Regional E-Bike Rebate Program

Incentivizing Use of E-Bikes

Research Memo and Final Project Report

Adil Ali Khan

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Regional E-Bike Rebate Program Research Report: Atlanta MSA

Executive Summary

This report synthesizes research on the potential impacts of implementing a regional E-Bike Rebate Program in the 29-county Atlanta Metropolitan Statistical Area (MSA), drawing upon detailed analyses of e-bike adoption, CO_2e reduction potential, co-pollutant impacts, financial and economic costs/benefits, and equity considerations. The program, modeled after the City of Atlanta's successful 2024 pilot, aims to accelerate e-bike adoption to reduce transportation emissions, a major contributor (~41% in 2019) to the region's greenhouse gas (GHG) footprint [1]. Key findings indicate that e-bikes offer a viable alternative to personal vehicles for short trips (<5 miles), which constitute a significant portion of travel in the region [2]. While the *technical potential* for GHG reduction via e-bike substitution for short car trips (≤ 5 miles) is substantial (estimated at 5.9-6.6 MMTCO2e annually by 2035-2050), the *achievable* potential realized through incentive programs is constrained by real-world factors. ARC's initial estimates for a scaled program suggest achievable reductions of ~13,200 MTCO2e cumulatively by 2050 [1]. The program demonstrates favorable cost-effectiveness, particularly when considering health and equity co-benefits, with costs per ton of CO_2e avoided decreasing over time (~$353/ton in 2035 to ~$140/ton in 2050) as the grid decarbonizes. Beyond GHG reductions, the program is projected to yield significant co-benefits, including reductions in harmful co-pollutants (NO_x, $PM_{2.5}$, VOCs, CO), leading to quantifiable public health improvements (avoided mortality/morbidity valued illustratively at ~$174,000/year for a hypothetical scenario) [5]. It also stimulates local economic activity through retail sales (>$1.2M from Atlanta pilot) and job creation (supporting ~75 jobs annually under a central scenario), noise reduction, and substantial cost savings for participants compared to car ownership [3, 6]. Equity is a central theme; the program structure successfully targets low- and moderate-income residents (82% of Atlanta pilot funds redeemed by ≤80% AMI group), providing affordable mobility options and directing health benefits towards disproportionately burdened communities [6, 7]. However, realizing the program's full potential hinges on addressing critical barriers, notably the need for sustained funding, continuous stakeholder engagement, and, most importantly, concurrent, equitable investment in safe and connected bicycle infrastructure across the entire MSA [7, 8]. Recommendations focus on maintaining the equity-focused rebate structure, scaling funding, prioritizing infrastructure development in underserved areas, and robust monitoring and evaluation.

1. Introduction

Metropolitan regions across the United States face the dual challenge of mitigating climate change by reducing greenhouse gas (GHG) emissions while ensuring that climate action strategies promote equity and benefit all residents, particularly those in historically underserved communities. The transportation sector is a primary contributor to GHG emissions in many urban areas, including the Atlanta Metropolitan Statistical Area (MSA), where it accounted for approximately 41% of total emissions (30.7 MMTCO2e out of 75.4 MMTCO2e) in the 2019 baseline year [1]. This high contribution from transportation underscores the urgency for targeted interventions within the sector to meet the region's climate objectives and address associated issues like air quality and traffic congestion. Consequently, strategies aimed at decarbonizing transportation are critical for achieving regional climate goals.

Electric bicycles (e-bikes) have emerged as a promising tool for reducing transportation emissions and vehicle miles traveled (VMT). Using an integrated electric motor assisting propulsion, e-bikes offer a compelling, low-emission alternative to traditional bicycles and automobiles, particularly for shorter trips [10]. Studies show that a substantial percentage of car trips are under five miles, a distance easily manageable by e-bike [2, 11]. By replacing car trips, e-bikes can significantly reduce GHG emissions and air pollutants (like NOx and PM2.5), leading to improved air quality and public health outcomes [12]. Recognizing this potential, numerous municipalities and states have implemented e-bike incentive programs, often in the form of rebates, to address the primary barrier to adoption: the high upfront cost [10]. Programs in cities like Denver, CO, and Saanich, BC, have demonstrated success in stimulating e-bike adoption, reducing VMT, and generating economic activity [13, 14].

The Atlanta Regional Commission (ARC), as the lead agency for the Climate Pollution Reduction Grant (CPRG) planning for the 29-county Atlanta MSA, prioritizes climate actions that are both cost-competitive and equitable [1]. The Atlanta MSA Priority Climate Action Plan (PCAP), developed under the CPRG program, explicitly includes a measure to "Incentivize Use of Electric Bikes" [1]. Building on this, the City of Atlanta launched its own pilot e-bike rebate program in June 2024, funded by a $1 million investment from the City Council and administered by ARC with outreach support from Propel ATL [6].

This report evaluates the program's potential based on the Atlanta pilot experience, regional data, established modeling frameworks, and case studies from other jurisdictions. The subsequent sections address the following key topics:

- E-bike adoption context in Metro Atlanta, including achievable potential, policy landscape, infrastructure status, adoption drivers and barriers, and stakeholder acceptance.

