THE BENEFITS OF CARGO BIKES IN RIO DE JANEIRO: A CASE STUDY

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ABSTRACT

The use of bicycles and tricycles for goods delivery is growing in Europe and the United States, largely for environmental reasons and often aided by public policy. In Rio de Janeiro, goods delivery by cargo bike is already a thriving practice, with thousands of deliveries made every day, with no incentive from public policy or consumer preference for environmentally-friendly practices. This paper first examines existing literature, topics and trends regarding the use of cargo bikes in Europe and the US, then describes data collected on the use of these vehicles in Rio de Janeiro, and finally makes policy recommendations to strengthen this practice in Brazil in general and Rio de Janeiro in particular.

Keywords: bicycles, cargo bikes, urban goods movement, urban freight movement, sustainability, carbon emissions, local emissions, public health, urban economy

INTRODUCTION AND BACKGROUND

Urban trips that involve cargo transport make up a significant portion of overall trips in any city. For example, in urban areas in France, these are estimated to from 9% to 15% of total trips (Schoemaker, 2004 in Reiter 2012). While heavy freight deliveries make up approximately 10% of urban trips, light goods deliveries accounting for about 5%. This 5% of light goods deliveries in urban areas represents an important opportunity for bicycles and tricycles for goods delivery (hereafter referred to as “cargo bikes”). Cargo bikes can efficiently deliver goods while lowering greenhouse gas emissions by replacing motorized vehicles, and at the same time increase

available urban space, improve public health, reduce congestion, and generally improve quality of life in urban areas. We first review existing literature on the topic, then present data we collected on the very commonplace, but unheralded, practice of cargo bike delivery in Rio de Janeiro. We then compare cargo bike use in Rio to practices reviewed in other cities, and conclude with policy recommendations to preserve and encourage these vehicles in Rio de Janeiro and throughout Brazil.

Literature review: cargo bikes in Europe and the US

Despite their enormous potential for reducing emissions, saving space and generally increasing quality of life in cities, scholarship on cargo bikes is sparse. Publications in recent years include, a report by Transport for London on the potential of cargo bikes (TfL, 2009), a paper submitted to Transit Research Board on the potential of delivery cycles in New York City (Conway et al., 2011), a baseline report establishing the potential emissions savings of cargo bikes (Reiter, 2012) and an action plan for promotion (Wrighton, 2012) produced by an EU-funded advocacy project named Cyclelogistics, and at least one journal article (O'Connor, 2011). Additional texts related to cargo bikes include at least three master's theses (Muhlbacher, 2010, Riehle, 2012, Weirich, 2012), and a paper submitted to Transportation Research Board in 2012 (Conway et al., 2011).

Cargo bikes are bicycles and tricycles that are used to carry and deliver goods. Most of these have been designed or retrofitted to carry goods, and are propelled by human power, although some electric-assist bikes are used. Generally speaking, the upper limit of the freight carried is 250 kilos (551 lbs).

Reiter identifies the following types of urban goods transport:

- State postal companies and commercial parcel delivery services and haulage firms. After delivery to an urban distribution center, the "last mile" is often the most expensive (ITDP, 2010) and logistically challenging part of goods delivery.

- Deliveries of merchants (wholesale and retail), goods producers and services, e.g., pharmacies and dry cleaners.

- Services carried out on-site, such as by craftspeople or park maintenance.

- Trips by private individuals, including necessary trips (e.g., grocery shopping), but also leisure trips, including clothing shopping.

The literature reviewed for this paper mentioned the following advantages of cargo bikes vis-à-vis motorized options (in most cases, cars or vans) used for deliveries:

Lower costs associated with vehicles – these included purchase, maintenance, and running costs. Running costs include fuel, taxes, insurance, storage and depreciation. Also included here are lower costs for parking (advantageous where parking is metered and fines are given to improperly parked vehicles). Not paying user fees is an advantage in cities like London, which congestion charges and a Low Emissions Zone, where trucks that do not meet a stringent particulate matter emissions standard face a high penalty for circulation in the area (NYMTC, 1997, in Conway, 2011) Paris has restricted the circulation of trucks with areas greater than 29 m2 (312 ft2) to between 10 PM and 7 AM.

