laboratory (NREL)
- Carla Neudert, Director General of Energy and Climate Change Agency, Municipality of Hermosillo, Mexico.

List of Acronyms

NREL	National Renewable Energy Laboratory
USAID	U.S. Agency for International Development

Executive Summary

Decades of prioritization of roadways in global transportation infrastructure investments has over-emphasized designing one-size-fits-all public transit systems, resulting in widespread inequities in access, affordability, and reliability of transport options. These inequities have disproportionately impacted women, elderly minorities, and low-income communities. ***This publication highlights a just and sustainable mobility transition framework for transport practitioners and policymakers, with a focus on gender-mainstreaming considerations***.

With today's rapid global shift ***toward low-carbon transport,*** now is an opportune time to reimagine the world's transport systems through a holistic and sustainable approach, shifting to low- and zero-carbon modes and offering wider access to all segments of the population. Under the Strategic Transport Pillar of the U.S. Agency for International Development (USAID)-National Renewable Energy Laboratory (NREL) Partnership, this report ***proposes a conceptual framework*** that may, in the long term, enable just and sustainable mobility transitions in the transport sector. This framework focuses on five key impact areas (Figure ES- 1).

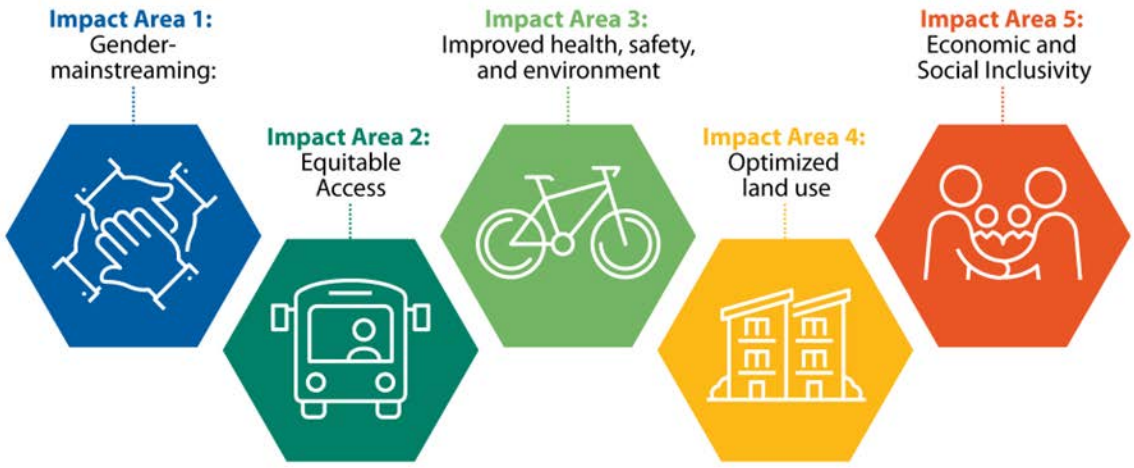

Figure ES- 1. USAID-NREL Partnership's conceptual framework for a just and sustainable mobility transition in the transport sector

- ***Gender-mainstreaming***: Developing more gender-inclusive mobility options by focusing on the needs and priorities of women travelers, prioritizing safety and access to employment opportunities, and providing more reliable, affordable, and time-efficient transport options.
- ***Equitable access*****:** New approaches to urban transport that links up with rural access, developing connectivity and economic opportunities for emerging cities and communities in an integrated and holistic manner.
- ***Improved health, safety, and environment*****:** Designing transportation systems, including active and non-motorized modes and minimizing the health impacts of transportation, including air quality, road safety, and personal safety.
- ***Optimized land use*****:** Rethinking how highly urbanized cities sustainably expand and grow road infrastructure and integrate low-carbon transportation solutions with wider availability to geographically and economically diverse communities.

- ***Economic and social inclusivity:*** Designing systems that create greater access and better first- and last-mile options for economically disadvantaged populations, with lower expenditures on transport as a percentage of income.

These five key impact areas were developed to facilitate actions by policy/decision makers and practitioners to incorporate equity into low-carbon transportation projects and programs. While many holistic and integrated approaches can be considered within this broader framework, this publication will focus on local ***gender-mainstreaming*** solutions by showcasing two regional case studies—from South Asia (New Delhi, India) and Latin America (Hermosillo, Mexico)—that describe novel pilot projects for introducing gender-inclusive transport options that address local challenges. Key challenges faced by women relate to physical safety, economics, and environment. Both case studies represent innovative programmatic solutions that address safety and employment opportunities for women while simultaneously working toward decarbonizing the transport sector and demonstrating replicable and scalable opportunities.