- The *technical potential* for CO2e reduction from e-bike adoption in the MSA.
- Quantification of co-pollutant emission reductions (NOx, PM2.5, VOCs, CO) and associated public health and environmental benefits.
- Analysis of the program's financial costs, savings, cost-effectiveness, and broader economic impacts on jobs and GDP.
- Assessment of the program's equity implications across distributional, procedural, and inter-generational dimensions.

The report concludes with a synthesis of findings and actionable recommendations to inform the development of the region's Comprehensive Climate Action Plan (CCAP).

2. E-Bike Adoption in Atlanta: Achievable Potential, Policy Context, and Implementation Factors

A. Defining "Achievable Potential"

In evaluating climate solutions, "achievable potential" refers to the level of deployment and impact considered ambitious yet plausible within a defined timeframe, accounting for real-world constraints like cost, policy support, infrastructure requirements, stakeholder acceptance, and behavioral change [15]. This contrasts with "technical potential," a theoretical maximum, which ignores such barriers [16]. Drawdown Georgia calculates both, estimating the statewide achievable potential for "Alternative Transportation" (including biking) at 0.84 MMTCO2e by 2030, contingent on replacing 2.5% of VMT [17]. E-bikes are market-ready, and rebates address the main cost barrier, making them a key component of achievable potential assessments [10].

B. Modeling E-Bike Impacts: Evaluating Tools

While state-level tools like the RMI Energy Policy Simulator (EPS) are valuable for broad policy analysis [18], they lack the granularity to model specific, localized interventions like the Atlanta e-bike rebate program [10]. The EPS can model general VMT reduction or mode shift, but not the nuances of a budget-limited, city-specific program with tiered incentives [19]. Therefore, supplemental tools are used. The RMI E-Bike Environment and Economic Impact Assessment Calculator is specifically designed for this purpose, estimating environmental, health, and economic impacts of shifting short trips (<5 miles) to e-bikes, including modeling specific incentive programs [13]. ARC utilized this calculator for the PCAP e-bike measure analysis [1]. The Drawdown Georgia framework provides state-specific context and benchmarks, including achievable potential estimates and trackers for solution adoption [17, 20].

C. Estimated Achievable GHG Reductions for Metro Atlanta's E-Bike Program

Using the RMI calculator methodology and regional travel data, the ARC PCAP estimated the achievable GHG reduction potential for the "Incentivize Use of Electric Bikes" measure across the 29-county Atlanta MSA [1].

- **Cumulative Reduction:** 1,937 MTCO2e by 2035 and 13,174 MTCO2e by 2050.
- **Annual Reduction (Implied):** ~456 MTCO2e in 2035 and ~760 MTCO2e in 2050.

These figures reflect the initial $1 million pilot funding level [1]. However, these estimates appear conservative compared to broader potential assessments and observed behavior:

- RMI's illustrative calculation for Atlanta suggested potential reductions of 106,603 MTCO2e over ten years [13].
- Denver participants replaced 3.4 car trips/week [13].
- Northern California participants replaced 35-44% of car VMT short-term [21].
- Atlanta pilot recipients reported a ~40% reduction in driving frequency for work/school commutes [6].

The substantial VMT reductions reported by Atlanta pilot participants suggest that the achievable potential could be considerably larger than initial PCAP figures if the program receives sustained funding and infrastructure support [6]. These calculations, based on a proposed central scenario, are performed in Sections 4 and 5, and result in higher reductions in CO2e and GHG emissions.

D. Contextualizing Impact: Drawdown Georgia's Framework

The ARC PCAP estimate (1,937 MTCO2e by 2030) represents about 0.23% of Drawdown Georgia's statewide achievable potential for the broader "Alternative Transportation" solution (0.84 MMTCO2e by 2030) [17]. This indicates that significant scaling of e-bike adoption and other alternative mobility strategies is needed statewide to meet the DDGA target of replacing 2.5% of VMT [17, 22].

E. Business-As-Usual (BAU) Transportation Emissions Baseline

The 2019 transportation baseline for the Atlanta MSA was ~30.7 MMTCO2e [1]. Projecting future BAU emissions is complex. Statewide, while overall GHG emissions have declined (due to electricity sector changes), transportation emissions increased by 4% between 2017-2021, driven largely by diesel truck fuel consumption [23]. This trend highlights the critical need for targeted transportation decarbonization strategies like e-bike promotion in the high-VMT Atlanta region [13]. The ARC PCAP analysis for the e-bike measure used a declining baseline, likely reflecting anticipated vehicle efficiency improvements [1].

F. Current E-Bike Promotion Policies and Regulations

- **State Law:** Georgia follows the 3-class system (≤750W motors), requires no license/registration, mandates helmets only for Class 3 riders (<16 for all bikes), and generally permits e-bikes on roads/paths (Class 3 often restricted from MUPs). Local governments can add restrictions [24]. Enforcement gaps exist for non-compliant devices [25].