Increased access for goods delivery – cargo bikes find on-street parking much more easily than vans, and can also be parked on sidewalks, often greatly reducing delivery time. Also, during rush hours, cycles often out-perform motorized vehicles that are stuck in traffic. Motor vehicle speeds during business hours in Manhattan average 15 kmph (9.3 mph), with even lower speeds downtown and in midtown (NYCDOT, 2011, in Conway, 2011), with similar speeds in Paris and London. Cargo bikes, which can travel up to about 20 kmph (12.6 mph), can overtake cars and vans, especially in areas with robust bicycle infrastructure, including physically segregated bike lanes.

Environmental benefits – Cargo bikes emit zero greenhouse gasses and local pollutants, leading to substantial emissions savings. According to the French cargo bike delivery company La Petite Reine, it avoids 203 metric tons (447,500 lbs) of CO2 emissions with one year of cargo bike delivery, while a study of London deliveries estimated a 62 % reduction in CO2 emissions per parcel (Gnewt company website), and a company in Portland (US) estimates savings in CO2 emissions of 24.5 metric tons (54,000 lbs) (B-line company website, in Conway 2011).

Lower infrastructure costs – while motorized vehicles, and particularly heavy trucks, can cause substantial damage to roads and bridges, requiring expensive maintenance regimes, cargo bikes incur relatively miniscule infrastructure costs.

Safety – Conway et al. point out that reducing the amount of heavy trucks and vans on city streets can lead to reductions in pedestrian and cyclist deaths and injuries.

"Green" image – The companies servicing Paris and London that use cargo bikes use the eco-friendly aspect of their business to attract clients and improve revenue streams. Both sell the advertising space on the cargo bikes and emphasize their environmentally-friendly business model on their websites (La Petite Reine and Gnewt Homepages). Gnewt's website showcases the prizes it has won for "green" business innovation.

Current use and potential

Transport of goods by bicycle by consumers (e.g., bringing groceries from the market to home) is currently a common practice in countries with high bike modal share, including Holland, Denmark and Germany. In other European and US cities, freight transport companies have adopted cycles for last-mile deliveries, and/or companies have been created specifically to transport goods via cycle.

In Paris and London, Urban Micro-Consolidation Centers (UMC), areas where freight is delivered by truck for distribution via cargo bike and van, have been set up, boosting cargo bike deliveries (Conway, 2011). In Paris, the UMC was established by a city government-led effort, and three third-party logistics carriers deliver packages there, which are distributed via cargo tricycle by a firm called La Petite Reine, established in 2003. In addition, La Petite Reine delivers goods for food, electronics and pharmaceutical distributers, as well as grocery stores, e-commerce, and other small businesses. Besides its operations in Paris, the firm is established in Bordeaux, Lyon and Toulouse, and delivers approximately one million packages per year (La Petite Reine website).

The UMC in London was established in 2009, and a major office-supply company hired Gnewt Cargo to make last mile deliveries. Gnewt Cargo has since added several other clients and employ 15 staff, and use 6 tricycles and 3 electric vans to deliver 4,500 parcels each week.

Cargo bikes have also proliferated in the US in recent years. In New York City, Revolution Rickshaws performs deliveries for small, local, “green” businesses, such as organic food restaurants, and completes 50-60 deliveries per day with 10 cargo tricycles. Other similar businesses include Zipments, a company that acts as a broker between independent bicycle couriers (75% the company`s deliveries) and cargo bike operators (20%) (Miller 2013). In 2012, Zipments received a $200,000 investment from the municipal government’s New York City Economic Development Corporation and private venture capitalists (Katz 2012). Cargo bike delivery services also exist in Berkley, California (Pedalexpress homepage, in Conway, 2011), Eugene (Pedalers Express webpage) and Portland (B-line homepage in Conway, 2011), Oregon, as well as in Boston (Metro Pedal Power homepage in Conway, 2011), Philadelphia (Pedal Co-op homepage in Conway, 2011) and Alexandria, Virginia (homepage in Conway, 2011).

Reiter considers that 25 % of all trips carrying cargo in European cities could be carried out by cargo bikes. Most of this (20 % of all urban trips) is represented by passenger transport with goods movement (e.g., grocery shopping, leisure with sports equipment), while 5 % of total urban freight/goods transport in Europe could be completed by cargo bike. A travel distance of 7 kilometres was used, and the load considered was more than a handbag but less than 200 kg. This would require a

modal shift from motorized to cargo bikes of 17 % for private trips involving goods transport, and 8 % of urban good delivery by professional services.

