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Climate Change and Environment in the Arab World

Sustainable Transport Series

Getting to Campus: Sustainable Public Transportation and Relocating the American University in Cairo

Richard Tutwiler, Hagar Eldidi, Yumna Kassim, and Andrew Petrovich

February 2015
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Abstract

Cairo is one of the most congested cities in the world, and public transportation is one of its greatest challenges. Government strategies to alleviate congestion have stressed horizontal expansion into the surrounding desert areas and the construction of more and ever larger motorways. This paper uses the experience of the American University in Cairo, which physically relocated in 2008 from its historic downtown campus to an entirely new campus in New Cairo, a planned city on the outskirts of Greater Cairo (GC), to assess policies and strategies for sustainable public transport within GC. By comparing how AUC students, faculty, and staff get to campus, the study concludes that sustainable urban transport systems must put priority on enhancing the mobility of people rather than vehicles. Furthermore, in light of current proposals by the University and the Ministry of Transport for bus and rail systems linking New Cairo to the rest of the metropolitan area, the paper identifies specific social, economic, and cultural differences among stakeholders in sustainable public transport that will strongly influence the outcomes of policy interventions.

1. Introduction

The American University in Cairo (AUC) was founded in 1919 with a location in a former palace adjacent to what would later become Tahrir Square. The university survived two world wars and the revolution of 1952, and continued to prosper. As the university grew in size, it was able to acquire additional land in central Cairo, and by the 1980s the university campus consisted of 9 buildings on about 3.8 hectares, spread over five city blocks. Crowded urban streets cut the university campus into a number of separate locations. Still anticipating more growth, the university explored the potential of purchasing additional and adjacent city lots, but despite concerted efforts, no land or buildings became available. The AUC Board of Trustees established a committee to consider the future of the University, and in 1997 the committee recommended buying land in the new desert city of New Cairo, building an entire campus as one unified project, and moving from downtown to the new campus within ten years.

The principal reasons for recommending a move from central Cairo to the desert fringe included:

1. Eliminating the overcrowding on the old campus and the institutional and educational fragmentation inherent in a tiny campus subdivided by busy city streets and overwhelming urban pressures (especially noise and air pollution and the deterioration of infrastructure and services).
2. Providing modern classrooms, laboratories, lecture halls and other essential facilities to support current and future teaching methods, curricula and educational technologies.
3. Improving campus life for students, faculty and staff by creating a campus designed to foster interaction and create a sense of community.

Accordingly, the university acquired a 110-hectare parcel of desert land in New Cairo, together with two other parcels nearby suitable for building faculty and staff housing. After an elaborate and thorough design and development phase, the cornerstone was laid in February 2003 and construction began. The university inaugurated the campus and held its first classes in the new facility in September 2008.

From the beginning of the relocation process, AUC administrators were concerned about the transportation implications of the move. It was recognized that for all intents and purposes, there was no public transportation system serving New Cairo or connecting the new settlement with the rest of GC; nor was one likely to emerge in the near future. A study of student residence locations revealed that more than half the student body resided either closer in distance or in commuting time to the new campus site as opposed to the downtown site. University policy was to encourage students to begin living on campus, with dormitories for about 450 students built on campus. Provisions were made to encourage faculty and staff to relocate to New Cairo, and land was obtained and sold as lots for faculty and staff to construct homes within a half-kilometer of the campus, and a significant number of parking lots were constructed on the new campus. In addition, university officials were aware of government intentions to extend the Cairo Metro to New Cairo, and that a station would be sited adjacent to the AUC campus entrance. In 2007, the last year before the move, the university signed a contract with a private transportation company to provide bus services to the students, faculty, and staff. Sixteen separate routes were identified to bring AUCians from all over GC, including at least one bus each day between the distant settlements of 6th October in the southwest and Shubra al-Khaymah in the north, each being more than a 100 km commuting round trip.

2. Urban Development and Modes of Transportation

Cairo has been characterized as "an increasingly dysfunctional and immobile metropolis (Sims, 2010: 249). During the colonial period, 1882-1936, Cairo was much smaller in population and growth was relatively well planned, including a modern mass transit system linking its various neighborhoods. By 1917, Cairo had 30 tramlines covering 65 kilometers and carried 75 million passengers per year (Raymond, 2000). It was to this system that the newly commissioned northeastern suburb of Heliopolis was connected to downtown in the first decade of the 20th century. At the same time, the new planned suburb of Maadi in the southeast was connected to downtown via the Helwan light railway line. Most people in Cairo, however, continued to travel by foot or animal drawn vehicles well into the first half of the 20th century.

Cairo experienced a sustained population explosion during the 20th century. In 1900, it is estimated that Cairo had a population of about 0.6 million people within a national population of about 10.2 million. By 1950, Cairo had quadrupled in population to 2.4 million in a national population of 20.3 million. In 1975, the GC population stood at 6.1 million in a national population of 38.9 million, and it reached 16.4 million in the last census in 2006 with about 68.8 million national population. About one quarter of all Egyptians live or work in GC. It is estimated that every workday about 2 million people living outside Cairo commute to work in the urban conglomeration from the surrounding areas (CAPMAS, various years).

As Cairo grew demographically, it also expanded geographically. By 2006, the GC Region (GCR) spanned an area of almost 4,600 km^2 and included all of Cairo Governorate and parts of Giza, Qaliubia, and Sharqia Governorates. About 60% of the total area was built upon, and the remaining 40% consisted mostly of old agricultural land interstitial to urban neighborhoods or desert designated for future urban development. The later includes vast tracts belonging to a total of eight "new urban communities" (or NUCs) geographically arranged around the urban core of Cairo beyond the ring road beltway (JICA, 2008).

