

Proposals for the Public Transport System in Beirut

Public Transportation, Design and Management

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10 January 2025

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1. Introduction

Is public transportation in Lebanon effective? Lebanon's public transportation is neither good nor bad because it barely exists.

Before the Lebanese Civil War (1975–1990), Lebanon had a functional public transport system, which included a railway network stretching around 408 kilometers¹ and nearly 30 stations, serving as an important mode of travel across the country. However, the civil war's extensive destruction devastated this infrastructure, and the railways were rendered inoperative. In 1990, the country's last remaining train line was abandoned, marking the end of rail transportation in Lebanon. Since then, public transport development has stagnated, and attempts to revive the railway system have repeatedly failed, largely due to economic and political challenges. In 2024, Lebanon made a small but significant step forward by introducing public buses in Beirut. While this marks progress, several challenges remain.

This paper aims to develop a balanced plan to promote the use of public transportation in Lebanon, with a particular focus on Beirut and its surrounding areas. The plan will address three key topics: integrating bike-sharing into the public transportation system, implementing modern payment solutions, and implementing a demand responsive transit system. It begins by analyzing the current situation and then proposes suggestions for improvement in these three areas.

Rather than searching for best practices, this paper will focus on identifying the most suitable solutions for Lebanon's context. The proposed plan will be tailored to Beirut but will also consider the applicability of these strategies in other countries facing similar challenges as Lebanon. Acknowledging the multitude of issues that warrant discussion, this paper will prioritize a detailed examination of the most critical ones, rather than briefly mentioning them all.

2. Analysis of current situation

Lebanon's transport sector is one of the least sustainable in the Middle East due to poorly maintained infrastructure, outdated regulations and, most notably, the absence of a reliable public transport system.

Lebanon has become one of the most car-dependent countries in the Middle East, lacking metro, tram, or train systems and relying solely on cars and buses. Nearly 80% of Beirut's commuters use private cars, 18% use taxis, 1.7% rely on vans and buses, and just 0.3% opt for non-motorized transport². Public transportation is largely informal, with buses and vans operating without a structured system. Additionally, walking and cycling infrastructure is nearly nonexistent.

As a result, Lebanon faces significant challenges. Lebanese roads experience severe congestion, with commuters spending an additional hour and a half daily in traffic³. Furthermore, the widespread use of older, polluting vehicles contributes to high levels of air pollution, worsening public health issues and deteriorating environmental conditions. And finally, inadequate infrastructure further limits mobility options, discouraging walking, cycling, and recreational activities. These factors collectively lead to a decline in the quality of life in Beirut and highlight the urgent need for a sustainable public transport system to improve mobility, public health, and overall urban livability.

However, several key issues contribute to the poor quality of Lebanon's public transport, making the need for reform even more critical. Firstly, Lebanon has been in an economic crisis since 2019, exacerbated by years of financial mismanagement and corruption, which leaves the government unable to fund and implement a comprehensive public transport plan. Secondly, political challenges further complicate the situation, since political parties often prioritize their agendas over collaborative development efforts. As a result, projects, including those aimed at improving public transport, are frequently stalled or abandoned due to lack of cooperation. Lebanon's regional divisions based on religious sects create social fragmentation, with people

reluctant to mix across these boundaries. This complicates the development of a unified transport network, as resistance to outsiders and inter-sect interaction hinders cooperation on infrastructure projects.

Thirdly, societal norms in Lebanon also play a role. Status symbols are highly valued, and owning a car is often seen as a marker of social standing. This cultural preference discourages the use of public transport, as many people prefer private vehicles to signal their position in society. Finally, public transportation in Lebanon is widely perceived as unreliable and unsafe, largely due to the risky practices of informal bus operators. This negative perception deters many from using public transport, reducing demand and ultimately discouraging investment in system improvements.

Additionally, the ongoing economic hardship and widespread poverty make it difficult for those in the informal transport sector to accept change. Many rely on their income from the informal system for survival, and the introduction of a formal, structured public transport system is viewed as a direct threat to their livelihoods. This resistance was demonstrated by the attack carried out by informal drivers on the first day of the public buses' return in 2024⁴.