- **Atlanta Pilot Program (2024):** Key features include $1M funding, ARC administration, Propel ATL outreach, point-of-sale lottery-based rebates, strong equity focus (82% funds to ≤80% AMI), tiered rebates ($500-$2000), City resident eligibility, purchase required at 12 local shops [6, 24]. High demand (>11k applicants), 579 redemptions, >$1.2M local sales, significant reported car trip replacement [6].
- **ARC/Regional Plans:** PCAP includes e-bike incentives [1]. MTP allocates funding for bike/ped infrastructure [26]. Safety and transit integration are priorities [26].
- **Dockless Devices:** Atlanta regulates shared e-scooters/e-bikes (permits, parking rules, no sidewalk riding, speed/time restrictions) [27].

G. Supporting Infrastructure: Status, Plans, and Gaps

- **Current Status:** Metro Atlanta's bike network is growing but fragmented, with limited protected facilities (only 4 miles reported in Atlanta in 2019) [28]. Key trails like the BeltLine need better connections [28]. This lack of safe infrastructure is a major deterrent [29].
- **Plans/Projects:** ARC's "Walk. Bike. Thrive!" and Regional Trail Vision aim for a connected network [26]. The MTP allocates $3.9B+ through 2050 for bike/ped projects [26]. Specific projects (BeltLine segments, DeKalb Ave improvements) are underway [30]. Advocacy groups like Propel ATL push for faster implementation and higher standards [30].
- **Gaps/Needs:** Critical needs include building a connected, protected network (especially in underserved areas), designing for mixed micro mobility speeds, providing secure end-of-trip facilities (parking/charging), and overcoming implementation delays/challenges [28, 25, 31].

H. Current Level of E-Bike Penetration in Georgia

Proxy indicators suggest the following:

- High demand for Atlanta rebate (>11k applicants) suggests significant interest [6].
- Drawdown Georgia tracks >100k EV registrations statewide [17], but not e-bikes specifically [20].
- Shared micro mobility increases public familiarity [27].

Conclusion: Interest is high, policy-driven adoption is starting, but overall penetration is likely low compared to potential [17].

I. Comparative Analysis: Georgia vs. Peer States

Georgia lacks statewide e-bike incentives, unlike CA, CO, MN, OR [32, 33]. Atlanta's pilot is significant locally but not statewide [24]. Peer states often have broader ZEV policies (e.g., ACC II), which Georgia lacks [15]. This policy lag likely contributes to lower adoption rates in Georgia compared to these leading states.

Table 1: Comparison of State-Level E-Bike Policies (Georgia vs. Select Peer States)

Feature	Georgia	California	Colorado	Minnesota	Oregon
Statewide Rebate/Credit	No (Local pilot only)	Yes (Income-focused) [32]	$450 Tax Credit; Past Rebate (closed) [32, 33]	Yes (Launched 2024, lottery) [34]	Yes (Launched 2025, income-focused) [32]
Max Rebate/Credit	$2,000 (Local pilot, income-qual.) [24]	$1,200-$2,000+ (Income-based) [32]	$450 (Credit); $1,100+ (Past Rebate) [32]	$1,500 (Income-based, % of cost) [34]	$500-$1,500 (Income-based) [32]
Key Local Programs	Atlanta Pilot [24]	Numerous (e.g., NorCal programs) [21]	Denver (Ongoing, equity focus) [13]	State program primary	Eugene (Utility rebate) [32]
Other State Policies	Basic 3-class system [24]	ACC II adopted [15]	ACC II adopted [15]	ACC II adopted [15]	ACC II adopted [15]
Adoption Indicators	High interest (ATL); Low overall (infer.)	Likely higher (longer policy history)	High demand (Denver); ~8k state rebates [33]	High demand (State program sold out) [34]	Growing interest
Infrastructure Focus	ARC plans; implementation challenges [26]	Significant investment, varies locally	Strong focus (e.g., Denver)	State funding includes infrastructure	Active transport planning

J. Drivers and Barriers to Widespread Use Across Georgia

- **Drivers:** Cost savings vs. cars [10], convenience for short trips [13], accessibility for diverse users [6], health/recreation benefits [12], policy momentum (Atlanta pilot, ARC plans) [24], growing awareness [10].
- **Barriers:** High purchase cost [10], inadequate/unsafe infrastructure [13], safety concerns (traffic, theft) [21, 25], lack of secure parking/charging [21], policy/funding gaps [31], car-centric culture, weather [21].

3. E-Bike CO2e Reduction Potential (Technical Potential)

A. Defining Technical Potential

Technical potential represents the theoretical maximum GHG mitigation achievable if a technology were deployed to its physical limits, disregarding costs, infrastructure, user acceptance, or policy constraints [16]. It serves as an upper-bound benchmark.

B. Methodology for Technical Potential

The technical potential for CO2e reduction from e-bike adoption replacing short car trips (≤ 5 miles) in the 29-county Atlanta MSA is estimated using the formula:

Technical Potential CO2e Reduction = (Projected Annual Short Trip VMT) × (Max Realistic Replacement Rate) × (Avoided CO2e Emission Factor)

Key assumptions):

- **Geographic Scope:** 29-County Atlanta MSA [1].
- **Baseline Year:** 2020 [35].
- **Target Years:** 2035 and 2050.
- **Population Projections:** Estimated by applying ARC's 21-county growth rates to the 29-county 2020 baseline.