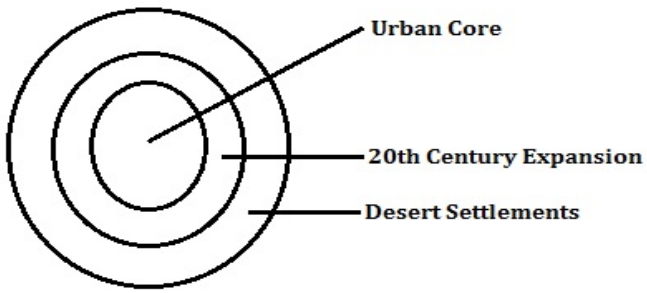


Figure 1. Greater Cairo Expansions Rings

At the beginning of the 21st century, GC could be described as a huge, sprawling urban conglomeration in which three historical phases of development could be distinguished on the ground. The first phase corresponds to the historic urban core neighborhoods mostly settled before or just after the turn of the 20th century. These include downtown proper, Garden City, Abbassia, Zamalek, Boulaq, Shoubra, etc. The second phase corresponds to the planned neighborhoods and suburbs (and their extensions) of the 20th century, including Heliopolis and Maadi in the first half of the century, and Mohandisseen and Nasr City in the second half. Located in the spaces between and among these planned urban neighborhoods are vast areas of unplanned, spontaneous, and largely extra-legal informal settlements called ashwa'iat in Egypt. Informal neighborhoods may be built either on former agricultural land for which there may be a land title, if not a construction permit, or they may be built on desert land owned by the state. In the latter case, these may be considered squatter settlements with little, if any, legal status. Informal settlements are estimated to house up to 60% of Greater Cairo's population (Sims, 2010; Kipper and Fischer, 2009).

The third phase is that of the new towns built in the desert with the purpose of alleviating congestion in the historic core. The recent development of desert settlements outside the urban core is not unlike the planned suburban expansions of Heliopolis and Maadi over a century ago in terms of strategic urban planning, but unlike those successful developments, the new desert cities such as 6th of October, 10th of Ramadan, and New Cairo are not tied to the core with a purpose built public transportation system. Instead, the government has built new road connections, expanded traffic capacity on existing roads, and allowed private initiatives to provide commuters with transport options (UNDP, 2013).

Within the historic urban core, Cairo has a relatively well-established and functioning system of public transportation. The principal components are the metro trains, the public bus lines, and to a much lesser extent, tramlines. Although basically the first modern public transport system in the city, the tramlines are being de-constructed and phased out, officially made redundant by an expanding metro network, but also in order to remove obstructions to traffic flows and accommodating more vehicles in the city streets.

Introduced in the 1950s, the public bus service is still a significant factor in moving around in the historic urban core. Operated by the Cairo Transportation Authority (CTA), the number of public buses is small compared to metropolitan cities of similar size (See Fig. 2). In 1971, public buses represented the majority (70%) of motorized trips in Greater Cairo. After the introduction of other modes of transport, such as privately operated microbuses, public bus use declined to represent only 22% of ridership in the urban core in 2001. Despite the decline in their popularity, public buses are still heavily used and visibly crowded (Huzayyin and Salem, 2013). At present there are two types of public buses; the smaller (25-30 passengers), teal and yellow "Nasr Auto" buses, and larger (40-50 passengers) red CTA buses. Though smaller, the old "Nasr Auto" buses are more maneuverable and numerous, but their maintenance is poor, they tend to spew black exhaust into the air, and they lack comfort, yet provide affordability, at 2 LE per ride. The newer CTA buses are more comfortable for passengers, but they tend to be fewer in number and less convenient in terms of frequency of service. It is rumored that CTA recently introduced a bus with Wi-Fi connection at the price of 3 LE per ride.

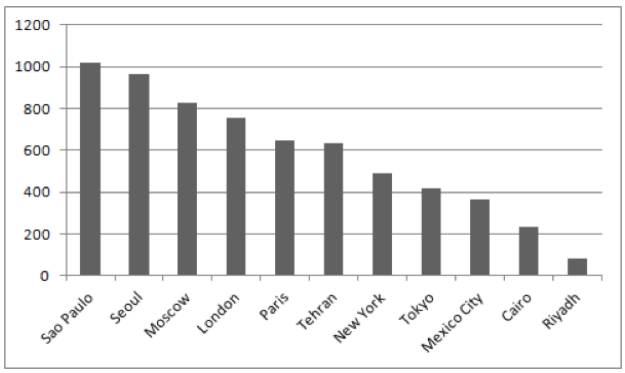


Figure 2: Number of full sized buses per million inhabitants among selected cities
(World Bank, 2003)

If there is a success story in the history of public transportation in Cairo, then it is the metro. The first metro line opened in 1987, providing passengers with service from Helwan in the south to El Marg in the north. The first line mostly incorporated existing light rail lines between downtown and southern and northern suburbs, but the second line and third lines (opened in 1996 and 2012, respectively) were mostly underground below major city streets.

The Cairo metro first began service in 1987 and maintains some of the highest ridership (See Fig. 3) rates in the world and at 1 LE (or 0.14 USD), including transfers, is the most affordable means of commuting within the urban core and first ring. In 2001, the metro captured 17% of motorized transport demand in Cairo, compared to only 3% in 1987

when it started operating (Huzayyin and Salem, 2013). In this same year, it represented only 5% of the total energy consumed by the transport sector, making it a more energy efficient transportation option. This can be compared to 51% of the total transport energy consumed by private cars and taxis in the same year. Metro ridership averaged 2.75 million per day in 2012, up from 2.35 million in 2008 (Huzayyin and Salem, 2013).