2.1 Pedaling Backwards: The Failed Bike-Sharing program

In 2017, the organization Bike 4 All, in collaboration with the local government, launched a bike-sharing program in Beirut, Lebanon's capital⁵. This initiative led other cities to join, creating a self-service bike system available 24 hours a day, allowing commuters to pick up a bike at one station and drop it off at another near their destination. Despite the initiative's promise, only a small number of cyclists actually used it. Many fear for their safety on Beirut's roads, which are ill-suited for cycling due to a lack of bike lanes and proper enforcement of traffic laws. Lebanese blogger Fares, for instance, pointed to the absence of bike lanes, safe pavements, consistent traffic law enforcement, and a trained traffic police force as reasons for his lack of enthusiasm⁶. The project was abandoned due to these obstacles.

2.2 Chaotic yet Important Informal Buses

Due to the government's incapability of reconstruction and lack of investment in public transportation, informal buses, which have no fixed routes and timetables, became the leading force. Totally demands driven, the informal bus system nowadays includes over 4,000 registered operating vehicles and more with fake licenses⁷, taking up 10% of the daily passenger trips⁸. The packed minibuses, usually 14-seat, account for 56.19% of total trips made by public transport in Beirut⁹.

Although for outsiders, the system seems to be chaotic and, the minivans operate on relatively fixed routes and a hierarchy can be found between the drivers and operators. For the bus lines, an overview of around 50 routes and their operation times can be gained from the map made by the Bus Map Project¹⁰, a grassroots initiative created through collective citizen efforts to provide a comprehensive and accessible map of bus routes, stops, and operators. As for the space of power, the current permits for operating informal public transportation, known as red plates, are issued to individuals and can be bought and sold without restrictions on the vehicles used. As a result, several syndicates corresponding to different politico-sectarian communities have been formed. These unions manage buses and vans, redistribute zone coverage to minimize overlap and conflict among operators serving their respective communities¹¹, which limits the ability of the system in meeting demands and produces injustice concerning workers and passengers. Drivers are charged by the unions for using certain routes and terminals while passengers may experience segregation based on their sectarian affiliations⁷.

2.3 The Economic Crisis and Its Disruptive Impact on Public Transport Payment Systems

Lebanon's ongoing economic crisis, which began to fully unfold in August 2019, has drastically reshaped the financial landscape. The chaos has caused the Lebanese lira to lose over 98% of its value¹², driving inflation into triple digits. As the economy deteriorated, trust in Lebanon's banking system collapsed. People were restricted to withdrawing only small, almost negligible amounts of money each month. To this day, no one can fully access

their savings and may never be able to. As a result, most Lebanese have abandoned traditional banks, relying heavily on cash—particularly U.S. dollars—to safeguard their funds and avoid further losses in both access and value. With trust in banks evaporating, the use of credit cards has also sharply declined.

Understanding the current financial situation is important because it has significant implications for payment systems. Credit cards are rarely used locally, though they see an increase during vacation seasons when Tourists and Lebanese immigrants visit and rely on cards for convenience.

3. Suggestions for improvement

The challenges facing Beirut's public transport system are significant but not insurmountable. In response to these ongoing issues, this section presents a set of improvement suggestions aimed at creating a more sustainable, efficient, and inclusive system. By implementing these strategies, Lebanon can begin to pave the way toward a more reliable and accessible public transport network. As it is not feasible to address every issue comprehensively, we will prioritize the most critical ones.

3.1 Pedal Power: Integrating Bike Sharing into the Transit Network

To address Lebanon's unsustainable public transit system, reduce congestion and pollution, and improve the quality of urban life, we propose integrating bike-sharing into the public transportation network.

3.1.1 Our plan

In our plan to enhance Beirut's bike-sharing system, we aim to create a safe, accessible, and sustainable urban mobility solution for residents and visitors alike.

Given that Lebanon currently lacks a well-established cycling culture, the initial focus of our project will be on introducing and promoting this culture among the youth, specifically targeting university students. Beirut's vibrant educational ecosystem makes it an ideal starting point for this initiative. The city is home to more than 18 universities¹³, hosting over 101,923 students, including 12,751 international students¹⁴. Our plan centers on implementing a bike sharing system primarily for students. Once this pilot phase proves successful, we will expand the program to include other demographics and areas, gradually making cycling a sustainable and popular mode of transportation in Beirut.