This publication also provides transport practitioners and policymakers with a compilation of key methodologies that can be adapted into new programs and initiatives that address gender-mainstreaming challenges (Section 4.0, Table 1). Proposed methodologies include generating gender-disaggregated travel data, efficient and safe first- and last-mile options, family fares for public transit, rethinking public transit for women's needs as caregivers, and inclusive road infrastructure, to name a few. These methodologies are aligned with regional needs, as showcased by those used in each case study. The USAID-NREL Partnership will continue to develop sustainable methodologies that foster gender-sensitive and human-centered designs for the transport sector.

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1 Conceptual Framework for a Just and Sustainable Mobility Transition

Decarbonization is only one of multiple objectives in a just and sustainable mobility transition. Modern, safe, and reliable transportation systems can increase social welfare and economic mobility by providing access to employment, recreation, and other opportunities that enable people to improve their quality of life and living conditions [30]. However, access to safe and low-carbon transportation services, and therefore to these essential opportunities, is currently unequal. Women and low-income populations face greater risks of accidents, sexual harassment, and violence during their trips [46]. In addition, women shoulder a larger proportion of caregiving burdens internationally; these burdens are often exacerbated by lack of safe or convenient access to public transit. Building on the challenges presented previously, rapid urbanization and motorization have placed enormous pressure on transportation networks in the Global South, resulting in further expansion of the transport disparities across the urban-rural spectrum. This pressure, coupled with insufficient urban planning and low investments in infrastructure and affordable housing, has led to high levels of traffic congestion, reduced social and economic mobility, pollution, and preventable fatalities in many cities and communities worldwide [46]. Therefore, these interconnected, complex challenges require integrated, people-centric solutions that reach beyond advancing to new technologies.

The USAID-NREL Partnership is focused on fostering gender-sensitive and human-centered designs for transport planning, operations, and the workforce, in conjunction with exploring the energy, emissions, and safety impacts of low-carbon mobility and accessibility solutions. To achieve a just and sustainable mobility transition in the transportation sector, key human dimensions for consideration include energy use and emissions from transportation, design of technologies, planning, policy, and finance, all of which impact the daily livelihoods of users of public transit. To facilitate the integration of just and sustainable transition goals into USAID-NREL's transport activities, we have developed a new conceptual framework highlighting ***five key impact areas and associated goals*** as considerations for new low-carbon transport projects and programs, which would enable reducing inequities in access and move the needle toward safe, reliable, and affordable transportation services for all. Figure 1 shows the USAID-NREL Partnership's conceptual framework for a just and sustainable mobility transition in the transport sector for which a series of publications will be developed, with gender-mainstreaming the focus of this publication.