CARGO BIKES IN RIO DE JANEIRO

Every day, thousands of cargo bikes circulate in the city of Rio de Janeiro. The use of these vehicles provides multiple benefits for the city compared to motor vehicles (vans and motorcycles), including lower emissions of greenhouse gases and local pollutants. Further, we suspect that these vehicles lead to fewer traffic deaths and injuries, increased profitability of commercial activities, and greater availability of urban space.

We present data on this mode of transport for delivery services in Rio de Janeiro, based on a case study in the neighborhood of Copacabana and complemented with data from the neighborhoods of Tijuca, Jacarepaguá and Santa Cruz. After quantifying the benefits to the city in terms of emissions, we outline other possible benefits proposes recommendations for increasing cycling in general, and cargo bikes in particular, in Rio de Janeiro and other cities.[1]

As the number of motorized vehicles in Brazilian cities increases, freight distribution in urban centers is becoming more challenging. Larger volumes of motorized vehicle travel have led to increased traffic congestion, and negatively impacted the environment and public health. In addition, commercial establishments are constantly reducing the size of their stocks (usually due to the rising cost of space), necessitating more frequent deliveries of stocks, and thus increasing the number of delivery vehicles and trips (Portugal, 2007).

We conducted a survey of businesses that use cargo bikes for delivery services in the neighborhood of Copacabana, the most densely populated neighborhood of Rio de Janeiro and Brazil (35,705 inhabitants/km^2, IBGE, 2010). The study was carried out between December 2010 and January 2011, over a total of approximately 40 days.

Copacabana was divided into four regions and all the shops were visited to confirm the use of bike for delivery. If the bike service existed, the researcher interviewed the manager or another employee or even the cyclists, to collect the following data: type

[1] The field data on cargo bikes in Rio de Janeiro was collected for a collaborative project funded by the Brazilian NGO Transporte Ativo and ITDP (Institute for Transportation and Development Policy), and also had the support of the Clinton Climate Initiative to calculate the estimated emission reduction of pollutants and greenhouse gases. The findings of the field studies were released in a paper Retrieved at the Transporte Ativo website (http://www.ta.org.br/contagens/carga.pdf) in February 2011, and presented at the ANTP Congress in Rio de Janeiro in October 2011.

of establishment, type of vehicle (regular bicycle, cargo bicycle and / or tricycle), amount of cargo bike, cyclists and deliveries per day, range of delivery and owner of the cargo bike.

A complementary survey conducted in January 2011 identified qualitative data on the use of bicycles for freight transportation in some of the establishments identified in Copacabana, and also included the neighborhoods of Tijuca, Jacarepaguá and Santa Cruz, in the Northern (Tijuca) and Western (Jacarépagua, Santa Cruz) zones of the city. Interviews were completed in 15 establishments in each of those neighborhoods, for a total of 60 interviews for this section (second) of the field research.

Data on Cargo Bikes in Rio de Janeiro

Below are the results of the first survey, carried out exclusively in Copacabana:

The researchers identified 372 establishments that used cargo bikes in Copacabana. These establishments included: pharmacies (11%), bakeries (10%), hardware stores (9%), diners (9%), restaurants (8%), dry cleaners (8%), supermarkets (8%), beverage distributers (6%), pet shops (5%), and others (23%) – including kiosks, bars, independent goods movers, mattress stores, delicatessens, electronics repair shops, DVD/video rental, automotive parts distributers, and florists.

All told, these businesses used 732 cargo bikes, of which 40% were regular bicycles, 30% cargo bicycles and 30% tricycles.


Figure 1 - Regular bicycle


Figure 2 - Cargo bicycle


Figure 3 – Cargo tricycle

This provided 768 direct jobs for cyclists in the neighborhood. On average, the commercial establishments consulted had two bicycles or tricycles, two full-time cyclists making 31 deliveries each, and a minimum of 62 trips per day.

These cyclists made an average of 11,541 deliveries per day, equivalent to at least 23,082 daily trips (each delivery equals two trips).

Figure 4 – Map of businesses that use delivery cycles in Copacabana

The second survey, designed to complement the data above and carried out in was complemented by a field survey in the neighborhoods of Copacabana, Tijuca, Jacarepaguá and Santa Cruz, gave the following results:

The largest group of trips by cargo bikes in these neighborhoods (29%) carried up to 25 kilos (55 pounds), 17% carried up to 50 kilos (110 pounds), 8 % up to 70 kilos (154 pounds), 21% up to 100 kilos (220 pounds), 8% up to 150 kilos (331 pounds), 13% up to 200 kilos (441 pounds), and 4% transported up to 250 kilos (551 pounds).