We began by identifying the five most prominent universities in Beirut based on their student populations. These universities operate across multiple campuses, totaling ten sites throughout the city. This analysis enabled us to pinpoint strategic locations where bikes would have the greatest impact (Cf. Appendix, Fig. 3.). Due to the absence of established cycling routes in Beirut and our inability to conduct on-site inspections, we relied on feedback from cyclists familiar with navigating the city. Among the routes discussed, one stood out as being recognized among the top ten cycling routes in Lebanon. This 19.6-mile route, predominantly paved and encircling Beirut, has been highly regarded for its practicality and accessibility.¹⁵ Based on this feedback, we adopted this route as the foundation for our proposed cycling infrastructure plan (Cf. Appendix, Fig. 4.). To connect the main cycling route to university campuses, we propose dedicated pathways utilizing underused spaces such as alleyways and small, unused streets between buildings. These pathways are strategically designed to keep cyclists away from heavy traffic and vehicles, ensuring a safer and more efficient commuting experience. The finalized map of this network is illustrated below:

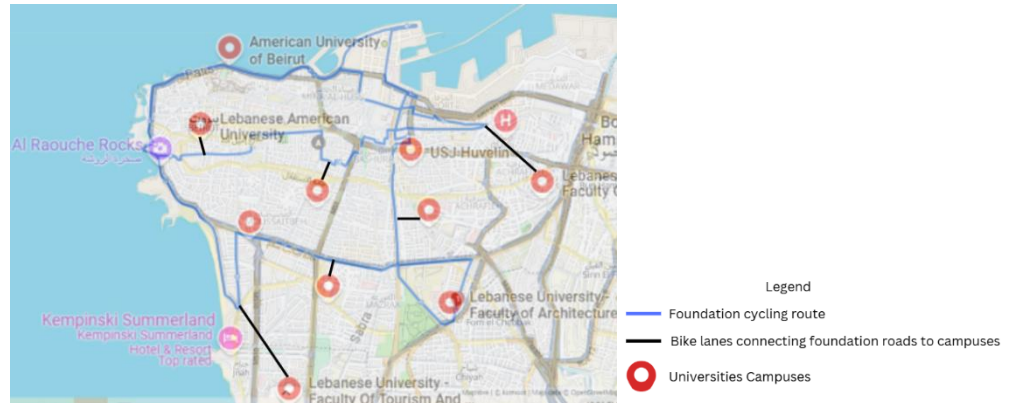


Figure 1 : Cycling network

To enhance security and prevent theft, bike parking will be available exclusively on each university campus, accessible only to students via their university ID cards. Inspired by the bike shelter at INSAVALOR, these facilities will accommodate up to 50 bikes across two levels¹⁶. Additionally, surveillance cameras will be installed in the shelters to ensure security and monitor any issues.

Furthermore, all bike parking facilities across participating universities will be interconnected and accessible exclusively to students with an active bike subscription, regardless of their home institution. This system enhances security by restricting access to authorized users, thereby increasing safety and reliability, and provides students with the flexibility to park their bikes at the university campus closest to their destination.



Figure 2: Parc à vélos sécurisé de INSAVALOR¹⁷

In this system, individuals can subscribe to a bike-sharing service on a monthly or yearly basis. Upon subscribing, they are assigned a bike for their exclusive use during the subscription period. This approach is due to time and budget constraints and aims to ensure more controlled and secure operations in the early stages.

3.1.2 Costs

The initial cost of implementing the bike-sharing system primarily are the following. These general estimates, and actual costs can vary.

Cycling Routes: The cost of installing a bike lane typically ranges from \$5,000 to \$50,000 per mile. Given the lack of existing bike lanes, we are considering the worst-case scenario, estimating the cost to be approximately \$50,000 per mile. With the total route distance estimated at 22 miles, the total cost would be approximately \$1,100,000 (€1,770,000).¹⁸

Parking Facilities: Each shelter can accommodate 50 bikes, and we estimate having one shelter at each site. The cost of one shelter is approximately €10,000, so the total cost for all shelters would amount to €100,000.

Initial Purchase of Bikes: At the start of the project, we will make 500 bikes available. With each bike costing €270¹⁹, the total cost for the bikes will be €135,000.

Surveillance Cameras: With one camera (€45/camera²⁰) installed per parking shelter, the total cost is €450.

Operation and maintenance: It can range from €96 to €193 per bicycle²¹. Taking the mean, the total cost is approx. €72,250/year.