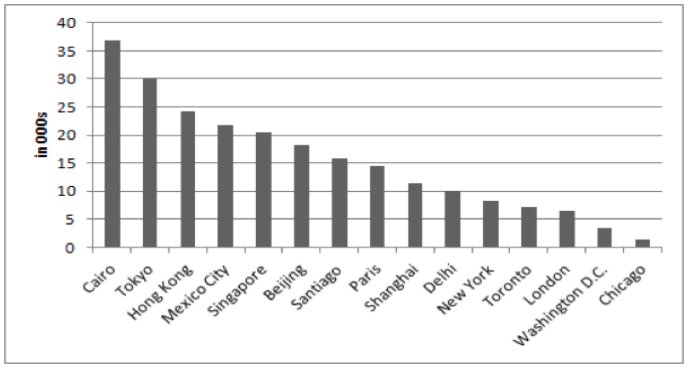


Figure 3: Ridership per day per kilometer of metro network among selected cities
(World Bank, 2003)

Despite its potential, the underground metro has very limited coverage, especially for a city the size of Cairo (See Fig. 4). The metro does not serve major areas including Mohandisseen, Zamalek and Giza. None of the new satellite cities in GC are connected to the metro lines yet, although there are existing plans to link some in the future.

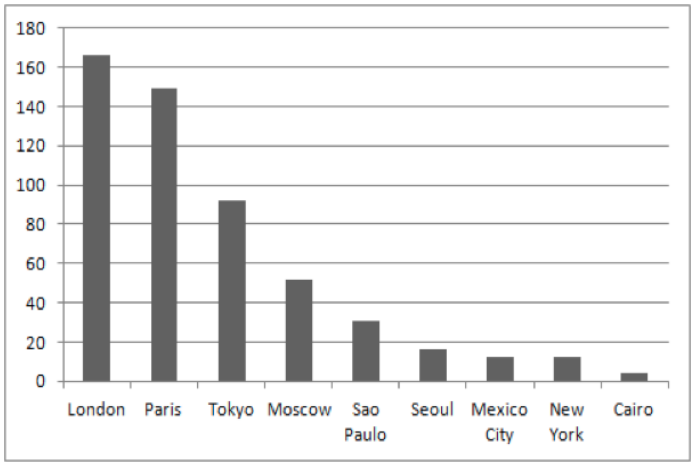


Figure 4: Kilometers of metro per million inhabitants among selected cities
(World Bank, 2003)

Apart from those served conveniently by metro stations or CTA bus routes, Cairenes that travel outside the inner core must rely on private means of transportation. These include microbuses (also called shared taxis), regular taxis, employer buses (rihlat), or personal automobiles. First authorized in the 1970s, to alleviate demand that the public buses could not satisfy, by 1998 the number of microbuses reached 27,300 vehicles serving around 650 routes, covering the whole of GC (Sims, 2010; 229). In 2001, microbuses accounted for 37% of all motorized trips (Huzayyin and Salem, 2013). The flexibility of microbuses to swiftly adapt to new market demand and provide extra routes, allows them to immediately cater to newly established areas and villages (Sims, 2010; 230, Huzayyin and Salem, 2013). Moreover, microbuses represent one of the cheapest forms of transportation in Egypt, with fare rates of only 0.5 to 1.5 LE, or between 0.07 and 0.21 USD. However, due to high competition and low profit margins, microbus drivers aim to maximize the number of daily trips

by resorting to erratic driving and illegal parking, therefore causing a significant road hazard, especially in the presence of insufficient official control and low maintenance (Wahdan, 2012). Microbuses are little more than vans fitted with seats. They usually come in two sizes: between 5-7 and 8-12 passengers. Although cheap and cheerful, riding in them can be dangerous due to high accident rates, and inconvenient, since the routes are relatively fixed and confined to single streets, meaning that commuters frequently find that their daily journey will entail taking a relatively large number of microbuses, switching from one microbus to another when moving from one street to another.

The widespread practice of employers providing employees with transportation from home to work appears to have begun in the 1950s when there was a great expansion of state ownership in the economy. Indeed, busses marked with the logos of government agencies and private companies are very common on Cairo's streets and highways. Oftentimes, company buses travel long distances between places of residence and employment. An extreme case is that of Sadat City, a new town to the northwest of Cairo. Because of the local shortage of labor, factories that opened in the new town of Sadat City decades ago due to tax and other financial incentives, still resort to bussing their employees back and forth from the capital each day, a distance of over 200 km. Like Sadat City, companies, agencies, schools, and even large retailers in Cairo's new desert settlements are largely dependent on providing their employees and students with private transportation arrangements.

Between 1976 and 2006, the number of private automobiles in Cairo rose remarkably from 86,000 to about 960,000, an increase of 1016% (Huzayyin and Salem, 2013). Over approximately the same period, population grew by "only" 169% (CAPMAS, Various Years). Improved access to credit and rising incomes are, in part, the enabling forces behind this large expansion in private vehicle ownership. During the 1980s, however, out of necessity to relieve the paralysis, the construction of the Ring Road was started and more bridges over the Nile were built, as well as roads elsewhere. Overall, forty-five bridges and roads with viaducts and overpasses were completed between 1982-1988 (Raymond, 2000). Although the public works projects served an immediate need, the expansion of automobile infrastructure further accelerated urbanization and favored private vehicles. Moreover, large fuel subsidies, equivalent to 20 billion USD or estimated to be 20% of Egypt's state budget and 10% of its GDP, keep gasoline and diesel inexpensive, encouraging more private cars on the road (UNDP, 2013). Improving street capacity and expanding metro networks at the same pace of growing automobile numbers has proven a serious challenge, whereas large investments in highway expansion is not keeping pace with growing traffic congestion (World Bank, 2010a). The past decades expansions in road infrastructure have all remained unable to keep up with the growth in population and vehicles. The expected consequences have been augmented congestion, fuel consumption and pollutant emissions. A recent World Bank (2010a) report estimated the annual costs of the congestion in Cairo to be around 8 billion USD (or 4% of GDP).