Survey respondents cited the following advantages for using cycles versus and motorcycles and vans: agility (44%), freight carrying capacity (24%), cost (24%) and environmental benefits (8%). This shows that the most important perceived advantage is the ability to quickly deliver products with cargo bikes, and that environmental benefits are a low priority for survey respondents.

Regarding accidents, 56% of respondents said they had never had accidents. Of those that did reports accidents, 82% of these were classified as "small accidents", and 8% as "serious accidents." Although this suggests that traffic safety is not an enormous concern for respondents, we think that a reported percentage of 8% “serious accidents” is significant.

With regards to improving safety conditions, the main suggestions given by survey respondents were: cycling infrastructure (47%), education campaigns (39%), reduced speeds for motor vehicles (10%) and improved signage (4%).

Of the respondents, 42% said that their companies "would not function" (meaning that they would not be economically viable) without these vehicles.

Benefits of cargo bikes in Rio de Janeiro

Cargo bikes provide important benefits for the city of Rio de Janeiro, in terms of emissions, urban space, the local economy, public health, noise pollution, congestion and general quality of life.

Emissions

Had the 23,082 daily trips made by cargo bikes in Copacabana been made by motorized transportation, they would have generated significant emissions of greenhouse gasses and local pollutants. The authors calculated these emissions savings by substituting the trips made by bicycle (73%) by motorcycle (model year 2008, less than 150 cc) and those trips made by tricycles (23%) by vans (model year 2009, 1.3-8V). The authors concluded that delivery bicycles and tricycles in Copacabana alone generate annual savings of 286.5 tons of CO_2, 4.3 tons of CO, 630 kilos of HC, and 358 kilos in NOx. These calculations are conservative, since the per-kilometer emissions levels for each type of vehicle were taken from published literature that assumes that the engines of these vehicles are perfectly tuned; in practice, the engines of motorcycles and vans driving in Brazilian cities are normally not well tuned, and thus create even more emissions. In addition, the cargo bikes do not emit any suspended particulate matter (soot), further improving local air quality versus motorized vehicles.

Table I – Vehicle emissions factors used

Emissions Factors	g CO/Km	g HC/Km	g Nox/ Km	g CO2/Km
Motorcycle 2008 < 150 cc	1.13	0.21	0.09	44.1618
Van 2009, 1.3 - 8V	1.197	0.043	0.104	158
Bike	0	0	0	0

Urban space

We also calculated the space efficiency of cargo bikes due to their smaller size. A parking space for a motorcycle can be used for two bicycles and the parking space for a van can accommodate three tricycles. We calculated the parking space that would be needed to accommodate 515 motorcycles and 217 vans, versus the space needed to park the same amount of bicycles and tricycles, and concluded that non-motorized delivery vehicles in Copacabana save 9,600 m^2 of urban space; this is considerably larger than an average soccer field (7,140 m^2). This is a conservative estimate of the space savings, since it does not consider the additional space efficiency of cargo bikes versus vans and motorcycles in terms of travel lanes.

Local economy

Considering that 42% of the survey respondents said that their businesses would not be economically viable without cargo bikes, we can clearly appreciate the enormous importance of these vehicles to the economy of the city of Rio de Janeiro. In many cases these are small businesses, and are often run by lower-class entrepreneurs. The profit margin for these businesses is likely quite low. In this way, the cargo bikes are an important factor for the survival of the businesses and the livelihood of the cyclists. In this way, the cargo bikes provide economic opportunities and make important contributions to promoting social equity in the city.

Public health

Cargo bikes also provide important benefits to public health in terms of reduced traffic deaths and injuries. Although we did not quantify these benefit thoroughly, our initial comparisons with data on traffic deaths and injuries suggest that the benefits of cargo bikes could be considerable. Using data from the São Paulo Prefecture (CET, 2010) we used a simple proportion of the populations of Rio and São Paulo and data on deaths of cargo motorcyclists in the former city to estimate that the use of bicycles instead of motorcycles for deliveries saves 29 lives per year in the city of Rio de Janeiro. Of course, there are many more factors involved (land use, trip frequency, trip length, vehicle speeds, etc), and this comparison is simplistic. However, we feel that these preliminary findings alert us to the possibility that cargo bikes make an important contribution to avoiding traffic deaths and injuries in Rio de Janeiro.

