*Photo: Courtesy of City of Vernon*

# Equity Impacts in Shared E-scooter Programs:

## *A Case Study of Vernon*

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# Contents

## Executive Summary

This report is structured into two parts, the first part reviews literature and policies across North America to identify equity requirements of shared e-scooter programs and the second part investigates the equity impacts of the shared e-scooter program in Vernon. In Vernon, the e-scooter program was initiated as a three-year provincial pilot in 2021. The City recently extended the contract with the current Provider to Dec 31, 2024. The program aligns with the City's Climate Action Plan and the 25-Year Master Transportation Plan, aiming to enhance mobility, reduce car trips, and reduce emissions, among other benefits. Vernon's current Provider reported that 40% of e-scooter trips replaced car trips and 21% of trips would not have been made if e-scooters were not available, underscoring the potential of e-scooters to improve urban mobility.

Equity requirements in shared e-scooter programs are crucial to ensuring that everyone receives adequate service, particularly underserved communities. Common equity measures include discount programs, equitable geographic distribution, non-smartphone access, cash payment options, multilingual services, targeted outreach, and adaptive vehicles. These requirements ensure that all residents, particularly those from equity-seeking communities, benefit from shared e-scooter programs.

The operational structure of shared e-scooter programs typically involves a permit or license system. Public-private partnerships have proven effective in enhancing program outcomes, especially regarding equity. Effective cost and revenue management strategies can help the city offset program costs and reinvest revenue into infrastructure improvements and equity initiatives.

The primary objective of this project was to evaluate the equity impacts of Vernon's shared e-scooter program. To achieve this, we created equity and transportation access maps using Census 2021 data. Additionally, we analyzed community survey responses and the Provider's trip data. Our findings indicate that e-scooter users tend to be younger and perceive e-scooters as enjoyable and safe, expressing a preference for program continuation. While users and non-users reside in neighborhoods with similar deprivation levels, users typically live in areas with better transportation access. Furthermore, our trip distribution analysis revealed that trips are more frequent in equity-seeking neighborhoods and regions with better walking and transit accessibility. The proximity of trip end locations and young users' residences to schools highlights the potential for facilitating e-scooter access for youth, given their demonstrated interest in using e-scooters from the community survey. Pricing discounts during 'Go By Bike' week increased trips and overall usage modestly, highlighting the potential impact of such initiatives on program engagement given adequate promotion.

## Key Recommendations

- **Identify Mobility Needs and Equity Goals:** Adopt a partnership model that reflects the city's specific mobility requirements and equity objectives. Implement an equity evaluation framework to assess the impact of shared e-scooter programs post-implementation.

- **Adopt a Flexible Permit System and Engage in Partnerships:** Merge a flexible permit system with public-private partnerships, allowing for adjustment to the current e-scooter program. Encourage Provider's involvement in infrastructure improvements and offset costs for low-income passes through strategic incentives.

- **Evaluate Continuously:** Mandate that Providers regularly provide data to the city, facilitating ongoing operational improvements and shaping future programs. Employ both real-time and standardized data sharing for robust evaluation and regulatory compliance.

- **Conduct Targeted Outreach:** Enhance the visibility of discounted fare programs through strategic partnerships with local community organizations, aiming to boost program participation.

- **Ease the Burden on Low-Income:** Simplify the verification processes and enforce more affordable pricing in equity-seeking neighborhoods to make current passes more accessible.

- **Implement Joint Requirements to Address Multiple Barriers Simultaneously**: This includes providing alternative access options for individuals without smartphones or credit cards. Additionally, we suggest ensuring a minimum fleet in underserved neighborhoods and offering discounts for trips starting in those areas.

- **Expand the User Market:** Incorporate adaptive vehicles to cater to the needs of older adults and incentivize e-scooter integration with other sustainable transportation modes, potentially offering subsidized rides connected to public transit.

- **Subsidize Rides in Equity-Seeking Neighborhoods:** Offer discounts for rides originating/terminating in equity-seeking neighborhoods to increase usage and support equity goals.

- **Provide E-Scooters Where Transportation Access is Limited:** Promote the use of e-scooters in areas with limited transportation accessibility by ensuring a fair distribution of vehicles.

# 1. Lessons for The City: Equity Requirements in Shared E-scooter Programs

## 1.1 Shared E-scooters In Vernon

Recent studies have shown that shared e-scooter trips are typically short, with the average distance ranging from 1 to 4.7 km (average duration of 7.6 to 20 minutes), and can replace 8% to 52% of car and ride-hailing trips, depending on the context [1]. In addition to reducing car trips, e-scooters offer other benefits such as promoting physical activity, providing cost-savings [2], and emission reductions [3]. Recognizing these advantages and in line with the City's Climate Action Plan [4] and 25 Year Master Transportation Plan [5], Vernon has adopted a shared e-scooter program as a part of a three-year provincial pilot initiated in 2021. The City has renewed the current Provider's permit until Dec 31, 2024. The current Provider conducted a survey across six cities in Canada, including Vernon. The survey revealed that 50% of e-scooter trips are commutes or trips connected to transit [6]. Specifically, in Vernon, 40% of trips replaced car trips and 21% of trips would not have been made if e-scooters were not available [7], further emphasizing the potential of e-scooters in enhancing mobility.

## 1.2 Shared E-scooters Can Address Equity Gaps

This report delves into the equity impacts of shared e-scooter programs in the context of Vernon. The equity implications of transportation are complex and multifaceted [8]; the quality of transportation modes can influence accessible economic opportunities, travel costs, and disproportionate concentration of vehicular emissions. For instance, residents of Metro Vancouver spend up to 49% of their income on housing and transportation [9], while affordable transportation requires less than 45% of household resources to be allocated to housing and transportation [10].

Shared e-scooter programs have the potential to address certain transportation equity issues. For instance, one study discovered that the gender gap among shared e-scooter users is smaller than that of shared bike users [11]. Vernon's Provider also reported a smaller gender gap among e-scooter users in their Canadian market (57% male users and 40% female users) [12]. Consistent with these findings, a 2023 community survey conducted by the City reveals that e-scooter users are evenly distributed across genders (see Figure 1). E-scooters are also generally more supported by low-income individuals [11]. In Vernon, shared e-scooter users tend to have lower incomes compared to non-users (see Figure 2). However, there is a lack of evidence in the literature regarding the equity evaluation of these programs post-implementation [13], [14].

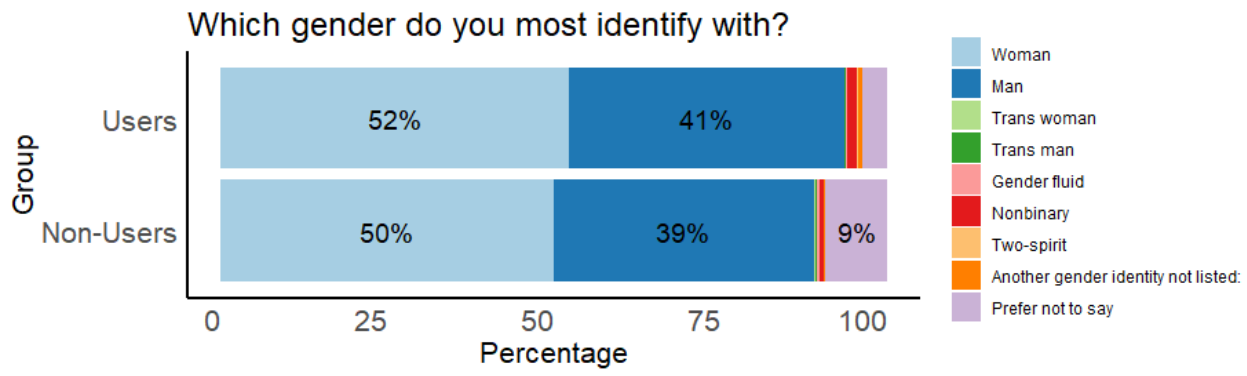


**Figure 1. Gender distribution among shared e-scooter users and non-users in Vernon, drawn from the community survey conducted by the city in 2023.**