Year	Estimated/Projected Population	Data Source/Methodology Note
2020	6,089,815	U.S. Census Bureau (2020)
2035	~7,230,000	Estimated by applying the interpolated 2020-2035 growth rate from ARC's 21-county forecast [26] to the 2020 29-county baseline. Interpolated 21-county population for 2035 is ~7,140,000, representing ~17% growth from 2020. Applying 17% growth to 6,089,815 yields ~7,125,000. Rounded for estimation clarity.
2050	~7,917,000	Estimated by applying the 2020-2050 growth rate (30%) from ARC's 21-county forecast [26] to the 2020 29-county baseline (6,089,815 * 1.30 ≈ 7,916,760).

Note: 2035 and 2050 figures derive from applying ARC's 21-county growth rates to the 29-county baseline population.

- **Baseline VMT:** Estimated by scaling the FHWA 2019 Atlanta UZA DVMT to the 2020 29-county population and projecting forward with population growth, assuming constant VMT/capita.

- **Short Trip VMT Share:** Assumed 15% of total passenger car VMT comes from trips ≤ 5 miles, based on national estimates [36].

Year	Estimated Total Annual Passenger Car VMT (Billions)	Estimated Annual Short Trip VMT (≤ 5 miles) (Billions)	Data Source/Methodology Note
2020 (Baseline)	~85.8	~12.9	Calculated from FHWA 2019 UZA DVMT [9], scaled to 2020 29-county population [35], annualized (x365). Short trip VMT assumes 15% of total VMT based on national estimates
2035	~100.4	~15.1	Scaled from 2020 baseline using estimated 2020-2035 population growth factor (~1.17). Short trip VMT assumes 15% of the total.
2050	~111.5	~16.7	Scaled from 2020 baseline using estimated 2020-2050 population growth factor (~1.30). Short trip VMT assumes 15% of the total.

Note: VMT figures are estimates based on scaling 2019 FHWA UZA data and applying national short-trip VMT share estimates. Assumes constant VMT per capita.

- **Max Realistic Replacement Rate:** Assumed **100%** of VMT from trips ≤ 5 miles is replaced by e-bikes, consistent with the technical potential definition [16].
- **Avoided CO2e Emission Factor:** Uses EPA's standard factor of **393 g CO2e/mile** for an average gasoline passenger vehicle (includes CO2, CH4, N2O) [37]. This factor is held static for projections.

C. CO2e Reduction Technical Potential Estimate

Applying the 100% replacement rate to the projected short-trip VMT and using the 393 g CO2e/mile emission factor yields the following technical potential estimates:

Table 2: Estimated Annual CO2e Reduction Technical Potential from E-bike Adoption in Atlanta MSA (29-County)

Year	Projected Annual Short Trip VMT Replaced by E-bikes (Billions of Miles)	Estimated Annual CO2e Reduction (Million Metric Tons CO2e - MMTCO2e)
2035	~15.1	~5.93
2050	~16.7	~6.56

*Calculation: Replaced VMT (in miles) * 3.93×10^{-7} MTCO2e/mile*

The technical potential increases from ~5.9 MMTCO2e annually in 2035 to ~6.6 MMTCO2e annually in 2050, driven by projected population and VMT growth under the static emission factor assumption.

D. Context and Discussion

- **Comparison with Drawdown Georgia:** The estimated 6.6 MMTCO2e technical potential for e-bike substitution in the Atlanta MSA represents ~30% of DDGA's statewide technical potential (21.5 MMTCO2e) for the broader "Alternative Mobility" solution [17]. However, it vastly exceeds DDGA's statewide *achievable* potential estimate of 0.84 MMTCO2e by 2030 for the entire bundle [17].
- **Comparison with Modeled Incentive Programs:** The technical potential (millions of tons annually) dwarfs the achievable potential estimated for ARC's PCAP e-bike incentive measure (~760 MTCO2e annually by 2050) [1] and observed impacts from programs like Denver's or Atlanta's pilot [13, 6].
- **Significance:** The large gap between technical and achievable potential highlights the impact of real-world barriers discussed earlier, such as the high upfront cost of e-bikes, the lack of safe and connected cycling infrastructure across much of the MSA, and persistent safety concerns among potential riders [16]. The technical potential serves as a benchmark showing the substantial theoretical opportunity if these barriers were overcome.

4. E-Bike Rebate Co-Pollutant Impacts

A. Methodology for Co-Pollutant Analysis

As standard state-level tools like the Energy Policy Simulator (EPS) lack granularity for specific e-bike programs [18, 19], this analysis uses an alternative approach consistent with the RMI E-Bike Calculator framework [13] or direct application of emission factors to estimated VMT reductions.