It is becoming more and more obvious that a safe, efficient, and cost effective public transportation system is crucial for the future sustainability of GC. The original vision of the urban agglomeration, articulated in the Cairo Master Plan of 1982, was that GC, including the desert satellite settlements, would evolve into a decentralized, poly-nuclear metropolis in which congestion and all its associated ills would be relieved through geographic spread and localization (Wahdan 2013:44-45). Each of the planned new settlements would be largely self-contained in terms of population, economy, and society. People would live close to work, each neighborhood and settlement would be equipped with essential infrastructure and services, residents' subsistence and social needs would be taken care of within the local neighborhood or urban area. Ironically, The Cairo Master Plan advocated restricting use of private cars, encouraging mass transit, and minimizing commuting distances (Wahdan 2013:45) within urban settlements and between the various settlement nodes. The reality of the last 25 years of urban expansion has produced something different from the original utopian vision. Instead of self-contained and self-sufficient settlements, a new long distance commuter culture is emerging. Place of residence and place of work are becoming increasingly separated spatially. The new urban community of New Cairo is an excellent example of this phenomenon.

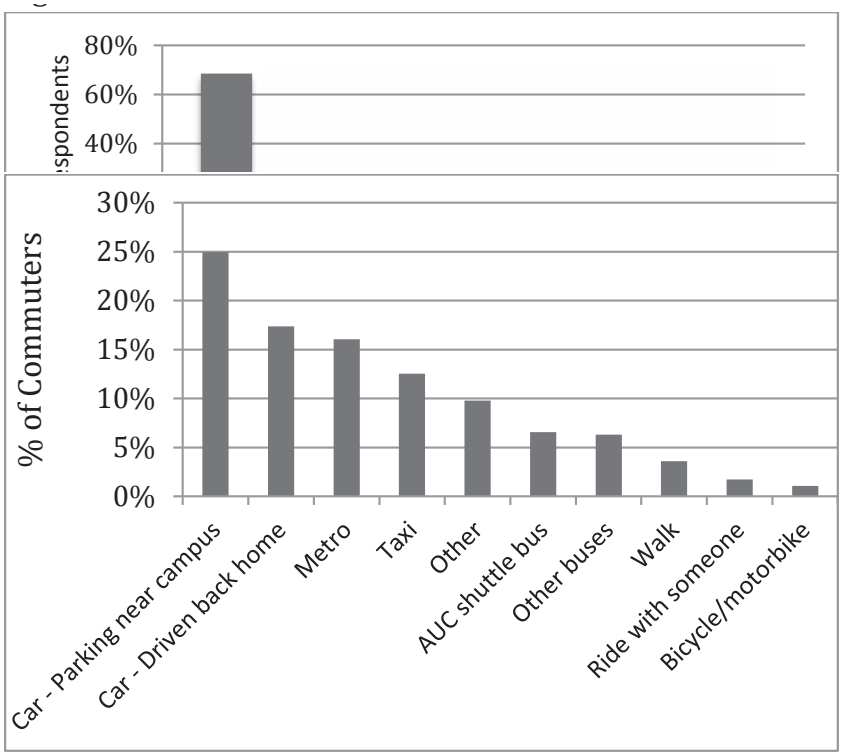
3. Relocating the American Univerity in Cairo

3.1 Commuting to Old Campus

Students, faculty and staff commuting to the old campus downtown had many available options to get to campus, as it is located in the heart of Cairo and well connected to public transit. Commuting included the metro, public buses, private cars and taxis, as well as a few university shuttle buses. The University operated three small shuttle buses (two serving Heliopolis and one serving Maadi), which about 60 people in total used.

As relocation to the new campus approached, a survey of the AUC community was conducted in the spring of 2007 to assess the current commuting patterns to downtown and to gauge the commuting preferences of AUCians after the planned move. Survey results were taken into consideration by a task force deciding on transportation and parking options for the new campus. The survey had 2,708 respondents out of approximately 6,500 AUC community members. The response was represented by; 14% faculty, 51% students, and the remaining 35% staff. However the sample was biased by a higher response rate from faculty and staff than from students.

While only a very small percentage of the respondents lived downtown (3%), a large majority of all respondents lived within around a 10km radius of the University downtown. Yet, it is noteworthy to mention that due to high traffic congestions on the streets of GC, those who live within the 10 km radius did not necessarily experience an easy and swift commute to the downtown campus. Only 3% of the respondents were living in New Cairo at the time. With such a small fraction living in the vicinity of the proposed location of the university, the survey also attempted to determine the likelihood of AUCians relocating closer to the new campus. The majority (68%) stated that they never intend to move and only 9% of the respondents planned to move within the next year (see Figure 5). That is, the time of the move to the new campus. Although the majority of AUCians were not planning on relocating and a small portion was relocating soon, a sizeable 17% were planning on moving in one to five years, with the remaining 6% planning to relocate after five years. Of the respondents, 11% planned to move to the New Cairo area, however, more planned to move to Heliopolis, approximately 20 km from the New Cairo campus.



ınsportation Survey, 2007)

ondents commuting to the downtown
ısed cars that were driven back home,
he second most popular transportation
oy 13% who took taxis. Thirteen percent
survey, four percent walked, and even
with someone else that parked near
a hybrid option.