Noise pollution

Although this study did not quantify the noise pollution savings generated by human-powered motor vehicles, the authors suspect that these are significant and recommend additional studies related to this subject. Although it is anecdotal, visitors to São Paulo immediately notice the cacophony of motorcyclists beeping as they ride through traffic; this undoubtedly raises stress levels for visitors and residents alike. The World Health Organization identified the potential negative consequences for the quality of life and health of people from the traffic noise pollution in cities (WHO, 2002) and certainly the cargo bikes of Rio de Janeiro (silent), with 23,082 trips per day only in Copacabana, contribute significantly to noise reduction throughout the city.

Congestion and quality of life

Because each cargo bike represents either a van or motorcycle that does not travel in the city, the savings in travel lane space are considerable. This undoubtedly

contributes to lower levels of traffic congestion for motorized vehicles. Also, having quiet, zero emissions, space-efficient vehicles undoubtedly increases quality of life in the city. Having fewer motorized vehicles taking up space, at times moving very quickly, making noise and emitting toxic pollutants undoubtedly affects life in Rio de Janeiro on a positive way. While we do not quantify the quality of life gains thoroughly in this paper, this is an important issue for further research.

COMPARISON OF CARGO BIKES IN RIO DE JANEIRO WITH EUROPE AND THE US

While there are some similarities between the practice and context of cargo bikes in Rio de Janeiro and in US and European cities, the differences are perhaps even more striking. These include:

Quantity - It appears that cargo bikes are much more widespread in Rio de Janeiro. The largest cargo bike service that we know of, La Petite Reine in France, owns a total of 80 cycles that operate in 4 cities. There are almost 10 times as many cargo bikes (732) in the neighborhood of Copacabana alone.

Cost advantages - Although the cost advantages of cargo cycles versus motorized vehicles are important to the operators encountered in the developed country cities, in Rio de Janeiro they appear to be *crucial* to the existence of the businesses themselves. This suggests that the cargo bikes play a fundamental role in the local economy – that without them, many small businesses would not be viable under their current configuration. In this way, cargo bikes play an enormous role in the local economy.

Ecological aspects – of cargo cycles, so important to the companies in London, Paris and New York, is much less important for the respondents to our survey (only 8% cited the environmental advantages in Rio). Related to this, cargo cycles in Rio do not make use of advertising space on the vehicles, as is done in London and Paris, perhaps because the ecological aspect of cargo bikes is not as appreciated in Rio.

Government support – While the governments of Paris, London, and New York City have been supportive of cargo bikes (by establishing a UMC, studying the feasibility of cargo bikes, and investing money in a fledgling cargo bike delivery company, respectively), the government in Rio de Janeiro has not done anything to stimulate the thousands of cargo bikes that operate in their city every day, beyond implementing on-street bicycle infrastructure. This is not to underestimate the importance of bicycle infrastructure or to admonish the government of Rio, but simply to point out that cargo bikes are a purely private-sector phenomenon (besides the use of cargo bikes by the Federal postal company, *Correios*).

The above comparisons highlight the lack of recognition by the general public or government of the important contribution to economic activity, urban ecology and livability in Rio de Janeiro. The road-using public generally perceives cargo bikes to be a nuisance and does not appreciate the benefits that they bring to the city. The following section outlines possible measures to remedy this situation.

POLICY RECOMMENDATIONS

Due to the multiple benefits of cargo bikes to the local environment, public health, economic activity and quality of life in the city, the proportion of this mode of transport relative to trips by motorized vehicles should be increased in Rio de Janeiro, and in other large, medium and small cities of Brazil.

Cycling could also help reduce carbon emissions originated in the city of Rio de Janeiro, as transportation accounts for 52% of the emissions in the energy sector, representing the largest source of such emissions (COPPE/Centro Clima, 2011). According to the Municipal Climate Change Law No. 5248/2011, the goal of the City is to reduce carbon emissions by 20% by 2020; an increase in the use of clean vehicles (bicycles and tricycles) would be a particularly effective measure to meet this goal.