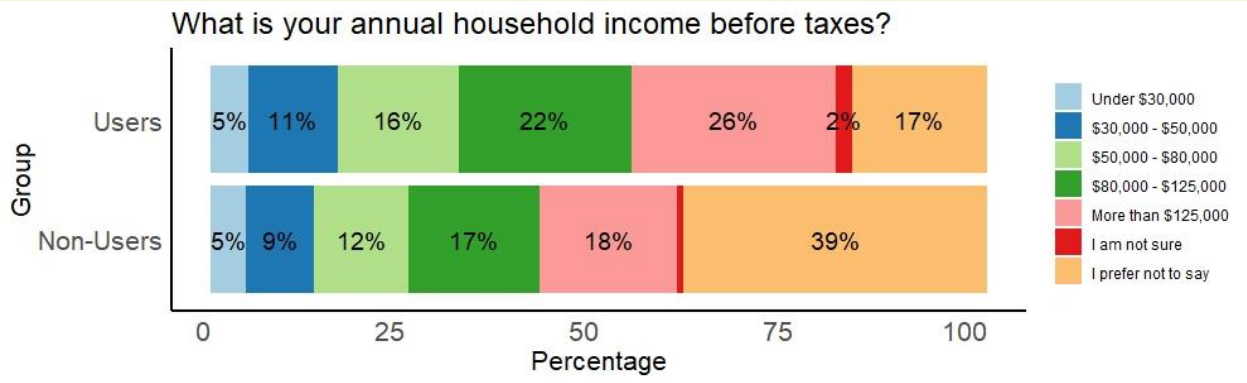


**Figure 2. Income distribution among shared e-scooter users and non-users in Vernon, drawn from the community survey conducted by the city in 2023.**

The first part of this report seeks to understand the **equity requirements** essential for shared e-scooter programs, drawing on a comprehensive review of the literature and established best practices from across North America. We also explore the **operational frameworks** of these programs to pinpoint key strategies for creating successful partnerships, particularly highlighting the role of public-private partnerships (P3). The first part concludes with a set of recommendations tailored for the City of Vernon and informed by our literature review and policy scan.

## 1.3 Equity Requirements Improve Access and Affordability

Equity requirements form a crucial component of agreements between private providers and cities. In the absence of such requirements or incentives, providers might primarily serve neighborhoods already equipped with several transportation alternatives, potentially neglecting the mobility needs of equity-seeking neighborhoods [15].

In the US, at least one equity requirement is present in 62% of shared micromobility programs [14]. The median number of equity requirements in North America stands at four [16]. Similarly,

our policy scan reveals that at least 60% of Canadian communities with shared e-scooter programs have implemented one equity requirement. The most prevalent equity requirement is discount programs [17] (see Figure 3). Major providers offer discounted pricing structures, irrespective of the specific city-provider agreement [18]. Similarly, Vernon's Provider has an access program that offers discounted prices for low-income individuals.

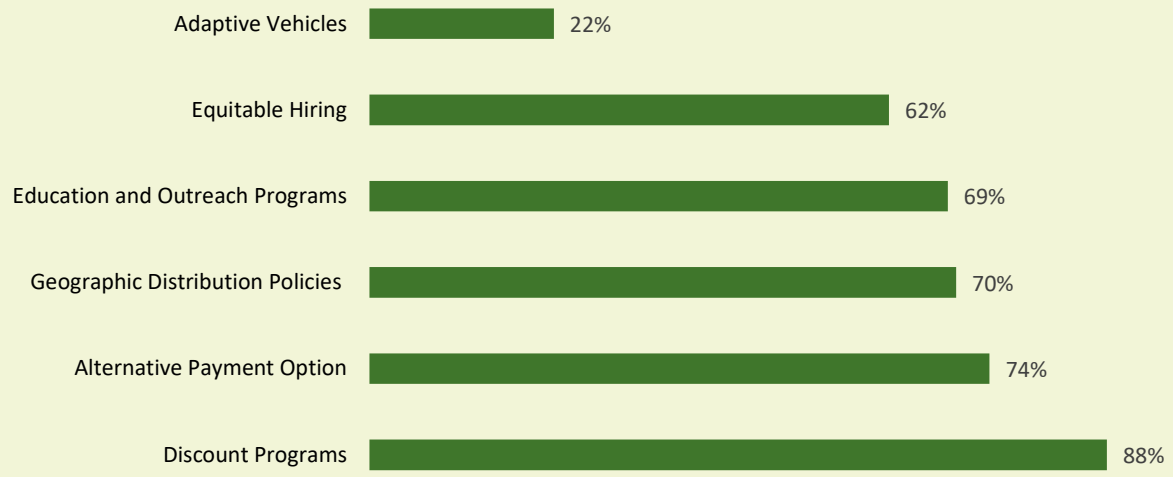


**Figure 3. share of equity programs in shared micromobility programs in North America, source: [17].**

**SECTION IS REDACTED FOR PUBLIC USE.**

Apart from discount programs, cities commonly implement the following equity requirements [14], [20]:

- Equitable geographic distribution
- Non-smartphone access
- Cash payment
- Multilingual services
- Targeted outreach and marketing
- Adaptive vehicles[1]

For an overview of case studies for equity requirements, please see Appendix A.

**FIGURE 5 IS REDACTED FOR PUBLIC USE**

## 1.4 Operational Structure of Shared E-scooter Programs

[1] Based on BC electric kick scooter pilot project regulation, the Provider must be in a standing position (available at https://www2.gov.bc.ca/gov/content/transportation/transportation-environment/active-transportation/scooter/safety)

In North America, the majority of shared e-scooter programs operate on a permit/license basis, as evidenced by online dashboards for the US [14] and Canada. As of 2022, more than half of these shared micromobility programs were privately owned [17]. Cities often prefer short-term permits for dockless micromobility, allowing them to revisit and adjust requirements as needed [21].

However, some cities run bike-sharing programs under public-private partnerships (P3) (see the US dashboard). The most common P3 models are "Design Build Finance Operate Maintain" and "long-term lease agreement" [22]. In the first model, the private partner provides, operates, and maintains the service, collecting user fees and local and regional/local funds in return. This model can be beneficial for cities looking to expand their mobility options without the resources to run the programs themselves [22]. In the latter model, the city leases its assets to private partners who run and maintain the program, with the private partner gaining the program's revenue [22].

*Case studies*

**Boise's** bike-sharing program is an example of the Design Build Finance Operate Maintain model. Most assets were purchased using local and regional funds, and operating expenses are primarily covered by sponsors. The private partner collects most of the revenues and, in return, owns and maintains the assets [49].

**Chicago's** bike-sharing program offers another example. A private partner is responsible for all capital costs, operations, and maintenance of the program and pays the city annual fees reflective of the current market. The city maintains control over the system through a service level agreement, and the private partner has exclusive rights to operate on public right of way, set pricing conditional on the city's approval, and use the city's trademark "Divvy" for bike sharing and other mobility solutions [50].

### 1.4.1 Local government involvement enhances micromobility programs

Active participation of local governments in shared micromobility programs often results in improved outcomes, particularly in terms of equity [19]. The P3 shared multimodal mobility program in Pittsburgh successfully displaced 257,000 Vehicle Miles Traveled with bike and e-scooter trips in its first year [23]. The success of this program can be largely attributed to the city's effective set of requirements, which include equitable deployment of vehicles, discounted rides when they start in equity zones, provision of low-income passes, and integration with the existing transit app [19], [23]. Another successful partnership is between the City of Collins and Spin. In this collaboration, Spin is integrated with a low-income access app called GetFoCo. In addition to the low-income pass (Spin Access), the city also provided 75 annual passes, each offering 5 free rides per day, to low-income individuals verified through the GetFoCo app [24].

### 1.4.2 Permit-Based Programs and Fee Structures

Permit-based programs include a mandatory fee incurred on providers. A common fee structure is an initial fee and a dynamic fee (e.g., per trip, per vehicle), reflective of an existing permit fee or an indicator of staff time [25]. These fees can be assessed and changed periodically, such as in response to a higher share of trips in warmer seasons or on weekends [26] or in downtown [25].

### 1.4.3 Cost and Revenue Management

Oakland estimated the cost to the city for their e-scooter program to be $288,000, which includes staff time to manage and enforce, hold outreach, and additional budget for software to monitor and evaluate the system [27]. Santa Monica also included staff times into their permit fees by assigning the time of a program coordinator and a code enforcement officer. The city gained $418,545 in revenue from permit fees and spent $567,859 on staffing and contracts [28].

Cities can use the revenues from these programs to facilitate their mobility and equity goals. For instance, Charlottesville spends revenue on improving parking and pavement [28] while Santa Monica and Seattle invest in infrastructure such as e-scooter drop zones and parking corrals [27]. Denver waives program fees but requires equity outcomes and other investments such as parking corrals [19], [13]. Spokane also reduces fees if providers supply helmets or parking corrals [25]. Major providers seem to be interested in infrastructure improvement as it is potentially conducive to more rides. An example is a provider that promised $1/scooter/day investments in protected bike lanes and other improvements [29].