As the program expands, additional costs will emerge, including those associated with increasing the number of bikes and bike stations, ongoing maintenance for bikes, stations, and routes, staff salaries, and upgrading infrastructure to extend coverage to new areas of the city.

The total cost of implementing the system is estimated at €2,077,700. Revenue generation will primarily rely on bike subscription fees, priced at €30 per month or €350 per year. Based on these rates, the projected income for the first year is approximately €175,000. Given this revenue model, the return on investment (ROI) is anticipated to be achieved within approximately 21 years. While this timeline may seem extensive, it aligns with the objectives of a long-term public project. The significant social and environmental benefits it offers outweigh the purely financial considerations. The cost in the current situation is €0, as there is no public transportation available. Although the costs of our project may seem high, the benefits it provides—both social and environmental—far exceed the financial investment. Moreover, it represents a necessary step, whether today or in the near future, to introduce public transportation in Beirut.

Given that our plan is centered around students, we propose a collaborative financial model involving the participating universities' support. The fees for implementing the system could be shared between the universities and the government, making the project more financially feasible while fostering a partnership that benefits the entire community.

3.1.3 Benefits

Bike-sharing offers several benefits. First, it provides a more environmentally friendly commuting option, reducing air and noise pollution and contributing to improved health and environmental conditions thanks to its zero-emission footprint. Second, it can help reduce traffic volume, which lowers stress levels and minimizes time lost to congestion, allowing people to be more productive. Third, bikes facilitate faster, more efficient travel for short distances—a practical solution in Lebanon's relatively compact cities, such as Beirut, which spans only 20 square kilometers. Additionally, bikes provide a low-cost transportation option in a country facing economic challenges, offering an affordable alternative for those who cannot afford a car. While a monthly fee of 30 euros may initially appear high, it is more affordable when compared to the costs associated with using a car, the primary mode of transportation in Beirut, which amounts to approximately \$276 per month in fuel expenses²². Lastly, a bike-sharing system would leverage Beirut's rich educational landscape to drive meaningful cultural change.

3.1.4 Limitations

One of the main limitations of our project is the uncertainty surrounding which universities will be interested in participating, which makes it challenging to finalize the specific routes needed to connect the universities to the main bike route. However, we will assume that the five most prominent universities in Beirut will be the initial participants in the project.

If the project proves successful, we could expand by offering students the option to use bikes on an hourly basis. However, this would require additional funding, planning, and coordination, which we have not addressed due to time constraints and the significant financial investment required, which the government is currently not ready to finance. Furthermore, if we have more funds, we plan to introduce secure bike parking spots outside the campuses to enhance convenience (Cf. Appendix, Fig. 5.).

3.2 Introducing DRT to the Informal Bus System

To attract more people to use public transport and to minimize the socio-economic challenges faced by the change in the public transport sector, we propose transforming informal buses into a semi-dynamic Demand-Responsive Transit.

3.2.1 Our Plan

From the government's perspective, the following measures should be taken.

Firstly, the red plates policy should be abolished. Instead, the government should require informal bus drivers to take their vehicles to the vehicle registration center for inspections and registrations. Drivers with vehicles in good condition will be employed as new bus drivers with monthly salaries. As for non-compliant vehicles, the government can implement a trade-in program. This program will allow drivers to trade in their non-compliant vehicles and purchase compliant new ones at a discount, making them eligible for employment. The bus driver's contract will be renewed annually, contingent on his vehicle meeting required qualifications and the demonstration of good driving behavior over the past year. Drivers will be required to operate with the vehicle registered in their name under this contract and follow regulations such as staying in the slow lane to minimize dangers from sudden stops for passenger pick-ups.

To further modernize the transport system, the government should hire ICT companies to develop software to support the semi dynamic DRT. This software will enable passengers to place ride requests in advance, using local landmarks such as restaurants and cafes near the bus routes as pick-up and drop-off points. The software will then allocate trips to drivers via tablets installed in their vehicles. If no rides are available within the requested time frame, the passenger's request will be declined.

To support the implementation of DRT, all vehicles should be equipped with government-sponsored tablets carrying the DRT software. These tablets, connected to the Internet, will inform drivers of their schedules, assigned routes, and real-time updates about pick-up and drop-off statuses. The GPS functionality will enable automatic location uploads, collecting data needed for recognizing travel patterns and congestion, eventually improving time predictions.