1. Estimate the program participation and annual VMT reduced by the program scenario.

The Atlanta pilot program demonstrated significant latent demand for e-bikes, with over 11,000 applications received for an initial funding pool capable of supporting approximately 579 redemptions [7]. This suggests that a sustained regional program could achieve substantial participation if adequately funded.

Assuming a scaled regional program with consistent annual funding (e.g., a central scenario of $3 million annually, reflecting a tripling of the pilot's funding scaled roughly by population from the City of Atlanta to the broader MSA), we can project the number of rebates issued. Using the average rebate value derived from the pilot (approx. $1,700, calculated from $1.2M sales / 579 redemptions, though actual rebate values varied [7]), $3 million could support roughly 1,765 rebates annually. Cumulative adoption under this scenario would lead to approximately 17,650 subsidized e-bikes by 2035 and 44,125 by 2050 operating within the region, assuming continuous funding and participation rates.

Based on evidence from various programs, a central estimate for average weekly VMT replacement per e-bike can be adopted. The Denver program reported an average of 26 miles per week replaced. RMI's calculator uses a default assumption that users replace 15% of their total VMT, while another study estimated e-bike users replace 3.4 car trips per week. Considering the strong equity focus of the Atlanta model (82% income-qualified redemptions [7]) and evidence that lower-income users replace more VMT, this analysis assumes a central estimate of **25 miles per week (1,300 miles per year)** of car VMT replaced per subsidized e-bike.

Table 3: Estimated E-Bike Deployment and Annual VMT Replaced (2035, 2050)

Year	Projected Annual Rebates (Total)	Cumulative E-Bikes from the Program	Assumed Annual VMT Replaced per E-Bike	Total Annual VMT Replaced (Millions)
2035	1,765	17,650	1,300	22.9
2050	1,765	44,125	1,300	57.4

Notes: Assumes $3M annual funding and average rebate structure consistent with Atlanta pilot. Cumulative e-bikes assume continuous program operation from 2025 and neglect bike retirement for simplicity.

2. Identify baseline emission factors (g/mile) for key co-pollutants (NOx, PM2.5, VOCs, CO) for the average passenger vehicle replaced, primarily using EPA MOVES model data or derived national averages [4, 38].

Table 4: Illustrative Average Passenger Vehicle Co-Pollutant Emission Factors (g/mile)

Pollutant	**Emission Factor (g/mile)**	**Source/Notes**
NOx	0.24	Based on EPA data [38]; represents exhaust NOx. MOVES5 outputs preferred. Older sources suggested higher values (e.g., 0.693-0.95 g/mile).
PM2.5	0.01	Based on EPA data [38]; includes exhaust + brake + tire wear. Exhaust PM2.5 is much lower in older estimates. MOVES5 outputs preferred.
VOCs	0.22	Based on EPA data [38]; total VOCs (exhaust + evaporative).
CO	2.54	Based on EPA data [38]; exhaust CO.

Note: Emission factors are highly variable. Values are illustrative and require verification/updating using the latest official EPA data.

3. Calculate total annual pollutant reduction = (VMT Reduced) × (Emission Factor) × (Conversion Factor).

B. Estimated Co-Pollutant Reductions

Applying these illustrative factors to the central VMT reduction scenario (approx. 22.9 million miles/year by 2035 and 57.4 million miles/year by 2050) yields estimated annual reductions:

Table 5: Estimated Annual Co-Pollutant Reductions (Metric Tons/Year) - Central Scenario

Year	Pollutant	Estimated Annual Reduction (Metric Tons/Year)
2035	NOx	~5.5
	PM2.5	~0.23
	VOCs	~5.0

	CO	~58.2
	NOx	~13.8
	PM2.5	~0.57
	VOCs	~12.6
2050	CO	~145.8

These estimates demonstrate measurable co-pollutant reductions achievable through a scaled regional program.

C. Public Health Co-Benefits Assessment

Reductions in NOx and PM2.5 improve public health by lowering rates of premature mortality, heart attacks, hospital admissions (respiratory/cardiovascular), asthma attacks, and lost work days [5].

- **Methodology:** EPA's CO-Benefits Risk Assessment (COBRA) tool links emission changes to health outcomes [5]. Simplified EPA Benefit-per-Ton (BPT) estimates provide pre-calculated average monetized health benefits per ton reduced for specific sectors [39]. Applying BPT factors is a practical approach.
- **Quantified Benefits:** Using illustrative BPT values (e.g., $100,000/ton NOx, $500,000/ton PM2.5) applied to the estimated 2035 pollutant reductions (5.5 tons NOx, 0.23 tons PM2.5) yields an estimated annual monetized health benefit of ~$665,000/year ($550,000 from NOx + $115,000 from PM2.5). By 2050, this could rise to ~$1.67M/year ($1.38M from NOx + $285k from PM2.5).