Additionally, cities can offset the providers' profit loss from their low-income passes by providing subsidies and incentives. Depending on the discount, providers can lose 50% or more of their earnings [13] (for context, the annual cost of discounted membership is on average $37 compared to $117 for a normal membership [17]). A common approach is providing incentives through fleet increase. For instance, Denver increased its e-scooter fleet to 350 if 100 of them remain in Opportunity Areas [20]. Similar incentives are found in shared micromobility programs in Los Angeles, St Louis, Charlottesville, Minneapolis, and Calgary [14], [20],[27], [30] whereas Seattle uses a penalty and reduces fleet size if equity requirements are not met [14]. Los Angeles also decreased the per-vehicle fees from $130 to $39 on streets in low-income neighborhoods [15].

## 1.5 Recommendations for The City

Informed by our policy analysis and literature review, we recommend the following for the City of Vernon:

- **Identify mobility needs and equity goals:** This will allow the City to select a partnership model that best suits its mobility needs and equity goals [22]. An equity evaluation

framework can be used to measure the effectiveness of their program post-implementation and identify areas for improvement, particularly in terms of equity (see this tool) [14].

- **Adopt a flexible permit system and engage in partnerships:** Vernon could benefit from a dual approach that combines a flexible permit system with strategic public-private partnerships. This would allow for periodic adjustments to the e-scooter program to meet evolving mobility needs. By adopting P3 models, Vernon can enhance its mobility offerings without straining municipal resources. Successful strategies in other cities suggest that the City can allocate revenues from permit fees to infrastructure improvements, which can also boost e-scooter use. The City can compensate providers for revenue loss from low-income passes through incentives like fleet expansion and dynamic fee reductions in equity zones. Additionally, the City can supply discounted passes and facilitate the provider's partnership with community organizations. Examples of successful collaborations include integrating discounted rides into existing low-income programs.
- **Evaluate continuously:** It's crucial to continuously evaluate the program, especially in terms of equity requirements and compliance. While most cities have equity requirements, post-evaluation is often lacking, making it difficult to assess how providers are meeting these requirements [14]. Providers should consistently share trip and fleet data with the city. This allows the city to conduct evaluations to enhance current operations and inform future adjustments. For example, Minneapolis was able to improve e-scooter availability in low-income neighborhoods, likely due to the city's minimum fleet requirement [31]. However, Santa Monica discovered that despite regulations about equity zones, none of their 10 Providers consistently complied with the requirement of fleets within priority areas [28]. Therefore, using real-time and standardized data on fleets and trips can enable more effective evaluation and enforcement. At the time of this study, disaggregated trip information (i.e., end-to-end trip details) and spatial vehicle deployment data are not readily accessible to the City.
- **Implement joint requirements:** The most effective requirements address several barriers at once [32]. For example, ensure sufficient devices in equity zones and offer discounted rides in these areas, as seen in Edmonton, Pittsburgh, and Denver. In Vernon, a community survey revealed that lack of smartphone and credit card access hinders some residents from using e-scooters. The city should require providers to submit detailed plans on how they will meet the equity requirements outlined in Appendix A and clearly state their equity goals. For instance, Seattle's request of proposals (RFP) mandates that providers distribute at least 15% of their fleet within designated Equity Focus Neighborhoods. Similarly, Coquitlam's RFP asks providers to "describe their approach to

developing community partnerships and offering options and incentives for key groups, such as social service providers, healthcare workers, and post-secondary students".

- **Conduct targeted outreach,** In Vernon and other communities, there has been less emphasis on raising awareness about discounted passes. Only a small percentage of users are aware of discounted programs, with many learning about them through informal channels like word of mouth [13]. The discounted program for low-income individuals was underutilized in other cities due to low investment in engagement and a general lack of awareness about these programs [28], [33]. This highlights the importance of working with vendors and community partners to promote these passes and extend their reach.
- **Ease the burden on low-income:** Most low-income passes require verification of eligibility, which can be burdensome. The City can alleviate this burden by implementing lower pricing in equity-seeking neighborhoods, similar to initiatives in cities like Pittsburgh and Edmonton. These cities provide discounted rides in equity zones regardless of rider eligibility, making e-scooters more accessible. While the current passes reduce trip costs, the upfront expense may still be unaffordable for equity-seeking groups. Notably, in second part of this report, we observe that e-scooters are predominantly used by general users (rather than pass holders), and a significant number of trips originate or terminate in equity-seeking neighborhoods.
- **Integrate with other mobility services:** Shared micromobility can complement public transit, especially for equity-seeking individuals who often face longer commute times [34]. By integrating these services and offering discounted fares, usage can be encouraged. For instance, Toronto transit pass holders can save 50% off an annual bike-sharing membership. In Hawaii Island, bus riders receive unlimited 30-minute free rides for a day. Similarly, LA Metro offers free transfers between transit and their bike-sharing services [15]. In the second part of this report, we observe that the current spatial distribution of trips in Vernon indicates the potential for subsidizing and integrating e-scooter trips with transit.

# 2. Lessons for The Provider: Equity Assessment in Vernon's Shared E-scooter Program

## 2.1 Provider's Data Are Essential to Assess Equity Impacts

To assess the equity impacts of shared e-scooter programs, we can analyze the Provider data. In the US, approximately 91% of these programs have data-sharing requirements, but only about 19% of them publicly publish evaluation reports. Furthermore, a smaller percentage (~17%) enforce equity requirements based on the published data. For effective evaluation and enforcement, cities need access to providers data on trips, routes, fleets, and the type of pricing used on trips, preferably in a standard format such as the Mobility Data Specification [21], [27]. In 2019, more than half of shared micromobility systems were required to share data both in General Bikeshare Feed Specification (for navigation purposes) and Mobility Data Specifications (for enforcement and operation) [16]. Additionally, trip and fleet data should be complemented by surveys, collision data, violation reports, and compliance reports [28].

## 2.2 Equity Impacts of Shared E-scooters In Vernon

Affordability remains a significant barrier for equity-seeking communities. Despite general support for e-scooters from low-income groups [11], usage remains low among them

[26],[35],[36]. Additionally, there are fewer vehicles available to low-income and minority groups [37]. However, in cities like Portland that implement both reduced fares and equitable access in underserved areas, higher usage is observed among low-income groups [26].

Low-income users with discounted passes tend to be more long-term and frequent users, using e-scooters for commuting and social purposes, with more trips either complementing or replacing transit trips [13]. Similar patterns of increased use among discounted pass holders have been observed elsewhere. For instance, the City of Fort Collins saw a 29% increase in trips for people with Spin Access [24]. In East Bronx, users with discounted fares made an average of 25 trips, compared to the overall average of 11 trips [33]. These figures indicate the effectiveness of discount programs if accompanied by targeted outreach and equitable vehicle access.

Shared e-scooter programs can have significant equity impacts, particularly when they include measures to improve affordability and access for equity-seeking groups. However, more transparency in data sharing and enforcement of equity requirements is needed to ensure these programs are truly equitable. When evaluating equity impacts, it is essential to consider both equity-seeking demographics and their accessibility to various destinations using different transportation modes [38].

In this part, we focus on Vernon's shared e-scooter program equity impacts and aim to address the following research questions:

- How can we classify neighborhoods to identify those that are **equity-seeking** and evaluate their **transportation access**?
- How do **perceptions and demographic profiles** vary between shared e-scooter users and non-users? Additionally, what are the **characteristics of the neighborhoods** where they reside, in terms of transportation access and equity?
- Where are the **origins and destinations** of trips situated within the city's neighborhoods, and is there a significant **difference between pass holders and general users**?
- Is there any **potential** to partner with schools and social service providers to **facilitate rides for youth** (16 years and older)?

For detailed information on the methodology used to address these questions, please refer to Appendix B. The following section presents the results and concludes with recommendations based on our thorough analysis of Vernon's context. These insights are designed to help the operator improve equity outcomes in the ongoing development of the shared e-scooter program.

### 2.2.1 Equity and Transportation Access Maps

Figure 6 shows the equity scores in Vernon, where greater scores indicate greater vulnerability to deprivation. Figure 6 highlights that most equity-seeking groups are located in central Vernon.