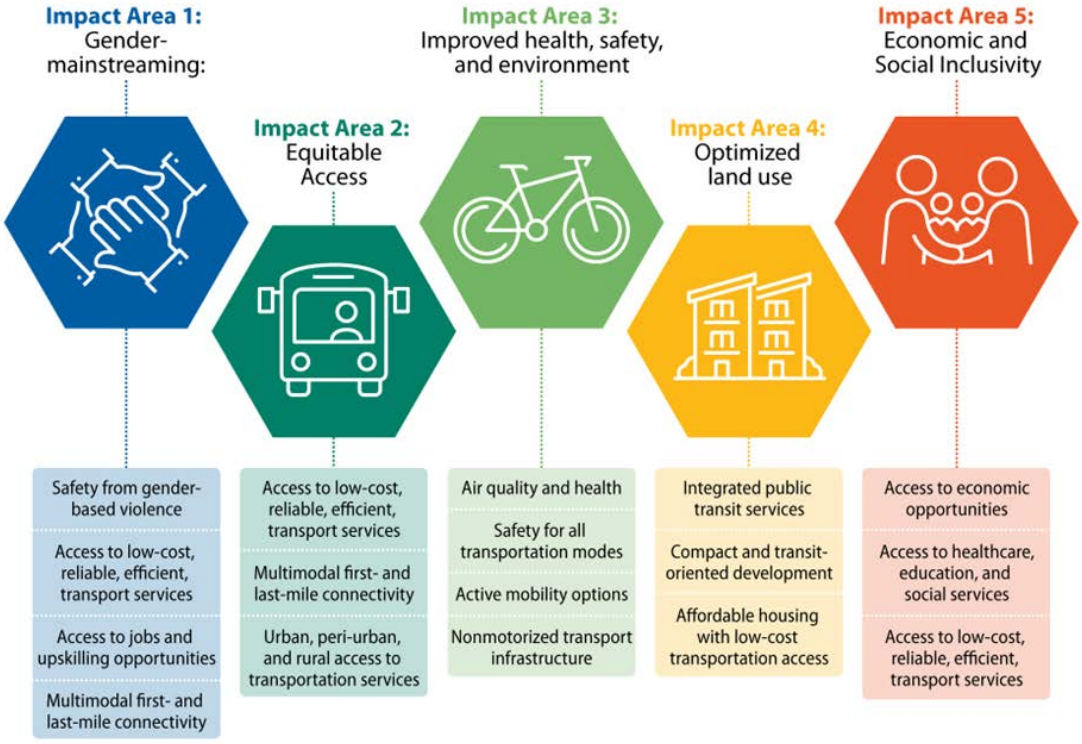


Figure 1. USAID-NREL Partnership's conceptual framework for a just and sustainable mobility transition in the transport sector

Many organizations have published detailed analyses and models for achieving a decarbonized transport sector, focusing on vehicles, fuels, workforce, and material supply chain considerations. However, developing practical and achievable goals that would lead to just and sustainable mobility transitions in the longer term is complex and nuanced and requires thinking through the lens of the traveler *in addition* to the vehicle. Our proposed five key impact areas were developed as foundational areas that align with just and sustainable mobility solutions.

Gender mainstreaming – Focusing on the priorities and needs of women is a key inclusivity tenet that could lead towards a more just transport sector. Primary themes under this impact area include increased safety from gender-based violence, access to low-cost transport services, efficient first- and last-mile options and workforce opportunities – as an aggregate these solutions address women's critical challenges in the transport sector – safety, access and employment opportunities (more details in Section 2.0) [33] [34] [35].

Equitable access – This impact area focuses on creating equitable access to jobs, health, education etc. for all segments of the population. Recent studies have shown that the first- and last-mile mode impacts access to transit and strategies need to account for local needs [36]. In Asia, the use of public transit has been declining in recent years and addressing access to transit is a key emissions reduction strategy as well [37]. Key solutions are low-cost transport services, first- and last-mile connectivity and bridging urban-rural access disparities.

Improved health, safety and environment – Globally, many low-income populations are disproportionately affected by poor air quality and lack access to active and non-motorized mobility options, resulting in a compounding negative impact on their health and well-being. Creating a variety of mobility options such the option to walk/bike and use non-motorized modes that are safe can lead to an equitable, resilient transport services that are also low-carbon.

Optimized land use – Today's highly urbanized cities are continuing to expand road transport infrastructure as cross-border trade, connectivity and economies grow [37]. This trend away from transit and rail in favor of road transport could result in congested roads, higher emissions and reduced access. These impacts can be mitigated by better land-use strategies such as transit oriented development, integrated transport services and developing affordable housing with access to low-cost efficient transport systems.

Economic and social inclusivity – An estimated household transport budget of 10% is an indicator of poverty [38] [39]. Developing low-cost, energy efficient, integrated transport systems that increase access to better economic opportunities and basic services can result in social inclusivity and economic growth.

Working to optimize these key areas can positively impact and resonate across every segment of the population. For example, a transport project that aims to address "energy-efficient first- and last-mile connectivity" can support gender-mainstreaming goals, bridge urban and rural access, and lead to economic opportunities. The themes across the five impact areas align with interconnected and synergistic options that can be addressed with a systems-based planning approach.

In this publication, we explore the impact area of gender-mainstreaming in the transport sector. Our goal is to support an accelerated uptake of gender-mainstreaming approaches for the transport sector. ***Women represent the largest group experiencing inequalities in transportation systems, resulting in lack of access to economic opportunities and safe mobility to support their priority needs [40]***. Therefore, viewing through a gender-based lens helps highlight opportunities to design just transitions for low-carbon transportation for a significant proportion of the population.

Efforts to increase access to low-carbon transportation must look beyond the location of charging stations and focus on the needs of people that use transportation services daily. Such needs include caregiving trips (70% of which are taken by women or girls, globally); traveling with young children and/or goods; "trip chaining," or making multiple stops in one trip; and traveling in off-peak hours or to noncommercial destinations, all of which are less well-served by public transport and typical commuter-targeted transportation services.[1] More troubling is the fact that the majority of women fear for their safety due to sexual harassment and gender-based violence, which could occur on public transit or nonmotorized trips.[2]

For countries prioritizing a just transition, it is critical to remove these barriers to accessing low-carbon transportation options. Additionally, as countries focus gender-mainstreaming strategies, they would also need to assess employment opportunities for women in the transport sector, with considerations for supporting more women decision makers to join the transport workforce (across many dimensions), positioning them to bring in new innovative ideas and contribute and lead on technical, policy, and social solutions that are needed to address the clean energy transition in the transport sector.