The proposed bus system will operate along existing routes and schedules of informal buses, with modifications based on passenger data to enhance accessibility and efficiency. If no online orders are placed, buses will be dispatched approximately every ten minutes during its operation time to maintain the current informal bus frequencies²³. Considering that 1GB of data costs 10% of the average monthly wage in Lebanon^{24 25}, this measure ensures that the demands of low-income individuals, who frequently use minivans but are not able to place orders through the DRT platform online, can still be met. For the same reason, online orders should not occupy more than 20% of the seats on each bus. This measure ensures that the demands of low-income individuals, who frequently use minivans but are unable to place orders through the DRT platform online, can still be met. To ensure inclusivity, online orders should not occupy more than 20% of the seats on each bus. This will guarantee that the average waiting time for those who do not book a ride will be no longer than 7 minutes, which is the longest acceptable waiting time at a bus stop with no bench²⁶, based on the assumption that the current informal buses run at full capacity and people arrive at stops following a Poisson distribution.

Additionally, if the number of people placing orders for a route through the software, which cannot be fulfilled within ten minutes, reaches 20% of a bus's capacity, an extra bus will be dispatched for that route presuming that the number of un-catered demands not reflected in the DRT software increases proportionally.

3.2.2 Costs

Since detailed information about the current informal bus system is unavailable, we estimate that 4,000 minibuses will be transformed. The cost of implementing the new DRT system consists of various components:

Tablets: A tablet in Lebanon costs €129.60²⁷, which amounts to €518,400.

Mobile Internet Bundle: A mobile internet bundle with 6GB costs €8.16²⁸, so for all vehicles it will be around €32,640 per month.

DRT software development: It is estimated that the set-up cost for the DRT application, similar to an Uber-like software, will be around €48,000 to €72,000 or more²⁹.

Vehicle fees: Considering the price for a second-hand minibus in Lebanon is €10,080³⁰, it is reasonable to estimate that the total cost will amount to €4,032,000 for the government to replace every informal bus in Greater Beirut. This cost will not be incurred all at once but rather spread out over several years.

Drivers' salaries: An average salary for a bus driver is approximately €48 per month³¹, resulting in total monthly salaries of €192,000 for all drivers.

Vehicle operation and maintenance: Assuming each vehicle operates an annual mileage of 100,000 km, the average operation and maintenance cost for a bus running on CNG is around €1,041.60 per month³². For all vehicles, this cost would total €4,166,400 monthly.

The total initial setup cost is around €4,622,400, with a monthly ongoing cost of €4,391,040.

The system's profits will come from bus tickets. The price for a local bus ride in Greater Beirut in 2024 is €2.51³³, while it is estimated that 280,000 riders are carried by minibuses and buses daily in Greater Beirut³⁴. Therefore, the monthly income is presumed to be €21,168,000. Since the profit is substantial, drivers who operate with fake red plates now can also be absorbed into the new system. If the system proves to be sustainable, afterwards a distance-based fare system can be introduced to reduce the price of the bus tickets and the salaries for drivers can be raised.

3.2.3 Benefits

This new system offers several benefits for different parties.

Minivan drivers will no longer need to worry about losing their jobs, as most of them will become contract workers for the government. With fixed salary, they will no longer have to engage in dangerous behaviors like excessive speeding to get as many passengers as possible. Additionally, since routes are now assigned by the platform in place of politico-sectarian communities, drivers will no longer be charged for their right of operating on certain routes³⁵, and the situation of overservice and underservice will be mitigated.

For existing passengers, the new Demand-Responsive Transit system will enhance service on previously underserved routes. Minivans will become safer, featuring more reliable vehicles that operate at safe speeds. For potential passengers, the DRT system will offer several benefits such as better knowledge of bus availability, a more affordable travel option, and improved safety, as both the driver and the trips will be recorded. Additionally, with social communities having less control over the bus system, passengers will experience a less fragmented public transport network, allowing for freer and more seamless travel.

For the government, the system makes public transport greener by attracting more people to use buses, which will reduce the number of private vehicles on the road, helping to alleviate congestion in Beirut. Additionally, by optimizing routes and schedules using algorithms to minimize empty trips and fuel consumption, the environmental footprint of the transport mode is reduced by cutting redundant vehicle mileages and encouraging shared rides. A convenient bus system can also attract more tourists and business, boosting the economy.