According to the most recent origin/destination survey for the city of Rio da Janeiro, bicycle trips represent 2% of total trips in the city, and 3.2% of trips in the metropolitan area (Rio de Janeiro State Secretariat of Transportation, 2005). Throughout Brazil, 7% of all trips are made by bicycles (IPEA, 2007). An option for the city of Rio is to consolidate and expand the municipal government's project "Rio Capital da Bicicleta" ("Rio, the Biking Capital") to gradually increase the percentage of trips made by bicycle over the coming years. A reasonable goal could be to achieve 20% bicycle modal share by 2030. Other Brazilian cities could have similar goals. That number is realistic given that in some cities in Brazil, like Santos in the state of São Paulo, 15% of trips are currently made by bicycle. (Governo, 2007).

The following measures would stimulate the use of bicycles in general, and cargo bikes in particular, in Rio de Janeiro and Brazil:

Infrastructure – The city of Rio de Janeiro has doubled its bicycle infrastructure from 150 to 300 km from 2008 to 2012. This includes bike lanes (physically segregated and on-street), sharrows and shared sidewalks. Although the quality of these facilities varies greatly, the city's efforts are to be commended and this initiative should continue.

The two bike lanes implemented in Copacabana since 2008 also represent an excellent cost/benefit ratio. These cost R$ 57.000, approximately US$ 31,666, per km (M.L. Navarro, personal communication, 18 August 2009).

Additionally, the slow speed zone (maximum 30 km/hour - called "Zone 30") implemented in 2009 in 70% of streets in Copacabana is an excellent measure, and has created better conditions for cyclists at a very low cost (approximately R$ 3.675 - approximately US$2,041 - per km) and with a very short implementation time (3 days) (M.L. Navarro, personal communication, 03 December 2009). Slow speed zones have since been implemented in 10 other areas of Rio de Janeiro (in 2010, in Anchieta, Bangú, Campo Grande, Del Castilho, Grajaú, Ilha do Governador, Ipanema, Jacarépaguá, Santa Cruz, in 2011, in Centro).

These measures (slow speed zones and bicycle lanes) should be implemented wherever possible in Rio de Janeiro, and in all Brazilian cities.

Designated bicycle parking has also become more commonplace in Rio de Janeiro, and since 2012, a well-designed bicycle rack has been used. Bicycle parking should also be expanded throughout the city.

Educational campaigns – These would help elevate levels of cycling if carried out consistently throughout the city. A specific campaign could target cargo bikes in order to improve their conduct in the streets and their perception by the public. For example, a campaign could seek to educate cargo bike operators on proper road etiquette, and at the same time, educate the public about the environmental benefits of the cargo bikes. This could be particularly appealing in Rio de Janeiro, where ecological consciousness is growing, as evidenced by high portion of votes that go to the green party in national and municipal elections.

In newly built areas - To encourage the use of cycling in general, and cargo bikes in particular, in new areas of Rio de Janeiro and other Brazilian cities, these areas should have urban design characteristics similar to those of Copacabana, including: high residential density, minimum or no setback requirements, high buildable area ratios[2] (up to 50%), and shops at street level. As in Copacabana, the streets in newly-developed areas should have up to a maximum of four lanes for motorized vehicle traffic. Blocks should be at most 100 meters long, with some streets exclusively for pedestrians and cyclists.

Urban development dominated by residential towers and shopping malls, with wide streets and ample parking for motorized traffic, should be avoided, as this urban design discourages trips by more sustainable modes of transport, such as cycling and walking. Since the wide availability of parking spaces for cars is a major incentive for using these vehicles, there should be no minimum requirements for car parking in new residential and commercial buildings.

[2]The percentage of a building's footprint related to the entire lot.

CONCLUSION

Cargo bikes are an excellent choice for the delivery of goods over short distances and should be further integrated into the busy streets of Rio de Janeiro and in cities throughout Brazil. The high number of trips made by bicycles and cargo tricycles in Rio de Janeiro (with 23.082 daily trips in the neighborhood of Copacabana alone) provide significant benefits in terms of emissions of greenhouse gases, urban space, and economic activity. Due to these benefits, we suggest that the participation of bicycles in general (not only for goods deliveries, but for all types of trips) in the modal matrix of Rio de Janeiro be increased from 2% in 2002 to 20%, for example, by 2030, with similar goals for other Brazilian cities. In order to achieve this, all levels of government in Brazil (federal, state, and municipal) should increase support for infrastructure and campaigns to improve road safety and comfort for cyclists, and new urban areas should have urban design characteristics that encourage cycling.

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