Table 6: Estimated Annual Health Benefits (Monetized Value) - Central Scenario

Year	Pollutant Reduced	Estimated Annual Reduction (MT/Year)	Illustrative Benefit-per-Ton (/ton)	Estimated Annual Monetized Health Benefit (/year)
2035	NOx	~5.5	$100,000	~$550,000
	PM2.5	~0.23	$500,000	~$115,000
Total (2035)	-			~$665,000
2050	NOx	~13.8	$100,000	~$1,380,000
	PM2.5	~0.57	$500,000	~$285,000
Total (2050)	-			~$1,665,000

*Illustrative BPT values requiring use of current, sourced EPA estimates.

This calculation demonstrates that the co-pollutant reductions achieved through e-bike mode shift yield tangible public health benefits with significant economic value. These benefits accrue in addition to the GHG reductions targeted by climate policy, and add significant health co-benefits and societal value, often disproportionately benefiting LIDACs near high-traffic areas [5]. The monetized value of health co-benefits from transportation measures can be substantial, sometimes comparable to or even exceeding the estimated costs of the intervention, thereby strengthening the overall policy case. Failing to account for these co-pollutants can cause an underestimation of the program's total societal value.

D. Other Environmental Impacts

- **Air Quality:** Reductions in NOx, PM2.5, and VOCs improve local air quality, especially in urban corridors, and help mitigate ozone (smog) formation [5].
- **Noise Reduction:** E-bikes operate significantly more quietly than ICE vehicles, reducing ambient noise pollution [10].
- **Lifecycle Emissions:** While manufacturing (especially batteries) and charging generate emissions, studies consistently show e-bikes have a substantially lower lifecycle footprint compared to cars [40, 41]. This advantage increases as Georgia's electricity grid decarbonizes [42].

5. Financial Costs, Savings, and Economic Impacts

A. Methodology for Financial and Economic Analysis

This analysis integrates program assumptions (derived from the Atlanta pilot [6] and relevant case studies [13, 14, 21]) with established modeling tools and data sources (EPA MOVES [38], COBRA framework [5], EPA eGRID [42], EPA SCC estimates [43], BEA RIMS II multipliers [44]) to project impacts through 2035 and 2050. The core approach estimates program uptake, quantifies VMT replacement, calculates GHG reductions, assesses cost-effectiveness ($/ton CO_2e vs. SCC), evaluates economic impacts (jobs, GDP), and quantifies health co-benefits. As discussed previously, our **central scenario** assumes sustained annual funding (e.g., $3 million) supporting approximately 1,765 rebates annually, distributed according to the pilot's structure (82% income-qualified, ~33% cargo bikes) [6], with each subsidized e-bike replacing an average of 25 miles per week (1,300 miles per year) of car VMT [14]. The central estimate of 1,300 miles/year replaced per e-bike is derived from analyzing case studies (e.g., Denver [13], N. California [21], Saanich [14]) and considering the strong equity focus of the Atlanta model, which suggests potentially higher replacement rates among targeted users compared to programs without such focus.

B. Policy Cost Distribution

- **Government Costs:** Primarily the direct outlay for rebates ($3M/year under central scenario) plus administrative overhead (estimated at 8% of rebate value, or $240,000 annually), totaling **~$3.24 million per year**.
- **Participant Costs & Savings:**
  - *Upfront Cost:* Average e-bike purchase price assumed at $2,300 [10]. The average rebate value (weighted by pilot distribution [6]) is ~$1,550. Net upfront cost for participants: $2,300 - $1,550 = **$750**.
  - *Annual Operating Costs:* Estimated at **$220/year** ($200 maintenance [45] + $20 electricity [46]).
  - *Annual Savings (Avoided Car Costs):* Based on replacing 1,300 miles/year at an operating cost of $0.25/mile [47], annual savings are 1,300 * $0.25 = **$325**.
  - *Net Annual Position (Operating):* Participants experience net annual savings of $325 (savings) - $220 (costs) = **$105**.
  - *Lifetime Net Cost/Saving (6yr):* Total cost = $750 (upfront) + 6 * $220 (operating) = $2,070. Total savings = 6 * $325 = $1,950. Results in a small net cost ($120) using conservative operating savings. Substantial net savings result if total ownership cost savings ($0.82/mile [47]) are considered.
- **Nonparticipant Costs:** Direct costs are negligible. Indirect costs are possible via general taxes. Complementary infrastructure investments carry public costs but benefit all users.

C. Cost-Effectiveness Calculation

Annualizing upfront costs over an assumed 6-year e-bike lifetime using a 3% social discount rate:

- Annualized Government Cost ≈ $3.24M/year.
- Annualized Net Participant Cost ≈ $33 per participant per year [($750 upfront / 5.417 annuity factor) - $105 net operating savings].
- Total Annualized Program Cost (for 1,765 participants/year cohort) ≈ $3.24M + (1,765 * $33) ≈ **$3.3 million per year**. (Refined calculation: $3.24M - (1765 * $105) + (1765 * $750 / 5.417) ≈ $3.13M/year).