3.2.4 Limitations

There are still several major limitations to this transformation. Firstly, the slow and unpredictable traffic in Beirut makes it particularly challenging to guarantee punctual arrival times at pick-up points, which could lead to a loss of confidence in the DRT system over time. Secondly, using the number of online orders to predict demand is not entirely accurate, as people from different income levels exhibit varying travel patterns. To address these

problems, the government can collaborate with universities to develop suitable algorithms for the DRT system by sharing travel data.

3.3 Inclusive, Efficient, and Modern Payment Solutions

3.3.1 Our plan

For the bike sharing system, to ensure convenience and encourage widespread adoption, bike usage payments will be integrated into the university's financial system. This system simplifies the payment process by consolidating it with existing fee structures, and ensures that all users fulfill their payment obligations seamlessly. In cases of loss or damage, any associated fees will be seamlessly added to the student's educational fees, promoting responsibility while maintaining a hassle-free experience for users.

For the Demand-Responsive Transport (DRT) system, we propose offering multiple payment options to accommodate a diverse range of users.

For cash payments, we accept both U.S. dollars and Lebanese lira to ensure accessibility for individuals using different currencies. Users can purchase tickets or rechargeable smart cards at money transfer offices, which will provide a QR code for scanning upon boarding the bus. Alternatively, they can pay the driver in cash when boarding.

For digital payment options, we propose equipping buses with NFC (Near Field Communication) technology, where users can tap their mobile wallet, debit or credit cards, or a QR code, directly on payment terminals to allow transactions during boarding.

Additionally, tickets could be purchased online, with users receiving a QR code to scan upon entry. For a forward-thinking approach, we consider accepting cryptocurrencies such as Bitcoin or Ethereum which will in the future be more and more present.

Mobile payment options linked to phone operators via SMS is also a solution in this context. Users can make purchases through their mobile operator, with the fees conveniently added to their monthly phone bill. Once the transaction is complete, they will receive a QR code via text message, which they can scan upon boarding the bus.

3.3.2 Costs

For these payment methods, these are the following costs. These general estimates, and actual costs can vary.

QR-coded tickets or rechargeable smart cards: Approximately €0.10 per piece, if we plan to purchase 500,000 cards initially, the total estimated cost would be €50,000.³⁶

NFC Payment Terminals: These terminals cost €179.5 per unit. Therefore, for 4000 buses, we need 4000 units, so the total cost will be €717,800.³⁷

Online Ticket Sales Platform: For the first year, the total cost is approximately \$200,000. The total cost includes the following components: Platform Subscription, Transaction Fees, Custom Development, Payment Gateway Setup, and Mobile App Development.

Mobile Payment Options Linked to Phone Operators: Typically range from €5,000 to €20,000, depending on the complexity and the mobile operator involved.³⁸

Cryptocurrency Payment Gateway: Up to €10,000³⁹ by using an existing, instantly deployable crypto payment gateway.

To ensure the success of this payment system, the government must coordinate with a diverse range of stakeholders, including mobile operators, universities, and other relevant entities.

3.3.3 Benefits

This initiative offers a simple and convenient payment method for the bike system. For the DRT system, it ensures that all users, regardless of their preferred payment method, have access. The system accepts payments in both USD and LBP currencies, thereby enhancing accessibility for users. By incorporating both traditional and digital payment methods, as well as multiple currencies, we create an inclusive, efficient, and modern public transport experience for all.

3.3.4 Limitations

In this initiative, there is no direct return on investment, which poses a risk of insufficient funding and a lack of revenue proportional to the effort invested. We are concerned that this project might not be financially sustainable. However, the effects of this project will be reflected in the DRT and bike-sharing initiatives separately. The revenues generated from these two initiatives will be used to fund this aspect of the project.

Another critical challenge lies in the socio-economic profile of the primary users of informal bus services, who are predominantly from lower-income groups. These individuals often rely on cash transactions due to limited access to credit cards, unfamiliarity with online platforms, or lack of engagement with digital currencies. Consequently, the advanced payment solutions we propose—such as digital wallets or cryptocurrency-based systems—are likely to cater primarily to tourists and higher-income demographics. This creates a significant risk of underutilization for the majority of our proposed solutions, rendering them ineffective in addressing the broader needs of the target population.