Figure 7 presents the transportation access overlayed on the corresponding mode's network, with peripheral areas of Vernon showing reduced access to various destinations via walking, cycling, and public transit.

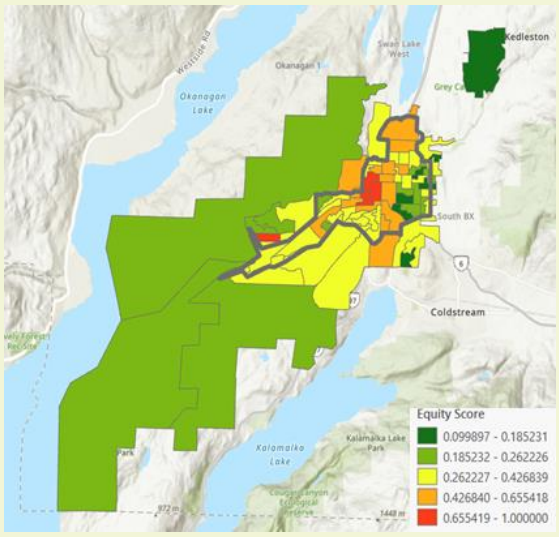


**Figure 4. Distribution of equity scores across Vernon, the gray border outlines the Provider's service area**

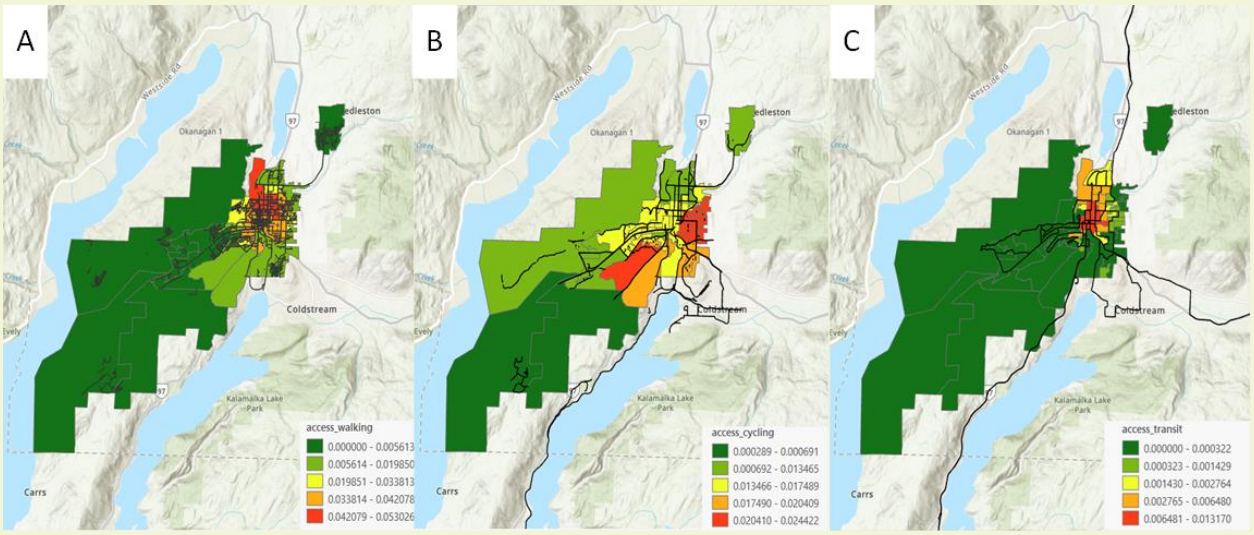


**Figure 5. Distribution of a) walking access (left), b) cycling access (center), and c) transit access ranks across Vernon, black lines illustrate the transportation network for each mode (i.e., sidewalks, cycling facilities, and transit routes), higher access values represent better accessibility**

### 2.2.2 Shared E-scooter Users and Non-users

Our analysis suggests users are more inclined to view e-scooters as enjoyable to ride rather than beneficial for GHG reduction or transit connectivity. Additionally, users are typically younger, as those above 45 years old are less likely to use e-scooters. The consensus among users is that e-

scooter travel and parking behaviors will improve, and they perceive e-scooters as safe. Users also prefer the continuation of shared e-scooter programs in Vernon.

Overall, users and non-users live in neighborhoods with comparable deprivation levels, as shown in Figure 8. However, users tend to reside in areas with better transportation access as seen in Figure 9. Limiting the residential locations to the Provider's service area (90% of users and 63% of non-users) shows similar transportation access for both groups. However, more non-users live outside the service area compared to users, suggesting that expanding the service area could convert some non-users into users.

### 2.2.3 Where Did Trips Take Place?

Figure 10 displays trip counts at trip start and end locations. Our analysis revealed that pass holders generally took fewer rides and trips were more frequent in equity-seeking neighborhoods and areas with better walking and transit accessibility, but lower cycling accessibility.

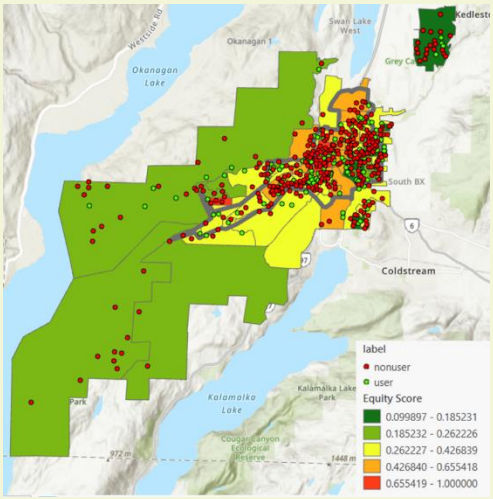


**Figure 6. Distribution of residential locations for users and non-users across equity scores, the gray border outlines the Provider's service area**

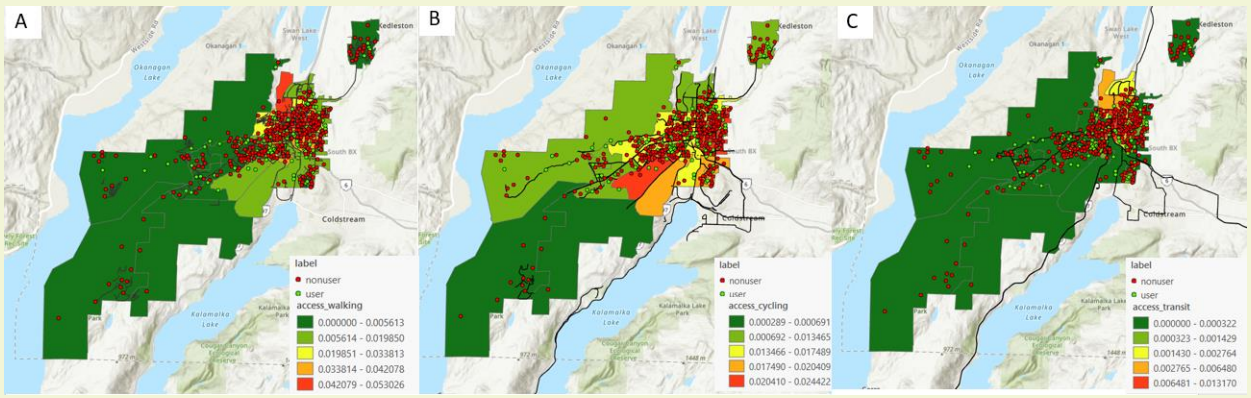

**Figure 7. Distribution of a) walking access (left), b) cycling access (center), and c) transit access ranks across Vernon with respect to residential locations of users and non-users.**

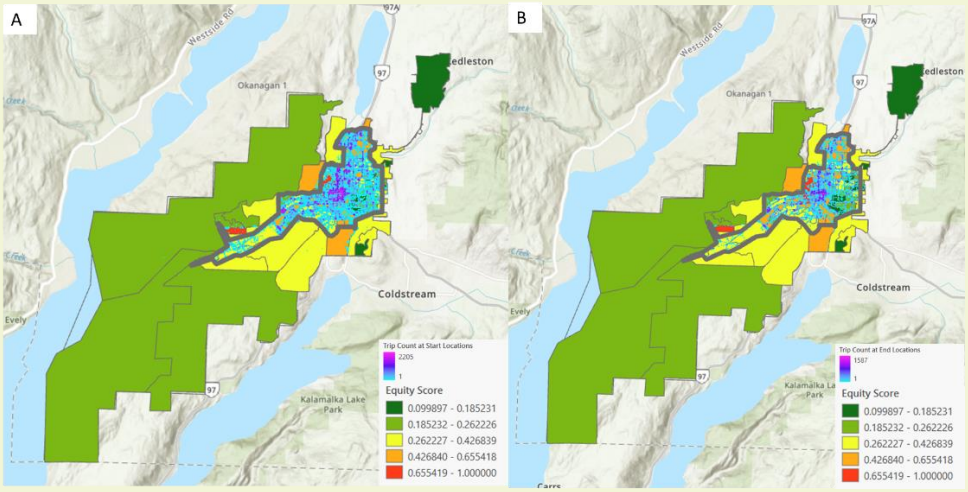


**Figure 8. Trip count density raster at A) start locations and B) end locations against equity scores, the gray border outlines the Provider's service area**

## 2.2.4 Rides for Youth

Around 16% of shared micromobility users in the US ride to school [39]. Many North American cities, such as Fort Collins, Fort Wayne, Los Angeles, and Coquitlam, include discounted memberships in their equity requirements targeting students and youth[2]. In Vernon, the Operator's survey revealed that 40% of the most frequent trip purposes were commutes to work or study.