Comparing this refined cost to annual avoided GHG emissions (from the Topic 4 source):

Table 7: Cost-Effectiveness ($/ton CO2e Avoided) and Net Climate Benefit Analysis (2035, 2050)

Year	Total Annualized Program Cost (M)	Annual Avoided GHG (MTCO2e)	Cost−Effectiveness (/ton CO2e)	Social Cost of Carbon ($/ton CO2e, 2% rate)*	Annual Net Climate Benefit ($M)**
2035	$3.13	~8,860	~$353	~290	-0.56 (neg)
2050	$3.13	~22,300	~$140	$310	~3.8

Notes: Table 3 for Annual Avoided GHG.
SCC values from EPA 2023 estimates (2% discount rate, 2020) [43].
**Net Climate Benefit = (Annual Avoided GHG * SCC) - Total Annualized Program Cost. Negative value indicates that costs exceed monetized climate benefits based solely on SCC.

The program becomes increasingly cost-effective over time, yielding positive net climate benefits by 2050 under the central SCC estimate. Furthermore, when considering the substantial monetized public health benefits from reduced air pollution (estimated at $665,000 annually by 2035 and $1.67M by 2050), the overall value proposition of the program appears strong even in the near term, despite the climate benefits alone initially falling short of the estimated costs under this SCC scenario. The overall value proposition is stronger when considering health and equity co-benefits.

D. Economic Impacts: Jobs, GDP, and Development

- **Impact on Local Retailers:** The program directly stimulates local retailers. The Atlanta pilot ($1M funding) generated >$1.2M in sales at 12 participating shops (~$2,070 sales/rebate) [6]. A regional program (1,765 rebates/year) could inject

~$3.65 million in direct annual sales into participating MSA bike shops.

- **Employment Impacts:**
  - *Direct Employment:* ~$3.65M annual retail sales could directly support **~36 jobs** (using national avg. ~9.9 jobs/$1M retail final demand [48]).
  - *Indirect & Induced Employment:* Using representative BEA RIMS II multipliers (e.g., ~10.6 indirect jobs/$1M final demand [48]), the $3.65M could support **~39 indirect/induced jobs** annually.
  - *Total Employment:* Estimated **~75 jobs** supported annually (36 direct + 39 indirect/induced). Requires Atlanta MSA-specific RIMS II multipliers for precision [44].
- **GDP Contribution (Value Added):** Requires applying Atlanta MSA-specific RIMS II Value Added multipliers to the ~$3.65M direct spending to quantify the contribution to regional GDP [44].
- **Broader Economic Development:** Supports small businesses [6], may spur growth in related services (repair, charging), enhances neighborhood vitality, and offers workforce development potential.

Table 8: Estimated Annual Economic Impacts (Central Scenario)

Impact Category	Metric	Annual Value	Basis of Estimate
Direct Economic Activity	Spending at Local Bike Shops ($M)	~$3.65	1,765 rebates/year * ~$2,070 sales/rebate [6]
Employment (Jobs Supported)	Direct Jobs	~36	$3.65M * ~9.9 jobs/$M (Retail avg. [48])
	Indirect & Induced Jobs	~39	$3.65M * ~10.6 jobs/$M (Retail avg. [48])
	Total Jobs	~75	Direct + Indirect/Induced
GDP Contribution	Total Value Added ($M)	Requires MSA Multiplier	$3.65M * RIMS II Value Added Multiplier (Retail) [44]

Note: Job estimates use representative national multipliers [48]; precise impacts require Atlanta MSA-specific RIMS II multipliers.

6. E-bike Rebate Equity Analysis

A. Defining Equity

Equity analysis considers fairness across multiple dimensions :

- **Distributional Equity:** How benefits (e.g., cost savings, health improvements, access) and burdens (e.g., costs, negative externalities) are shared across socioeconomic, racial, and geographic groups.
- **Procedural Equity:** Fairness and inclusivity in decision-making processes, ensuring meaningful participation from affected communities.
- **Inter-generational Equity:** Fairness in distributing benefits and burdens between present and future generations, particularly concerning long-term environmental and health impacts [43].

B. Distributional Equity

- **Targeting LIDACs:** High e-bike costs ($2,600-$5,000+) are a major barrier for Low-Income and Disadvantaged Communities (LIDACs) [10]. Income-tiered rebates, like Atlanta's pilot (82% funds redeemed by ≤80% AMI group [6]), effectively address this. This is crucial as LIDACs often face higher transportation cost burdens and fewer options [10]. Studies suggest lower-income recipients may replace more car trips, maximizing benefits [21]. Flat rebate amounts are generally considered more equitable than percentage-based ones [10].
- **Geographic Distribution:** Access to safe biking infrastructure is unevenly distributed, often lacking in LIDACs [8]. Equitable access requires prioritizing infrastructure improvements in these areas, identified using tools like the Climate and Economic Justice Screening Tool (CEJST) or EJScreen and ARC's equity criteria [1]. Access to participating local bike shops can also be a geographic barrier; allowing online vendors could increase access but might reduce local economic benefits [10].
- **Accessibility for Diverse Users:** E-bikes enhance mobility for older adults and those with physical limitations. Cargo e-bikes (~1/3 of Atlanta redemptions [6]) increase utility for families. Program design should consider the needs of diverse users (e.g., higher rebates for adaptive/cargo bikes) [10].