4. Conclusion

The current public transport in Lebanon, especially Beirut, is faced with multiple challenges due to historical neglects, economic crises and political instability. However, the measures we proposed in this paper provide a possible way to transform the city's public transportation into a more sustainable and efficient system. By integrating bike-sharing programs, adopting demand-responsive transit systems and modernizing payment methods, Beirut can address the urgent need for a reliable and inclusive public transport network.

The bike-sharing initiative, focused on university campuses, aims to promote a cycling culture, reduce traffic congestion and offer an environmentally friendly commuting option. Meanwhile, the transformation of the informal buses into a demand-responsive transit system seeks to formalize operations, improve service reliability for passengers. The implementation of versatile payment solutions will ensure accessibility for a diverse range of users to further encourage people to use public transport.

While the upfront costs for implementing the measures are significant, the long-time benefits in terms of environmental impact, social inclusion and economic gains justify the investment. It is estimated that the total initial setup cost for the measures would be around €6,310,100, excluding ongoing costs. Currently, there is no cost associated with public transportation, as there is no public transportation available, but this also means there are no benefits or revenue. This project represents a crucial step, whether today or in the near future, toward introducing public transportation in Beirut.

The benefits of these measures span across various domains. Environmentally, they contribute to a significant reduction in vehicle emission by encouraging more people to shift to public transport. Socially, these measures enhance the accessibility and inclusivity of the transport system, making it safer and more reliable, which in turn increases passenger usage while securing jobs for informal bus drivers. Economically, these initiatives are expected to boost revenue through bike-sharing subscriptions and demand-responsive transit fares, leading to long term savings in road maintenance and healthcare due to decreased traffic congestion and pollution. Additionally, these initiatives promote a cultural shift by fostering a cycling culture among the youth and encouraging broader societal acceptance of public transport as a viable alternative.

Although there are limitations and challenges such as cultural resistance and infrastructural constraints in implementing these plans, the proposed solutions come from Beirut's unique context and aim to create a more

integrated and user-centric public transport system. By prioritizing these strategic interventions and carefully managing costs, Beirut can lay the groundwork for a wider regional shift towards sustainable transport modes, ultimately improving the quality of life of its residents and inspiring similar cities worldwide.

5. Appendix

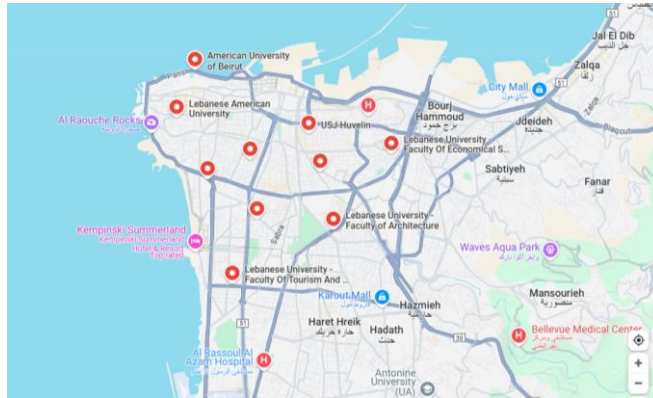


Figure 3: Campus Locations of the Five Most Prominent Universities in Beirut

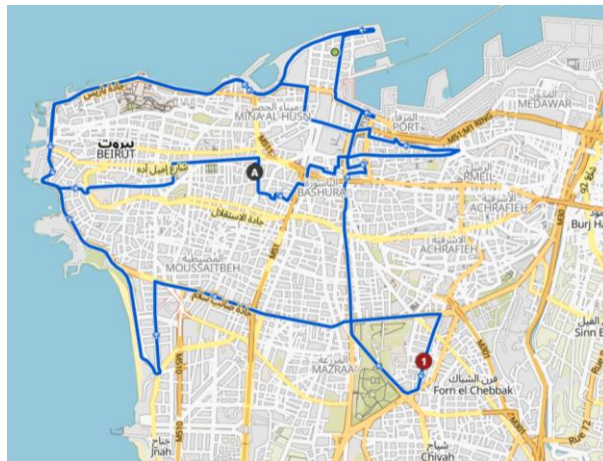


Figure 4 : Foundation Cycling Route



Figure 5: Le box à vélos individuel et sécurisée⁴⁰

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The grammar and structure of this report were reviewed using OpenAI's ChatGPT (Jan 11 version).