[1] https://www.itdp.org/2022/04/19/from-commuter-to-care-public-transports-role-in-creating-the-new-normal/

[2] https://womenmobilize.org/towards-safe-and-empowering-streets-and-public-transport-systems-for-women-and-girls-in-latin-america/

2 Global Transport Sector Gender-Mainstreaming Challenges

Advancing the status of women and girls is not only a matter of human rights, justice, and equity—it is also a strategic and development-centered imperative that can reduce poverty and promote sustainable economic growth, increase access to education, improve health outcomes, advance political stability, and foster democracy [46]. Women are key stakeholders in the global clean energy transition and must be included in the global movement toward gender-transformative projects, programs, and policies that will accelerate universal energy access and address climate change more equitably. Transportation, as the most energy-intensive sector, is particularly important in this discussion. Transportation and accessibility are central topics for empowering women and bettering their lives and the lives of their care recipients and community members. Transportation system design can become safer and more user-friendly for women and disenfranchised groups, all while building women's confidence in considering different mobility options. This section offers a deep dive into the gender-mainstreaming opportunity space for a just and sustainable transition in the transport sector—through regional case studies, discussion, and new insights into the significant challenges and opportunities for developing low-carbon, sustainable transport options that support the needs of women. Gender inequality is a global problem [27], but it is more profound in developing countries—with far-reaching impacts. Most transport programs and policies are "gender-blind," meaning that it is assumed that benefits will automatically flow equally to men and women if there are well-designed policies, programs, and initiatives in place. This assumption is incorrect, and many well-intentioned projects and policies leave women behind. Currently, transport institutions' design, planning, and operations fail to recognize the specific mobility needs of women and girls [41].

Globally, women are more frequent users of public transit systems than men, and in developing countries, a vast majority of women rely solely on it as their only accessible, affordable choice of transport [42]. For this reason, unsafe conditions can result in significant losses in opportunity, increased monetary costs, time-inefficient trips, and, most importantly, physical harm. Women endure many forms of unsafe conditions in public transit—emotional, verbal, and physical abuse—and, in some extreme cases, even fatalities have been reported. A recent survey of 15 global cities revealed that about 60% of women travelling in public transit in cities such as Mexico City, Bogota, and Lima have experienced sexual harassment, making Latin America the world's least-safe region for women on public transport [28]. It is also believed that many incidents worldwide are underreported due to women experiencing apathetic responses from local authorities.

Global Challenge: "Women are three times as likely to be concerned for their safety on shared modes of transit, and as a result, choose longer, more costly, or less-efficient transportation options."

The physical and psychological impact of gender-based trauma can result in lifelong preferences for cars or taxis instead of public transit or bikes. Moreover, 61% of caregivers are women; escorting children or the elderly further reduces travel options and adds costs [3].

Safety is the foremost gender-mainstreaming consideration in designing inclusive transportation projects and programs. Unsafe conditions are the most important parameter when selecting a mode of travel. A recent study in the United Kingdom revealed a ~10% projected increase in railway travelers if safe conditions were guaranteed while waiting at stations [29]. Therefore, safety is not simply a goal that would result in more women taking public transit, but is also a key strategy for decarbonizing the transport sector; shifting to public transit and limiting the need for personal vehicles is an important step in reducing emissions [29]. Additionally, global development metrics consider car ownership as an indicator/measurement of development. Considering new indicators such as "safety in public transit" could accelerate a transition to inclusive transport systems. While global changes have been slow to progress, local governments are spearheading solutions that best fit their local contexts. Section 3 of this

publication showcases two regional case studies in which local authorities developed solutions to increase safety for women via innovative, low-carbon transport and infrastructure solutions, resulting in far-reaching positive impacts to overall local communities.

The global economy stands to benefit from equal participation opportunities for women, and enabling a safe transport sector for women would enhance women's participation in the global workforce. Achieving this goal requires an understanding of the types of employment opportunities women seek (i.e., understanding the local context) and their complex travel patterns, as well as understanding that the ***lack of safe transport is a significant barrier to accessing education, health care, and jobs*** [29] [43].

Global Challenge: "Women are one-half of the world's population but only contribute to 37% of the global GDP. An economy cannot operate at its full potential if half of its population cannot fully contribute to it" [20]. Lack of access to safe transport has been identified as a barrier that limits economic opportunities for women.