C. Procedural Equity

- **Stakeholder Engagement:** Meaningful engagement with LIDACs, advocacy groups (e.g., Propel ATL [6]), bike shops, and potential participants is crucial for program design, implementation, and evaluation. ARC's Transportation Equity Advisory Group (TEAG) provides a platform.
- **Application Process:** Must be accessible (online/assisted options [14]), transparent (clear eligibility, lottery process), and minimize barriers (simplified income verification [10]).

- **Program Evaluation:** Equity metrics (rebate distribution by income/geography [LIDACs], participant surveys disaggregated by demographics, impact on local businesses) should be central [12]. Distinguishing between baseline vs. induced buyers is important [12].

D. Inter-generational Equity

- **Climate Mitigation:** Reducing GHG emissions benefits future generations by lessening climate change impacts. The Social Cost of Carbon reflects this value [43].
- **Reduced Pollution Legacy:** Lowering criteria pollutants improves long-term air quality and health [5].
- **Sustainable Infrastructure:** Promoting e-bike use encourages investment in active transportation infrastructure, creating more sustainable, less car-dependent communities for the future [8], contrasting with highway expansion [58].

E. Addressing Stakeholder Concerns & Recommendations

- **Concerns:** Key stakeholder concerns include safety (inadequate infrastructure [13], traffic interactions [25]), affordability (ongoing maintenance costs [10]), infrastructure access (uneven distribution [8]), and program accessibility/fairness (application complexity, lottery fairness [10]).
- **Amplifying Support:** Highlight co-benefits (health, cost savings, economic development [12]), build community partnerships (advocacy groups [6], health orgs, bike shops [15]), use data-driven advocacy [6], and integrate with broader regional plans (MTP [1], climate plans [1]).
- **Equitable Design Recommendations:** Maintain/strengthen income tiers [10], use point-of-sale rebates [6], adopt flat rebate amounts [10], include essential accessories [59], consider flexible vendor options [10], and prioritize concurrent infrastructure investment in LIDACs [8].

7. Conclusion

The analysis compiled in this report indicates that a Regional E-Bike Rebate Program represents a viable and potentially highly effective strategy for advancing equitable climate action within the Atlanta MSA. By addressing the primary barrier of upfront cost, such programs can accelerate the adoption of e-bikes, leading to measurable reductions in VMT and associated GHG emissions from the transportation sector. The estimated achievable GHG reduction potential, while modest compared to the overall transportation footprint, contributes meaningfully towards regional climate goals.

Crucially, the program demonstrates significant potential for positive equity outcomes. When designed with intentionality, utilizing income-based tiers and point-of-sale mechanisms, rebates can disproportionately benefit low-income and disadvantaged communities. Evidence from Atlanta's pilot and other case studies shows that lower-income recipients often utilize e-bikes more frequently and replace more car trips, maximizing both emission reductions and personal cost savings. This aligns directly with ARC's goals of promoting equitable access to affordable, sustainable transportation options.

Beyond carbon reductions, the program yields substantial co-benefits. Improvements in local air quality resulting from reduced NOx and PM2.5 emissions translate into tangible public health benefits, including avoiding mortality and morbidity, particularly in overburdened communities. Furthermore, the program stimulates local economic activity by driving sales at participating bike shops and creates user savings through reduced vehicle operating costs. The program's cost-effectiveness appears favorable, especially in the longer term and when considering these multifaceted benefits.

However, realizing the full potential requires addressing key challenges. Ensuring equitable access necessitates not only financial assistance but also sustained investment in safe, connected bicycle infrastructure, particularly in historically underserved areas identified through tools like CEJST and EJScreen. Safety concerns, both real and perceived, must be mitigated through infrastructure improvements, rider education, and appropriate enforcement of traffic laws. Continuous and inclusive stakeholder engagement is essential to ensure the program design remains responsive to community needs and priorities.

Recommendations:

1. **Implement and Scale:** Pursue the implementation of a sustained, adequately funded Regional E-Bike Rebate Program for the 29-county Atlanta MSA, building upon the successful structure and equity focus of the City of Atlanta pilot.
2. **Maintain Equity Focus:** Continue prioritizing income-qualified residents (e.g., ≤80% AMI or tiered) with significantly higher, flat-rate, point-of-sale rebates.

3. **Integrate with Infrastructure:** Coordinate program expansion with accelerated, equitable investment in a safe, connected network of protected bike lanes and regional trails, prioritizing routes serving LIDACs and key destinations.
4. **Foster Partnerships & Engagement:** Continue collaboration with advocacy groups, community organizations, local governments, and bike shops for outreach, education, and program refinement. Ensure ongoing, inclusive stakeholder engagement.
5. **Monitor and Adapt:** Establish a robust monitoring and evaluation framework tracking participation demographics, usage patterns (VMT replacement), costs, GHG/co-pollutant reductions, economic impacts, and equity outcomes. Use data for adaptive management.

By strategically investing in both e-bike affordability and safe cycling infrastructure, the Atlanta region can leverage this program to make significant progress towards a more sustainable, equitable, and economically vibrant transportation future.

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