Analysis showed that 48.9% of trip start locations and 47.1% of trip end locations were within 500 meters of a school. Additionally, 96% of community survey respondents aged 15-24 lived within 2 km of a school (a typical travel distance for e-scooters in Vernon) (Figure 11). These findings highlight the potential for providing discounted memberships for youth and conducting targeted outreach in partnership with schools and social service providers to reach them.

[2] For details refer to
https://public.tableau.com/app/profile/anne.brown1036/viz/OperationalizingEquityUSMicromobilityEquityRequirementsDatabase/OperationalizingEquityUSMicromobilityEquityRequirementsDatabase?publish=yes
and
https://public.tableau.com/app/profile/elmira.berjisian/viz/Escooter/Dashboard1

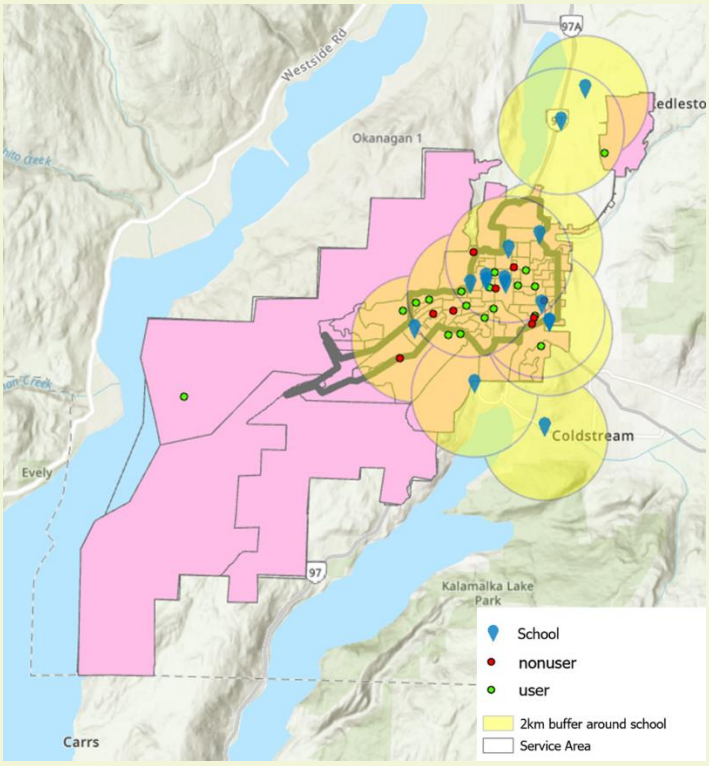


**Figure 9. E-scooter trip to school feasibility based on residential locations of community survey's respondents aged 15-24 years old and schools.**

## 2.3 Recommendations for The Provider

Based on our data analysis, we recommend the following actions for the Provider to increase their community impact:

- **Expand the User Market:** Currently, e-scooters primarily serve young individuals for recreational travel. To broaden the market:
    - Consider including adaptive vehicles to accommodate other age groups.
    - Encourage the use of e-scooters in conjunction with other sustainable transportation modes, possibly by subsidizing rides connected with transit.
- **Subsidize Rides in Equity-Seeking Neighborhoods:** Approximately 40% of both users and non-users reside in equity-seeking neighborhoods. Subsidizing rides originating from these areas could encourage more rides and help achieve equity goals. Additionally, it is crucial for the Provider to distribute vehicles adequately in these neighborhoods; unfortunately, we did not have access to spatial deployment data for further exploration.
- **Provide e-scooters where transportation access is limited:** Support for the adoption of e-scooters as a transportation mode in less accessible neighborhoods, where non-users predominantly live. A 2022 survey conducted by the Provider revealed that users ranked

"a larger operating area" as the second most desired factor for taking more rides. To gain insights, it is crucial that the city has e-scooter distribution data for all hours of the day. This information will help us understand whether limited vehicle access is the primary barrier preventing non-users from utilizing e-scooters.

- **Enhance e-scooter accessibility and equity**: The spatial distribution of trip counts indicated that trips often start or end in equity-seeking neighborhoods and areas with good walking and transit accessibility. The model suggested that general users, as opposed to pass holders, undertake more e-scooter trips. To address the fact that equity-seeking groups may not afford the upfront charge for a pass, as discussed in part one, we recommend:
    - Integrating subsidized e-scooter rides within transit fares or in connection with transit along with greater discounts on trips that start/end in equity-seeking neighborhoods. This will make e-scooters more equitable and support increased transit mode share.
    - Providing a mechanism to reduce the upfront cost of acquiring a pass to make e-scooters more accessible.
- **Promote e-scooter use through pricing strategies**: Promotions during GoByBike (GBB) week led to a marginal increase in trips, ridership, and trip duration. To attract more users, consider addressing the price barrier—a significant deterrent for non-users. According to a community survey, the second most commonly cited obstacle preventing non-users from adopting shared e-scooters is pricing. Additionally, the Provider survey revealed that pricing discounts and promotions could encourage more frequent e-scooter use. Providers can enhance the impact of pricing discounts by collaborating with the city and other community partners to raise awareness of these promotions.

## Case Study: Go-By-Bike (GBB) Week Promotions

GBB week is an annual initiative promoting active transportation. The 2024 event ran from June 3 to June 9, offering participants the chance to win prizes. During the week the Provider and The City partnered to offer riders 20 minutes free on their first ride and a 50% discount on all subsequent rides throughout GBB week. Out of 1000 tokens issued, only 199 users used the promotions during GBB week (~20%). To evaluate the promotion's effectiveness, we analyzed Provider data to compare daily activity during GBB Week against the preceding and following weeks. We focused on three key metrics:

- The number of trips per deployed vehicle
- The number of unique users per deployed vehicle
- The median trip duration (minute)

Additionally, we conducted a difference-in-difference analysis to isolate the promotion's impact. This approach allowed us to assess the promotional discounts' impact on e-scooter usage during GBB Week.

Figure 11 illustrates the average number of trips per deployed vehicle, users per deployed vehicle, and median trip duration over seven days before, during, and after GBB week in 2024. The data indicates that the promotion was effective across all measures, albeit marginally. The only sustained effect into the following week was on median trip.

The difference-in-difference analysis, accounting for annual trends, GBB week, and rides in 2024, showed that the promotion did not significantly affect the average daily trip count at start locations per average daily deployed vehicle (for details, refer to Appendix B). The results imply that the changes were not meaningful, a post-evaluation survey could help us understand the reasons behind low engagement. Moreover, it is strongly recommended that promotional efforts take place in partnership through local advertisement and other community partners (such as schools, social workers, and health care facilities) to guarantee better engagement.


**Figure 10. Mean of trips per deployed vehicle, users per deployed vehicle, and median trip duration in minutes, for preceding week, GBB week, and the following week. Error bars indicate standard deviations**

# Appendix A

Table 1.A. provides an overview of case studies for equity requirements across cities' shared micromobility programs. For a comprehensive list of equity requirements in US cities, please refer to the online dashboard. Similarly, we have scanned policy documents available for Canadian cities and reached out to city staff to develop a similar dashboard. The dashboard additionally includes critical variables for each city regarding equity (such as the percentage of residents speaking non-official languages, the percentage of immigrants, etc.) from the 2021 Census [40]. Figure 13 shows the distribution of shared e-scooter programs across Canada. For a comprehensive list of equity requirements in Canadian cities, refer to our online dashboard.