Transport is not a gender-neutral sector, and many studies have shown that men and women have distinctively different travel needs and patterns [44]. ***Lack of gender-disaggregated data*** is a barrier to better understanding women's needs under each local context. These local contexts for women often focus on caregiving and inefficient transport options, and a lack of connectivity restricts the movement of women and leads to a general loss of opportunities.

Global Challenge: "In the U.S., women represent 61 to 75% of caregivers and may spend 50% more time providing care than males, and are more likely to travel with strollers, wheelchairs, or groceries" [14].

"Yet the design of most transportation options almost never takes this into account: bike share lacks baby seats; car share rarely offers car seats; many train stations lack elevators; fares are per person, not per party; trips with multiple stops are harder to plan." Most current electric micro-mobility riders are men; 76% of buyers in California, America's biggest electric vehicle market, still identify as male, with no real change in gender split (across the United States and China) [6].

Women are also typically underrepresented as employees in the transportation sector and in leadership roles—for example, in jobs such as driving, construction, engineering, managers, and project leads. A survey across 46 countries shows that, on average, only 17% of transport sector employees are women [31]. This disparity exists even though women offer diverse perspectives, skill sets, and experiences that are proven to enhance ideation, problem-solving, and positive impacts to business revenue. When women are given equal opportunity to bring their unique skills, experience, and leadership to bear across key transport sector institutions, they can strengthen collective decision-making, accelerate innovation, and drive dynamic solutions to meet urgent global challenges. Alternatively, this means that if planning and implementation processes in the transport sector do not take the different needs and concerns of women into account, projected benefits for women may not be realized, and negative unintended consequences may occur.

The sources, impacts of, and potential solutions for gender injustice, vulnerability, and just transitions in transportation are complex and far-reaching. Many injustices are rooted in broader social issues yet are apparent in the transport sector, and these injustices can be practically addressed within transportation systems through targeted interventions. The next section explores practical, on-the-ground solutions that address gender-focused challenges in the transport sector.

3 Regional Case Studies Demonstrating Gender-Mainstreaming Actions in the Transport Sector

3.1 Case Study 1: Advancing Women-Driven Electric Rickshaws in Delhi, India

3.1.1 Piloting a Gender-Inclusive Transport Project With a Focus on Addressing Safety, Access, and Opportunity

In 2021, in an attempt to tackle Delhi's notorious air pollution and simultaneously make India's transport system safe and gender-inclusive, the Transport Department encouraged more women to apply for permits to drive electric rickshaws by designating that 33% of the issued 4,261 e-auto rickshaw permits would be reserved for women applicants. The goals of this initiative were threefold: to encourage more female drivers to seek employment, create a safer travel option, and mitigate air pollution [9]. To differentiate the gender of the driver, the e-rickshaws driven by males are painted blue, and those driven by females are lilac [32].

Figure 2. Woman electric rickshaw driver (left) and typical traffic congestion in Delhi (right)

Source: [32]

3.1.2 Understanding the Local Context

Developing gender-inclusive transport sector strategies and impactful actions requires a deep understanding of unique local contexts and a historical perspective of the social and economic constructs within communities that have led to present-day inequalities in the transport sector. These perspectives can enable the development of sustainable gender-mainstreaming programs and initiatives that integrate with the local communities. Delhi's local context includes:

- ***Delhi is a rapidly growing city***, with an estimated population of 32 million in 2023 and a high urbanization trend with rapid motorization (almost 600,000 new motor vehicles sold in 2022 and 10 million-plus vehicles in Delhi today). This creates significant congestion and demands on infrastructure, often outpacing municipal capacity to keep up with service planning and management—leading to inadequate, poor-quality transport, in addition to other services (e.g., electricity, water, sanitation, housing) [45].
- ***Delhi is also known for its high levels of air pollution*** and has an annual average of PM 2.5 per cubic meter that is 15 times above the safe limit set by the World Health Organization. Despite the travel disruptions during the COVID-19 pandemic and a "next normal" that significantly (but briefly) transformed transport demand, congestion, and air quality, poor air quality continues to impact the everyday lives of Indian citizens. Evidence regarding the health and cost impacts of air pollution abounds [1], from 10,000 or more premature deaths each year in Delhi, to estimates for the high transport costs associated with accessing health care for ill citizens or those accompanying patients with pollution-related cardiovascular and respiratory illnesses [2]. Some have estimated that PM 2.5 pollution in India resulted in an economic loss of USD $2.2 billion per year [3].
- ***Delhi's gender challenges are intertwined with transport and pollution,*** with women and girls disproportionately affected by the health impacts of air pollution, lack of clean energy/transport access, and