Figure 6: Methods of Commuting to AUC Old Campus, 2007 (AUC Transportation Survey, 2007)

In the survey, 58% of the respondents stated that they would prefer to commute to the new campus by an AUC operated bus. Almost 30% would prefer to drive their own car and park on campus. The remaining 12% indicated a variety of other options, including taking a taxi, walking, cycling, etc. Interestingly, an informal survey in March 2008, a few months before the move, suggested that while many were concerned about the longer commuting distances and (lack of) transportation methods, positive aspects of the move included the fact that downtown is very crowded and that roads in New Cairo would be less congested with a much better traffic situation (CAMPUS, 2008).

In terms of transportation cost, more than half (54%) of those surveyed in 2007 paid less than 150 LE per month in commuting expenses. Another 42% paid between 150 and 600 LE/month (21 and 96 USD). The remaining 4% paid over 600 LE/month. Parking was a major component of commuting costs. There was no parking on the AUC campus; instead there were privately operated parking garages in the neighborhood. However most commuters appeared to have utilized an informal system whereby self-appointed street parking attendants, locally known as munadis (Sims, 237), each claimed sidewalk territories and assisted drivers in finding parking spot in exchange for a small tip of about 5 to 10 LE a day (Genena, 2014). Alternatively commuters driving to campus could negotiate a monthly fee with a munadi of about 50 - 80 LE (Shalaby). This system, informal as it may have been, solved a large portion of the parking issue in one of the most crowded pockets of the city.

As illustrated in Figure 7, most commuters to the old downtown campus had a round trip commute of less than an hour. Almost a quarter (23%) of all respondents had a round trip commute of less than 20 minutes, 31% spend 20-40 minutes, 25% spend 40-60 minutes, and the remaining 21% spend over one hour. Of those that spend over an hour in their round trip commute, 13% or around a half, spend between an hour to an hour-and-a-half traveling. Such reasonable round trip commuting times can be attributed to the fact that most people lived within a 15 km radius of the campus, making their round trip commute of 30 km much shorter compared to the 65 km average at the New Cairo campus.

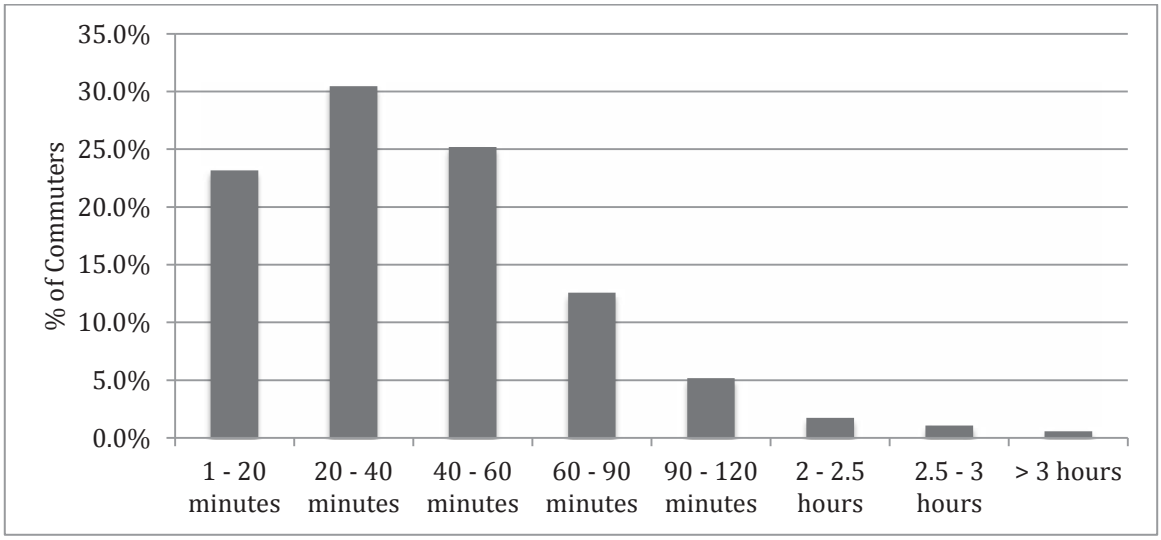


Figure 7: Round-trip Commuting Distances at Old campus
(AUC Transportation Survey, 2007)

3.2 Commuting to New Campus

Commuters to the new campus do not have the same transportation options. Currently, AUC offers a bus service to community members along thirty routes to different districts within GC. The bus service is divided among students, faculty and administrators on the one hand (17 routes), and custodial and security staff on the other hand (13 routes). In the spring of 2012 and again in 2013, surveys were conducted by email among AUC students, faculty, and staff, eligible for the 17 routes, to discover the ways in which AUCians were getting to campus. In addition, the records of the bus service were examined to cross-check ridership and observations were made concerning parking arrangements and the use of private vehicles.

During the last two academic years, the AUC community on the New Cairo campus has numbered about 10,400 people according to the 2014 AUC Factbook. The population can be differentiated among 6,600 students (graduate and undergraduate, full and part-time), 800 faculty (full and part-time), and 3000 staff and administrators. Of these, only about 450 students reside on campus, together with a handful of administrative staff in the dormitories. In 2013, about 12% of AUCians reported living in New Cairo including the gated community of El Rehab on the Suez Road, located around 10 km away from the campus. Interestingly, 17% of freshmen in the fall of 2013 listed New Cairo as their home address. This might indicate a shift in residence patterns. Overall, in 2013, AUCians commuted to campus an average of 32.5km each way with the largest contingents of AUCians coming from Heliopolis and Maadi, followed by Nasr City, Zamalek, Mohandisseen and Giza.