**Figure 11. Shared e-scooter programs across Canada**

Table 1.A. Equity requirements across cities

| Equity Requirement | Case study |
|---|---|
| **Discount program** | Baltimore, Santa Monica, Washington, Los Angeles: waives base fee for eligible low-income (Provider: Bird) [15], [41]<br>Chicago, Santa Monica, San Francisco: discounted rides ($5 monthly for a 1-hour free daily ride) for eligible low-income (Provider: Jump) [15]<br>Santa Monica: $5 yearly for unlimited free 30-minute rides for eligible low-income (Provider: Lyft) [15]<br>Los Angeles: $5 monthly and $ 0.05 per minute for eligible low-income (Provider: Lyft) [41]<br>Santa Monica, Washington: 50% discount on e-scooter rides for eligible low-income (Provider: Lime) [15]<br>Portland: $0.5 to unlock and $0.07 per minute [41]<br>Denver: discounted prices in "opportunity areas" [19]<br>Atlanta: affordable discounts for eligible low-income [26]<br>Boston: annual membership of $5 (normal fee: $85) for eligible low-income [32]<br>Austin: The Provider must have affordable pricing for eligible low-income [20]<br>Fort Collins: discounts for eligible low-income (Provider: Spin) [24]<br>Included in the city requirements: Durham, Minneapolis, Palo Alto [20]; Seattle [42], East Bronx [33]<br>Ajax: discounted prices in equity zones<br>Other Canadian cities: Brampton, Calgary, Cambridge, Coquitlam, Cranbrook, Edmonton, Hamilton, Kelowna, Kitchener, Leduc, Lethbridge, Mississauga, Okotoks, Ottawa, Regina, Richmond, Saskatoon, Vernon, Waterloo, Windsor |
| **Equitable geographic distribution** | Chicago: 50% of the fleet within priority areas [43]<br>Los Angeles: An additional 500 vehicles are allowed in disadvantaged communities [15], [41]<br>San Francisco: 20% of the fleet in the designated areas [15], [27]<br>Washington: distribution in equity zones [26]<br>Atlanta: distribution in equity zones [41]<br>Portland: 15% of the fleet in East Portland [41]<br>Santa Monica: limit 1/3 of the fleet to be located in downtown [28]<br>Pittsburgh: distribution in equitable zones [19]<br>Included in the city requirements: Nashville [15], Seattle [42], Oakland, Providence, Birmingham [14]<br>Brampton: required plans for equitable distribution including transit-oriented communities, multi-family housing, commercial zones as well as planned transit ways, park and ride, dense employment, educational and recreational activities<br>Edmonton: equity zones determined based on household income and walk score<br>Mississauga: required access to e-scooters in transit underserved neighborhoods and for households without a car<br>Other Canadian cities: Ajax, Calgary, Coquitlam, Kelowna, Leduc, Lethbridge, Ottawa, Regina, Richmond |
| **Non-smartphone access** | Chicago: text message [15], [43]<br>Los Angeles: text message [44]<br>Portland: text message, rent at the warehouse [41]<br>Fort Collins: text message [24]<br>East Bronx: text message [33]<br>Included in the city requirements: Atlanta, Austin [41], Santa Monica [28], Austin, Denver, Minneapolis [20], Seattle [42], San Francisco, Montgomery [18]<br>Canadian cities: Ajax, Brampton, Calgary, Coquitlam, Edmonton, Kelowna, Lethbridge, Mississauga, Richmond |
| **Cash payment** | Chicago: PayPal Cash, PayNearMe [15], [43]<br>Santa Monica: PayNearMe [15],<br>Los Angeles: cash payments [44], [41], [20]<br>Portland: prepaid debit cards, order forms, payment at warehouse [41]<br>Atlanta: PayNearMe, prepaid debit cards, money orders [41]<br>Fort Collins: Spin Cash cards [24]<br>Included in the city requirements: Santa Monica [28], Denver, Minneapolis, Palo Alto, San Francisco [20], Seattle [42], Montgomery [18], East Bronx [33]<br>Edmonton: Uber gift card, cash payment at their warehouse<br>Ajax: debit card, Apple Pay, Google Pay, PayPal<br>Other Canadian cities: Brampton, Calgary, Coquitlam, Lethbridge, Kelowna, Richmond |
| **Multilingual services** | Arlington: Spanish marketing campaign [30]<br>Santa Monica: some services offered outreach material and applications in other languages [27]<br>Seattle: required translation in smartphone and contact methods [48]<br>East Bronx: multilingual promotional materials [32]<br>Lethbridge: In application and at events pamphlets and hand-outs are available in multiple languages<br>Other Canadian cities: Ajax, Brampton, Mississauga, Coquitlam |

**Table 3.A. Equity requirements across cities (continued)**

| Equity Requirement | Case study |
|---|---|
| **Targeted outreach and marketing** | Los Angeles: mandatory equity engagement plans [41]<br>Minneapolis: outreach targeted at low-income [20]<br>Austin: targeted outreach in underserved areas [20]<br>Palo Alto: promote the use of shared micromobility among the low-income [20]<br>Seattle: partner with city and community partners for equity program outreach [42]<br>East Bronx: requires the vendor to host monthly engagements to promote reduced pricing [33]<br>Denver: to overcome cultural barriers, they designed approachable marketing material to be different from governmental letters [32]<br>Ajax: pop-ups at major events including Ajax Youth Fair, presentation to Accessibility Committee and Youth Engagement Advisory Committee<br>Brampton: the vendor is required to help low-income population or non-English speaking population understand the payment options and discounts<br>Other Canadian cities: Coquitlam, Kelowna, Lethbridge, Mississauga, Okotoks, Red Deer, Vernon, Waterloo, |
| **Adaptive vehicles** | Chicago: requires plans for addressing the needs of people with disability such as accessible technology or adaptive vehicles [43]<br>Fort Collins: Spin Adaptive [24]<br>Included in the city requirements: East Bronx [33]<br>Waterloo, Cambridge, and Kitchener: investigate the potential of adaptive vehicles |

# Appendix B

## B.1 Equity and Access Maps

We adopted the methodology behind the Canadian Index of Multiple Deprivation (CIMD) by Statistics Canada to develop an equity index [45]. CIMD consists of four principal components and measures disparities in social well-being, health, education, and justice at both national and provincial levels. Initially, thirty-two variables[3] were used in Principal Component Analysis (PCA). Variables lacking significant correlation with the four principal components were excluded [45]. We opted to create a specific index for Vernon, as it more accurately reflects the local deprivation levels compared to the broader British Columbia Index. The thirty-two variables were derived from the Census 2021 data [40]. A scree plot was used to determine the number of principal components and only the variables were maintained that displayed significant correlation with principal components. Varimax Rotation was then applied to simplify variable loadings and generate interpretable components [46]. The components were normalized using min-max normalization. Depending on the correlation sign between components, the normalized components were either used directly or their sign was reversed (considering the expected relationship with deprivation) and averaged to formulate an equity score. This score represents the marginalized populations and deprivation levels within census dissemination areas. Guided by Statistics Canada's analytical framework [45], we ranked the equity scores from least to most vulnerable to deprivation. These were then divided into five equal-sized categories, ranging from 1 (least deprived) to 5 (most deprived). The Scree plot indicated that two principal components are adequate to capture the data's variation. Together, these components account for 62% of the variance. For PCA results, please see Appendix B. Due to the negative correlation between components, we derived equity scores by averaging the normalized values of the first component minus the normalized values of the second component. Out of 32 variables, 29 (listed in Table 2.B.) showed a significant correlation with the two components. Figure 14 Illustrates each component with its included variables. For ease of interpretation, if a variable appeared in both components only one with the maximum loading is illustrated.