poor indoor air quality. Recently, USAID's Clean Air Catalyst Program and Gender Equality and Women's Empowerment Hub completed a gender analysis to ascertain the disparities in the impact of the transport system on women. The analysis showed that gender inequalities start at home, with women and children often taking public transportation or walking, thus being more exposed to air pollutants and safety issues. This analysis further showed that 37% of women walked to work, while only 27% of men did so. Furthermore, poor indoor air quality due to the use of various biomass fuels for cooking have resulted in reduced lung capacity, rendering women more vulnerable to air pollution challenges. In Delhi, "51% of women had faced some form of harassment while using public transport, and 42% while waiting for as stations/stops" [21].

3.1.3 Replicable Gender-Mainstreaming Transport Actions and Accomplishments

This case study focuses on overcoming the interacting challenges of urbanization, motorization, pollution, and gender issues in Delhi's transport sector. With multiple transport trends heading in less-sustainable directions (e.g., congestion, greenhouse gas emissions, safety, energy inefficiency, and wasted time and costs) and each area presenting its own individual challenges, an integrated solutions-oriented focus and framework can be offered by starting with novel ways to increase women's economic opportunities. This women-driven e-rickshaw service is a local solution to one of the most important gender-mainstreaming goals: safety and empowerment. By color-coding the rickshaws, passengers can easily recognize the gender of the driver, which creates more trust among the general public. Women feel safer when riding vehicles driven by other women. Additionally, the e-rickshaws will result in reduced air pollution in the highly congested urban environment, thus working as a transport decarbonization strategy as well.

Replicable actions from this case study include:

- **Prioritized investments**: Leveraging initial significant e-mobility investments in an integrated and inclusive way by designating and prioritizing women-owned electric rickshaws. This solution not only addresses women's safety and access issues but creates new economic opportunities as well.
- **Access to new income and job opportunities**: Incentivizing fuel-efficient electric rickshaws and introducing the vehicles into the domain of public transit options creates safer travel options for women and generates access to jobs and higher wage opportunities for low-income and informal economy workers.
- **Challenging gender norms** (autos are typically driven by men): Opportunity to have gender-transformative impact by challenging gender norms as well as enabling methods of obtaining gender-disaggregated data on commuter preferences and perception of safety.
- **Women-owned and women-driven transport services** result in increased sense of agency for women, through ownership of assets and income independence.

"Our aim is to make a public transport system which is conducive for women passengers and the most effective step to do that is to create a system steered by women themselves. Delhi will continue to empower its women both socially and financially."–Delhi Transport Minister, Kailash Gahlot [9]

"Delhi's public transport sector is undergoing a metamorphosis of sorts—one that aims to make it more gender equal and environmentally friendly. After nearly two decades of having just a lone woman auto-rickshaw driver [10], Delhi now has 500 more women drivers, and also the highest number of electric autos in any state in India, with the government issuing permits to 3,500 e-auto owners, 500 of whom are women."–[11]

3.2 Case Study 2: Gender-Focused Bicycle and WalkSafe Program in Hermosillo, Mexico

3.2.1 Advancing Gender-Inclusive Pilots With a Focus on Illuminated Safe Streets

Hermosillo is a rapidly industrializing city that includes three industrial parks, creating much-needed job opportunities for local communities as well as women workers. However, lack of safety for women workers traveling to work and home is a significant barrier to taking advantage of these new economic opportunities. To combat this challenge, the Municipality of Hermosillo developed and implemented a novel pilot program called the WalkSafe program. This program consists of the installation of bollard-type luminaires on paths, at bus stops, and other locations identified as "dark spots" where increased street lighting was observed to be beneficial (as shown in Figure 3). With an investment of 1.2 million pesos (USD ~$67,000), the city increased public lighting maintenance and added continuous surveillance (with video surveillance cameras, including panic buttons directly linked to municipal public security), as well as access to free internet and Wi-Fi along 10 different routes with 200 bollards installed to date.

Figure 3. Bollard-type luminaires lighting up the streets of Hermosillo, Mexico (left), led to increased confidence in women travelers using public transit and walking (right).