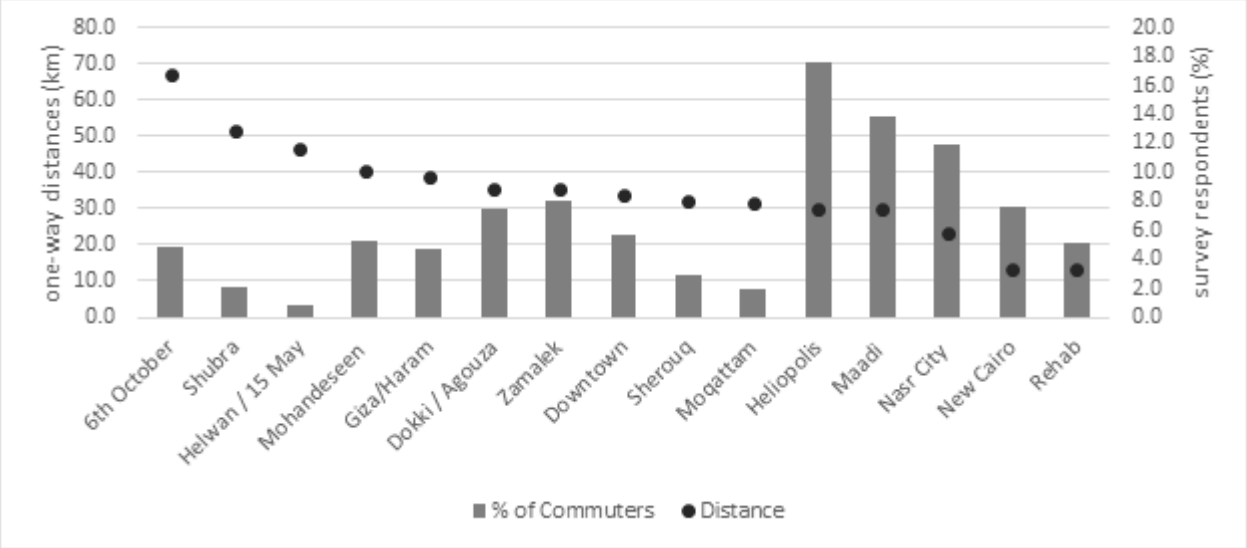


Figure 8: Commuting distances for AUC community, 2013*
(AUC Transportation and Carpooling Survey, 2013)
** Does not include staff-dedicated bus.*

Faculty and staff who previously worked at the old downtown campus report significant increases in their commuting distances since the move to New Cairo. Whereas commuting times, as indicated from the 2007 survey, were between 0-60 minutes for around half the population, it is now not uncommon for people to spend over two hours for their commute. After five years, very few have relocated their residences to New Cairo, and instead prefer the longer commute to the difficulties of relocating their homes in order to be closer to work. Nothing from the data indicates that the 25% of those that indicated an intention to move closer to the new campus have actually moved. Furthermore, only around 8% of respondents from the most recent survey indicated that their residence is in New Cairo. That is less than the 11% that planned on moving to the New Cairo area in the 2007 survey.

From both the spring 2012 and 2013 surveys, two-thirds (68%) of AUCians rely primarily on the bus service to commute to campus, and commuting by personal private car represents 30% (See Fig. 9). The residual 2% get to campus by walking, riding a bicycle, or taking a taxi.

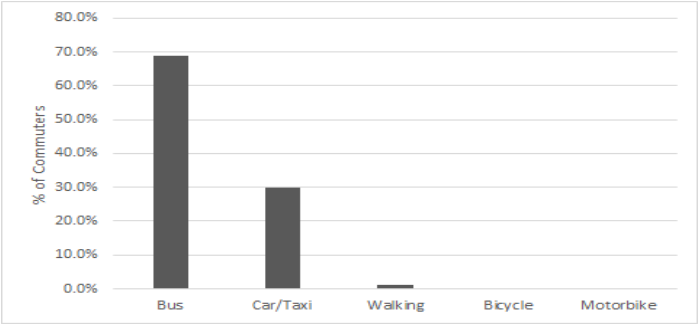


Figure 9: Methods of Commuting to AUC New Campus, 2013 (AUC Transportation and Carpool Survey, 2013)

None of the respondents reported utilizing the shared taxis (microbuses) that operate up and down Road 90, the traffic corridor that connects the AUC campus with the GC ring road. Perhaps this option is avoided by AUCians because the university has provided a better alternative by supplying its own bus service. Another possible reason is avoidance of what is generally perceived to be an inconvenient and socially unaccepted form of transportation. Among the users of private cars, about one in five carpools, i.e. shares a ride with at least one other AUCian, representing only 6 % of the total commuters.

3.2.1 On-Campus Parking

The New Cairo campus is equipped with parking lots inside the fenced security area. Originally the campus had a 1300 vehicle capacity. The plan was to charge faculty, staff and students on a yearly or per semester basis for parking, with the additional option of buying daily tickets. The initial fees were 825 LE per semester or 10 LE per day. Many students opted in the first few years to park outside the campus boundary fence to avoid paying fees. This resulted in considerable congestion and delays at the entry gates. Surprisingly many of the munadis from the downtown campus appeared in the empty streets around the new campus to resume their operation, charging a fee for parking in what was essentially a deserted street. "The only difference between parking inside and parking outside was that there is a gate encircling the campus, whereas outside was just a deserted street. In fact it wasn't uncommon to hear that a car parked outside, got broken into and had things stolen from it. Then there was "the university charging 10 LE for a parking lot that is not even shaded," commented an AUC staff member. Following increased security concerns after the January 2011 Revolution, and a student strike in September 2011 that resulted in a lowering of the daily parking fee to 5 LE, the number of cars parking inside the campus exceeded the parking lot capacity by almost 400 cars (Motorpool, 2011). This caused administration to expand the parking lots so that there is now the capacity to hold 1770 cars. Also, to encourage carpooling, the 5 LE fee was waived if more than one person with an AUC ID card was in the car. Despite an announced AUC parking and traffic policy that included fines for parking outside designated areas, the university administration found that it could not enforce the rules and procedures. As a result, students and others parked wherever they pleased. This led to considerable congestion around those areas closest to the entrances of classroom buildings, in addition to the considerable loss in real and potential revenue to the university from parking.