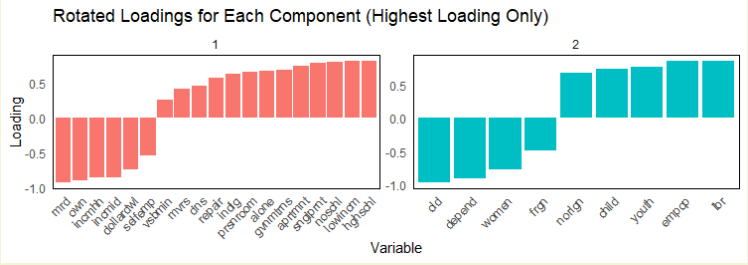


**Figure 12. two principal components with their constituting variables**

[3] For a full list of variables, refer to https://www150.statcan.gc.ca/n1/pub/45-20-0001/452000012023002-eng.htm

**Table 2.B. Equity requirements across cities**

| Variable | Definition based on Census 2021 [40] | Abbreviation for Figure | Maximum loading in which component |
|---|---|---|---|
| Married | Proportion of population that is married or common-law=Married or living common-law/ Total - Marital status for the total population aged 15 years and over - 100% data | mrd | |
| Owned dwellings | Proportion of dwellings that are owned= Owner/ Total - Private households by tenure - 25% sample data | own | |
| Household income | Median total income of household in 2020 ($) | incmhh | |
| Individual income | Median total income in 2020 among recipients ($) | incmid | |
| Dwelling value | Median dollar value of dwelling =Median value of dwellings ($) | dollardwl | |
| Self employed | Proportion of population that is self-employed =Self-employed/Total - Labour force aged 15 years and over by class of worker including job permanency - 25% sample data | selfemp | |
| Visible minority | Proportion of population who self-identify as visible minority =Total visible minority population/Total - Visible minority for the population in private households - 25% sample data | vsbmin | |
| Movers | Proportion of population who moved within the past five years=Movers/Total - Mobility status 5 years ago - 25% sample data | mvrs | |
| Population density | Proportion of persons per square kilometer =Population density per square kilometre | dns | |
| Repair | Proportion of dwellings needing major repairs =Major repairs needed/Total - Occupied private dwellings by dwelling condition - 25% sample data | repair | |
| Indigenous | Proportion of population that identifies as Indigenous =Indigenous identity/Total - Indigenous identity for the population in private households - 25% sample data | indig | 1 |
| Person per room | Average number of persons per room =Number of persons in private households /(Average number of rooms per dwelling*Total - Occupied private dwellings by number of rooms - 25% sample data) | prsnroom | |
| Alone | Proportion of persons living alone=Living alone/ Total - Persons in private households - 100% data | alone | |
| Government assistance | Proportion of population receiving government transfer payments =Number of government transfers recipients aged 15 years and over in private households in 2020 - 100% data/Total - Income statistics in 2020 for the population aged 15 years and over in private households - 100% data | gvrnmnts | |
| Apartment | Proportion of dwellings that are apartment buildings=(Apartment or flat in a duplex+ Apartment in a building that has fewer than five storeys+ Apartment in a building that has five or more storeys)/ Total - Occupied private dwellings by structural type of dwelling - 100% data | aprtmnt | |
| Single parent | Proportion of single parent families =Total one-parent families/Total number of census families in private households - 100% data | snglprnt | |
| No school | Proportion of population aged 15-24 not attending school =No certificate, diploma or degree/Total - Highest certificate, diploma or degree for the population aged 25 to 64 years in private households - 25% sample data | noschl | |
| Low income | Proportion of population that is low-income =Prevalence of low income based on the Low-income measure, after tax (LIM-AT) (%) | lowincm | |
| No high school | Proportion of population aged 25-64 without high school diploma =No high school diploma or equivalency certificate/Total - Secondary (high) school diploma or equivalency certificate for the population aged 25 to 64 years in private households - 25% sample data | highschl | |

**Table 4.B. Equity requirements across cities (continued)**

| Variable | Definition based on Census 2021 [40] | Abbreviation for Figure | Maximum loading in which component |
|---|---|---|---|
| Elderly | Proportion of population aged 65 and older =65 years and over (from Total - Distribution (%) of the population by broad age groups - 100% data) | old | |
| Dependent | Dependency ratio (population aged 0-14 and population aged 65 and older divided by population aged 15-64) =(0 to 14 years+ 65 years and over)/15 to 64 years | depend | |
| Women | Proportion of population that is female =count women/ count total Total - Age groups of the population - 100% data | women | |
| Foreign born | Proportion of population that is foreign-born =Place of birth for the immigrant population in private households - 25% sample data/Total - Immigrant status and period of immigration for the population in private households - 25% sample data | frgn | |
| Religion | Proportion of population with no religious affiliation =No religion and secular perspectives/Total - Religion for the population in private households - 25% sample data | norlgn | 2 |
| Children | Proportion of children younger than age 6 =0 to 4 years/Total - Age groups of the population - 100% data | child | |
| Youth | Proportion of population that are youth (aged 5-15) =(5 to 9 years+10 to 14 years)/Total - Age groups of the population - 100% data | youth | |
| Employment-population ratio | Ratio of employment to population =Employment rate | empop | |
| Labour force | Proportion of population participating in the labour force (aged 15 and older) =In the labour force/Total - Population aged 15 years and over by labour force status - 25% sample data | lbr | |

Figure 15 shows the equity scores alongside deprivation ranks in Vernon, highlighting that most equity-seeking groups are located in central Vernon.

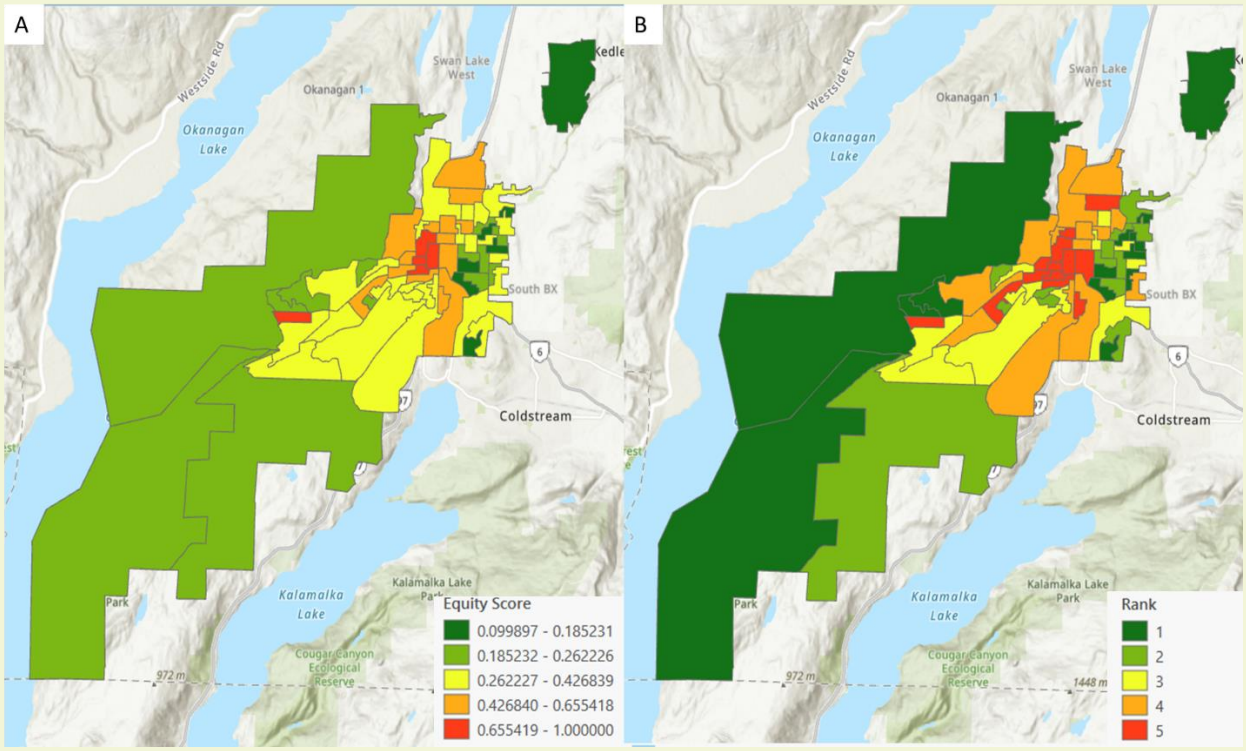


**Figure 13. Distribution of a) composite score (left) and b) deprivation ranks (right) across Vernon, higher ranks/composite values represent greater deprivation levels**

Furthermore, we evaluated spatial access measures for census dissemination areas, considering the proximity to educational, healthcare, employment, grocery, cultural, arts, and recreational facilities. These measures were calculated for walking, cycling, and transit (during peak and off-peak hours) and provided by Statistics Canada at the census dissemination block level [47]. While access to all destinations is normalized nationally, grocery store access is provided in minutes. We inverted the travel time to the nearest grocery store and normalized it against the national maximum and minimum values. For each census dissemination area, we calculated the median access to the aforementioned destinations. We then established an overall access score by obtaining median access across all modes of transportation. It's important to note that for transit, peak hour values were used for essential services (i.e., education, employment, and healthcare), while off-peak values were applied to other destinations.