Sources: [22] [23] [24]

3.2.2 Understanding the Local Context

In the city of Hermosillo, more than 42% of the city's population is economically active women, resulting in 200,000 women working away from home, making safety during travel an important criterion for women to continue to be employed. Unfortunately, Hermosillo is also a city where women are constantly warned of gender-based violence, and many local programs have been developed for added security to support women's safe passage to work and home. Hermosillo's local context includes:

- ***Significant safety risks posed to women, as travelers or operators of transportation.*** Oftentimes, workplace hubs and transit or walking corridors are sites of significant incidences of violence toward women. Observations of the environments surrounding crimes committed shows that a key barrier is the lack of streetlights, including by parks and transit hubs used for work commutes.
- ***Public transport is the second-most-common location where sexual violence against women in Mexico is perpetrated.*** To help remedy this problem, World Bank recently invested over $700 million in Mexico, focused on boosting women's economic opportunities across the country, with the aim of increasing safe access to jobs, in addition to setting up processes to improve safety on public transport and prevent gender-based violence. [25].
- ***Rapid economic growth*** in Hermosillo has made the city a competitive location for industries, creating new job opportunities [26]. Much effort is needed to support and enable women's access to these new opportunities via safe travel to job sites.

3.2.3 Replicable Gender-Mainstreaming Transport Actions and Accomplishments

This case study addresses the foremost barrier for women in transport systems—safety—and utilizes new infrastructure, like lighting and access to W-Fi to enable more women to safely participate in Hermosillo's thriving industrialized economy. The WalkSafe program has resulted in women's increased confidence in public transit and has also resulted in unexpected co-benefits, such as *safety through community gathering and reduced transport emissions*. The ability to access free Wi-Fi has increased community gatherings, as neighbors started to gather to watch games on their phones, and resulted in increased confidence in women and children using public transit and walking. Furthermore, assessing the success of the program through an opinion poll revealed that the behavior of social groups is measurably changing, and those who used to travel by personal vehicles for short trips are now walking. This program has resulted in the co-benefit of reducing emissions in the transport sector through reducing vehicle miles traveled by shifting to an active mode (i.e., walking). A notable point for this case study is that this initiative was designed and developed by a woman in a leadership role in the Municipality of Hermosillo, exemplifying the insightful and unique skills and personal experiences that resulted in a successful local program. We previously discussed the importance of women in leadership roles in Section 2.0.

> **"The WalkSafe Program is already generating a positive impact on the local community. Free Wi-Fi access is changing the dynamics of how people interact, increasing neighborhood coexistence, student homework in public places to gatherings of people watching baseball games in parks, creating the collateral benefit of doing that well-lit areas are safe for gatherings and more comfortable for women and families to walk and wait for public transportation to arrive."** Carla Neudert, Director General of Energy and Climate Change Agency, Municipality of Hermosillo, Mexico

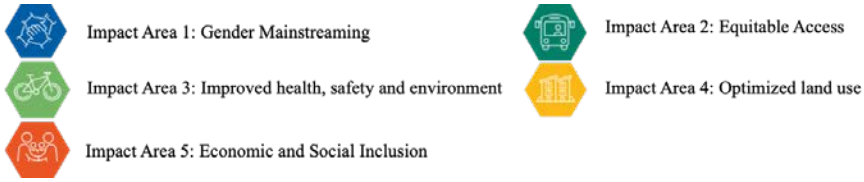
Replicable actions from this case study include:

- **Collecting and analyzing local crime/incident data,** such as incidents in areas surrounding manufacturing/employment facilities and common commuting routes of women employees. Analyzing the data to identify patterns and hotspots of criminal activities enabled the implementation of targeted safety measures.
- **Improving lighting infrastructure,** such as evaluating existing lighting and addressing areas with poor lighting coverage, which can be potential safety hazards. Video data and sensors can help optimize lighting patterns and reduce energy use.
- **Engaging communities** to provide input on safety risks and lighting needs. Also, informing community members of improved lighting and technology for incident monitoring/reporting for safer public transport and collaborating with law enforcement agencies (e.g., surveys, focus groups).
- **Tracking success.** To date, no damage to the lighting infrastructure has been reported, which means that the community itself is caring for them. Plans are being made for this effort to expand to an additional 30 points in the city by the end of the year.
- **Setting the stage for local programs with national mandates.** In 2021, the National Commission to Prevent and Eradicate Violence Against Women—part of the Ministry of the Interior—issued a Declaration of Alert for Gender Violence Against Women for the entire state of Sonora, and specifically for six of its most-challenging municipalities, which includes Hermosillo. This issuance compels the City of Hermosillo to initiate and implement safety interventions for women and girls in Sonora.
- **Supporting legal frameworks** that advance these initiatives. For example, the WalkSafe program depended upon an agreement by the Municipal Energy and Climate Change Agency, was published in the Official Gazette of the Government of the State of Sonora, and was then included in the Municipal Development Plan 2021–2024 and the General Law of Mobility and Road Safety.
- **Enabling women to attain leadership roles**. This program was *initiated by a woman for the women in her community*, thus exemplifying the unique skills and experience brought by women as project leads.