3.2.2 AUC Bus Service

According to 2013 bus service records during school terms, almost 7,000 AUCians took advantage of the bus service, where roughly half of these were students. After the move, it became apparent that the AUC bus service entailed considerable cost to the university budget. According to the 2014 transportation task force report, the bus service costs reached a total of 35.1 million LE per year (5 million USD compared to the 25 million LE (3.5 million USD) of the previous year, the difference attributed to inflation and rising fuel and operational cost, In that same year the university collected nearly 8 million LE (about 1.1 million USD) in student bus fees, keeping in mind that the faculty and staff do not pay bus fees. As the university is experiencing a severe budget deficit due to a host of reasons, the costs of the AUC bus service has become a focus of considerable attention and debate within the community. Hence, writing proposals to redress the situation include consolidation of routes, reduction of the frequency of buses, restriction of choice in selecting routes and times to ride, and charging faculty and staff bus fees. In summary, the available solutions appear to result in a reduction of service and increased cost to commuters who choose to ride the bus to campus.

Without question, commuting to the new campus is more costly for everyone in comparison to commuting to the old campus, with the possible exception of those who drive private cars to campus. At 4,500 LE an academic year, the bus pass for undergraduate students is more costly than almost any other option that was available on the old campus. In contrast, the 5 LE parking fee is considerably less than the cost of parking downtown five years ago, while gasoline prices have remained virtually the same. For example, in 2007, only 4% of the AUC community indicated that their monthly commuting cost was over 600 LE. Six years later a yearly AUC bus pass for undergraduate students was 4,580 LE (654 USD), amounting to approximately 664 LE/month (95 USD). According to the 2013 survey, 61% of undergraduate students are using the bus service as their primary mode of transportation.

3.2.3 Environmental Impacts

Given that the University chose to move to its current location, requiring large numbers to commute long distances daily, it is necessary to assess the environmental impacts of this shift. Not only has the University moved, but it is just one of many large institutions to move into the New Cairo area as well. The AUC case offers linkages to greater environmental concerns that arise from large institutions. Since 2007, Egyptian oil production has been outpaced by consumption, and in 2010 total road transport fuel consumption represented 18% of Egypt's primary fuel consumption. The growth in fossil fuel consumption from road transport has averaged 7% from 2005 to 2009, with continued growth in the number of passenger cars at around 7% over the same period (UNDP, 2013). With estimated total emissions of around 318.2 million tons of carbon dioxide equivalent emissions, Egypt is the second largest greenhouse gas (GHG) producer behind Saudi Arabia in the MENA region (World Bank, 2010b). As displayed in Figure 10, the transport sector represents a sizable proportion of its total emissions, around 14% (EEAA, 2010).

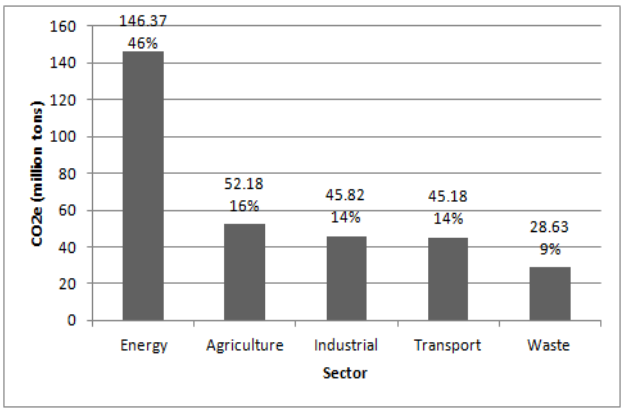


Figure 10: Carbon dioxide equivalent emissions, Egypt, by sector, 2010 (EEAA, 2010)

Like Egypt, AUC's carbon emissions resulting from transport are proportionally the same. From the 2013 carbon footprint, it was determined that more than 16% of AUC's carbon emissions in FY 2012 were attributable to commuting to the New Cairo campus by bus or car, contributing an estimated 6,171.54 metric tons of $MTCO_2eq$ of carbon emissions. Since GHG emission accounting at the University only began in 2011, no comparisons can be made to the situation at the old campus. However, given that there was a much higher reliance on the metro and an overwhelming majority of the community, approximately 75%, lived within a 15 km radius of the downtown campus, it is therefore safe to assume they were much lower.

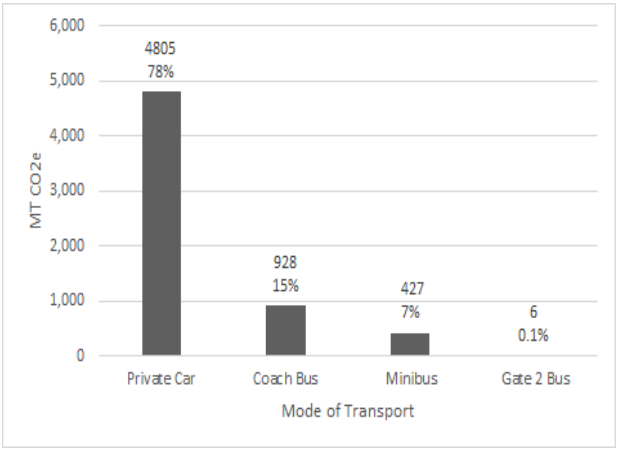


Figure 11: AUC Emissions from Commuting, 2012 (Our Carbon Footprint, 2013)

To date the UNDP/GEF Sustainable Transport Project has yet to make an impact on GHG reductions. With growing fuel subsidies, estimated to be 20% of the state budget and 10% of its GDP, it is clear that GHG emissions attributable to the transport sector will continue to rise (UNDP, 2013). As reported in the Cairo Regional Area Transport Study (2002), the annual GHG emissions in a business-as-usual scenario have been estimated to increase from the current 12.2 million tons of CO_2/year up to 15.9 million tons of CO_2/year by 2022, while in the alternative scenario promoting more effective use of public transportation and related transport demand management through a combination of different measures, the GHG emissions would only rise up to 13.6 million tons of CO_2/year.