## B.2 Users and Non-users Profiles

We analyzed data from the community survey conducted by the City of Vernon in 2023 to investigate the differences between shared e-scooter users and non-users. The survey collected data on 1,726 participants, with 1,560 responses coming from Vernon residents. We excluded e-

scooter users who utilized services other than those provided by the Operator, resulting in 1,528 respondents. Out of these, 470 were identified as users of shared e-scooter programs, and 1,058 as non-users.

The survey was structured into five sections with the first two sections focusing on users' ridership and non-users' attitudes. The remaining sections, which were directed at both user and non-user groups, included questions on education, awareness, perceptions, and socio-demographics [48]. We leveraged the data from the final two sections—pertaining to perceptions and demographics—to construct profiles for users and non-users. A logistic regression model was employed to obtain the likelihood of a respondent being a user, based on their perceptions and demographic information. We allocated 80% of the data for model training, with the remaining 20% used to test the model's predictive accuracy.

Figure 16 depicts the percentage change in odds for significant variables from the logistic regression model. The model demonstrated an 84% accuracy rate on the test dataset.

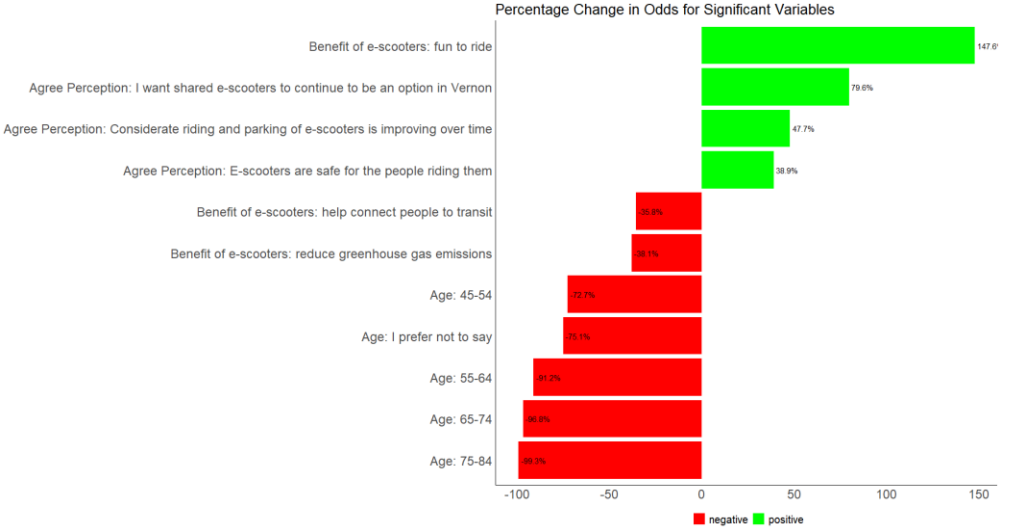


**Figure 14. Percentage change in odds from user logistic model, to interpret, for instance, respondents who find e-scooters fun to ride are 147.6% more likely to be in the user group as opposed to the non-user group.**

Furthermore, 342 users and 509 non-users provided their postal codes. Utilizing the geocode function from tidygeocoder package [40] in R, we inferred their residential locations. Our analysis sought to determine whether there was a distinct distribution pattern across the city for users and non-users, particularly in terms of equity and access with respect to where they live. Out of 851 respondents who provided their residential address, 768 were within Vernon. Users and non-users live in neighborhoods with comparable deprivation levels, as shown in Figure 8. The Chi-square test found no significant difference in the distribution of users and non-users across deprivation ranks (p-value = 0.8). However, a t-test indicated that users tend to reside in areas with better transportation access (p-value < 0.05), as seen in Figure 9.

## B.3 Distribution of Trip Ends across Pass Holders and General Users

The Provider has supplied trip count data for start and end locations for both pass holders and general users since the program's inception. We utilized this data, overlaying it with our equity and access maps, to investigate whether there are spatial differences in the trips made by these two user groups. We employed mixed-effect negative binomial regression to evaluate the number of trips (at start or end locations) in relation to the user type—pass holder or general user—and the equity index as fixed effects. We also incorporated random intercepts for each census dissemination area to account for area-specific variations. In addition, we developed analogous models that included transportation access in addition to the user types as fixed effects. For model training, we allocated 80% of the data, reserving the remaining 20% to evaluate the models' performance. The Root Mean Squared Error (RMSE) was calculated for the test dataset[4]. Table 3 summarizes the model results for the number of trips (at start or end locations) against user type (pass holder or general user) and the equity measure (composite score or transportation access). All variables were significant (p-value < 0.05).

**Table 3. mixed effect negative binomial regression for modeling count of trips ends**

| **Trip counts at start locations, trained on 68,555 locations nested in 63 dissemination areas** | | | | |
|---|---|---|---|---|
| | Model with composite score | Model with walking accessibility | Model with cycling accessibility | Model with transit accessibility |
| Intercept | 1.1611 | 1.2666 | 1.4885 | 1.3053 |
| Coefficient for equity/access | 0.5172 | 3.8123 | -7.4831 | 31.6154 |
| Coefficient for Pass holders | -0.3036 | -0.3035 | -0.3034 | -0.3035 |
| Random Intercept standard deviation | 0.2683 | 0.2775 | 0.2807 | 0.2643 |
| Marginal and Conditional R2 | 0.023, 0.079 | 0.021, 0.080 | 0.018, 0.079 | 0.029, 0.083 |
| RMSE | 10.86 | 10.86 | 10.86 | 10.86 |
| **Trip counts at end locations, trained on 56,879 locations nested in 61 dissemination areas** | | | | |
| Intercept | 1.3308 | 1.4237 | 1.6076 | 1.4851 |
| Coefficient for equity/access | 0.5232 | 4.4113 | -4.2771 | 27.3589 |
| Coefficient for Pass holders | -0.1873 | -0.1872 | -0.1871 | -0.1872 |
| Random Intercept standard deviation | 0.2703 | 0.2775 | 0.2852 | 0.2721 |
| Marginal and Conditional R2 | 0.011,0.062 | 0.010, 0.063 | 0.010, 0.063 | 0.014, 0.065 |
| RMSE | 12.16 | 12.16 | 12.16 | 12.16 |

[4] Notably, if the test data introduced a new dissemination area not present in the training data, we defaulted the random intercept to zero.

## B.4 Rides for Youth

List of schools were extracted from The City's website[5] and geocoded using tidygeocoder package [40] in R. We limited the schools to Secondary, Post-secondary, college, other, and alternate schools, as the legal age to ride e-scooter in Vernon is 16 years old[6].

## B.5 GoByBike Week

Difference-in-Difference analysis involved comparing daily trip counts at start locations normalized by average daily deployed vehicles from the week before and during GBB Week for the control group (years 2022-2023) and the treatment group (year 2024). The mixed effect regression model included: *year* to account for trend patterns, *period* to differentiate between the GBB Week and the preceding week, *group* to distinguish between the control and treatment groups, an *interaction* term defined as the treatment group during GBB Week (who received the promotion), and random intercepts to account for trips starts in the same dissemination area. The data included 18,932 trip start locations with aggregated trip counts per daily deployed vehicle ranging between 0.0029 to 0.0297. Table 2 summarizes the results of the difference-in-difference analysis.

**Table 4. mixed effect regression for modeling count of trips per daily deployed vehicle in start locations across 2022-2024 for GGB week and the preceding week**

| Variable | Coefficients | p-value |
|---|---|---|
| (Intercept) | 1.0473 | <0.01 |
| Year | -0.0005 | <0.01 |
| Period=During GBB week | 0.0000 | 0.332 |
| Treatment= 2024 trips | 0.0006 | <0.01 |
| Interaction (impact of promotion, i.e., during GBB week multiplied by treatment group) | 0.0000 | 0.883 |
| Random Intercept standard deviation for 60 dissemination areas | 0.0001 | |
| Marginal and Conditional $R^2$ | 0.033, 0.041 | |

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[6] https://www.vernon.ca/roads-transportation/small-wheels#:~:text=Riders%20must%20be%20at%20least,and%20must%20wear%20a%20helmet.

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