4 Discussion and Outlook

As discussed in the USAID-NREL Partnership's conceptual framework (Section 1.0) for just and sustainable transitions in the transport sector, developing new programs and initiatives with a focus these five key impact areas (Figure 1) can result in positive impacts, particularly for women. This publication provides transport practitioners and policymakers with a compilation of key methods that can be adapted and utilized for new programs and initiatives that address local transit challenges, as shown in Table 1.

Table 1. Methodologies for Improving Gender-Mainstreaming for Transportation Systems



Methodology	Projected Impacts	Impact Area
Design shared, electric, and connected micro-mobility (i.e., bikes, e-bikes, e-scooters, rickshaws) and (micro) transit (e.g., on-demand vans) for women's travel needs	Expansion of e-rickshaw, van, and other two- and three-wheeler electrified micro-mobility fleets will enable women to travel safely between more common destinations.	
Modify public transit for women's travel needs	Addition of women-only areas on buses and trains with new designs to accommodate strollers, wheelchairs, and grocery bags, and focusing deployment on off-peak, shorter-range, or multiple-trip purposes (e.g., not just commutes, but convenient public mobility options to reach schools, health care, grocery shopping, etc.) will more directly center women's specific travel needs.	
Introduce app-based inclusive trip planning with safety and caregiving considerations (i.e., location-sharing and crowdsourced marking of dangers)	Support the utilization of a variety of transportation modes by women while being updated on dangerous situations. If a threatening situation arises, women can hit a panic button to broadcast their location and live video feed to authorities and designated contacts. Women will be able to see and avoid areas where the panic button is frequently deployed.	
Upgrade mobility/transit hub infrastructure	Safe transit hubs, bus stops, train platforms, and nearby corridors with sufficient lighting will be updated to make women feel safe, especially in off-peak hours or nighttime when fewer people are nearby. These facilities will also include clean public bathrooms in accessible and well-lit areas.	
Use gender audit tools to provide detailed assessments of the impact that major projects will have on women	Audit tools will ensure that major projects provide for women's needs (like the U.S. Green Building Council's LEED certification) and would help measure gender inclusion as a core planning consideration, rather than as an afterthought or	

Methodology	Projected Impacts	Impact Area
	with no thought as clean energy for transport and new mobility options emerge.	
Introduce family fares	Family fares will not only save the family money, but they will also streamline the payment and boarding process. This could increase ridership during off-peak hours, as families are less likely to travel during peak hours than single commuters.	
Integrate active transport with public transit	The first/last-mile gap will be filled with a wider array of options, including walking and cycling to the bus, making public transit more accessible to all.	
Build safe and well-lit continuous sidewalks	Making active mobility a priority for small trips, walkable cities, first/last-mile connectivity supports women's caregiving responsibilities.	
Collect gender-disaggregated travel data	Acquisition of appropriate data that reflects the mobility patterns of women will support the development of new programs and initiatives.	
Provide transport sector workforce development, technical training, leadership, and upskilling programs	Helps women attain skills needed to enter into the workforce within the transport sector and also advance their existing careers.	

Projected impacts are noted adjacent to each methodology to inform and advance the development of key metrics that can be monitored over time, along with the impact areas onto which each method maps. This information can inform and shape policy objectives, implementation of pilots and programs, and ongoing evaluation and monitoring to ensure long-term sustainability and enable scalability.

Our proposed gender-mainstreaming methodologies are aligned with regional priorities, as showed in this publication through the two regional case studies that represent two different solutions for improving safe transportation for women in two very different local and cultural contexts, which resulted in positive impacts to women as well as the wider local communities. The Delhi case study focused on generating new employment opportunities through a targeted permitting process for electric rickshaws, with the goal of making public transit safer and cleaner. The Hermosillo case study focused on adding infrastructure such as lighting, sensors, and free Wi-Fi that increased safety and confidence of women in transit and also generated a more cohesive local community, along with avoiding vehicle miles traveled. In both cases, the positive impacts were more far-reaching than anticipated and resulted in *reducing transport sector emissions*, even though the primary focus of each of the initiatives was not vehicles.

As global gender-mainstreaming strategies expand, the right to safety, provision of resources for observing and mitigating injustices, and representation of women in co-designing and allocating budgets, as well as authority for those working toward solutions, will be critical to delivering multiple just and sustainable mobility transition benefits.

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