Along with rising emissions and congestion, air quality is likely to continue to decline. Using data compiled by the World Health Organization (WHO) in 2008, Cairo ranks just behind Delhi and Kolkata in large particulate matter concentration (See Figure 12).

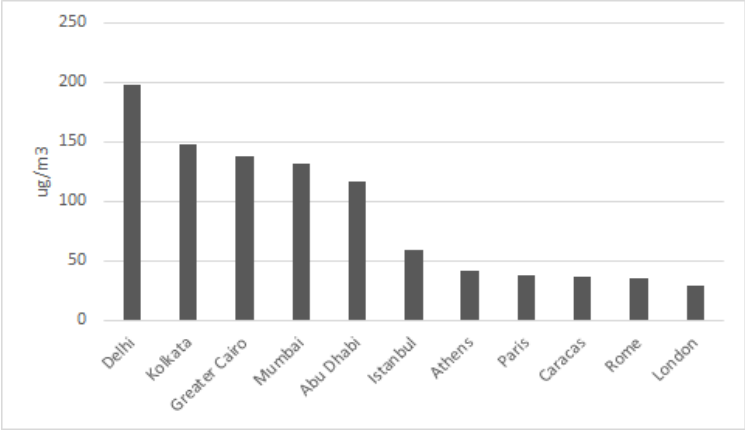


Figure 12: Annual mean PM10, among selected cities, 2008 (WHO database, 2008)

Reducing the numbers of small and old vehicles and increasing clean energy transportation alternatives are essential to reducing pollution and emissions from vehicles. Creating the modal shift away from private car to sustainable public transport and non-motorized transport (NMT) within urban Cairo is troublesome within a market heavily distorted by fuel subsidies. Based on 3rd quarter 2013 prices, Egypt has the fourth cheapest gas in the world at 1.85 LE (0.26 USD) per liter (Bloomberg, 2013). Making the switch to more sustainable modes of transport, especially among the wealthy, appears more feasible only with an introduction of multi-tiered mass transit options. Likewise, AUC faces a potentially troublesome situation should the University scale back the routes it offers.

3.2.4 Road 90: The Reproduction of Congestion

New Cairo lies adjacent to and east of, the Cairo Ring Road, and is Sandwiched between the Cairo-Suez highway to the north, and the Cairo-El Ain El Sokhna Highway to the south. New Cairo was declared a New Town in 1989 and incorporated along its southern boundary extensive public housing blocks originally built to house workers commuting to industrial plants located along the nearby road between Qattamia town and Maadi. The area of New Cairo is huge, over 264 km2, but despite the massive amount of construction in recent years, the planned settlement area is still overwhelmingly empty desert. In 2006, the census recorded 119,000 people living in New Cairo, and over 64% of completed housing units were vacant or closed (Sims 2010:179). The design plans for New Cairo envisioned a middle-to-upper class settlement without industry, but with extensive corporate and commercial areas, as well as large numbers of public and private educational institutions. Several golf courses, luxury hotels, and country clubs were built into the design, as well as numerous walled and gated compounds of expensive villas and associated amenities. The New Cairo Development Authority, the government agency responsible for implementing the urban plans, relied on mostly private sector real estate development companies. The central feature was a large east-west boulevard (named Road 90) serving as the commercial spine of the new city, with a direct connection to the Ring Road on the west and linking to the eastern desert boundary of New Cairo over 15 km to the east.

The AUC New Cairo campus is located on Road 90 almost exactly 10 km east of its intersection with the Ring Road. Vehicles coming to AUC from other parts of Cairo have three basic options. First, if coming from the southwest (primarily Maadi, Helwan, Giza, or 6th October), then the best option is to take the Ring Road and then Road 90 to campus. If coming from due west, such as Mokkatam or parts of Nasr City, then the best option is a new road connecting directly with Road 90 at its intersection with the Ring Road and then the 10 km stretch to AUC. The third route is for those coming from the north and northeast. They can come along the Suez Highway (going under and avoiding the Ring Road) and then taking the Mohamed Neguib Corridor road south from the Suez Road past the gated compound of Al Rehab City to Road 90 and proceed along Road 90 about 2.5 km to AUC. AUC is not served by any public transportation system as- there is no metro or tram to AUC. There are a few public city bus lines serving Road 90 from other parts of the city, but they only serve the first 2.5 km of Road 90 from the Ring Road. It is possible to take a microbus from the intersection of Road 90 and the Ring Road to a point about 1 km west of AUC and then walk from there to the entrance. It is possible to take a taxi from almost anywhere in the city, but this solution can be inconvenient and expensive (see below). The great majority of AUCians take either the AUC operated bus service or they drive their private cars to the university along one of the three routes described.

New Cairo, like other satellite cities, is not connected to GC by any mass public transit system. At the time of campus relocation in 2008, Road 90, the main traffic corridor that connects the new AUC campus with the GC ring road (see Figure 13), was surrounded by construction sites but was mostly empty of traffic. Apart from private residents and gated communities being built along the road, many banks and private companies were similarly preparing to relocate or expand their operations in the stretch of commercial buildings under construction. Currently, construction sites are still largely visible along the developing road.

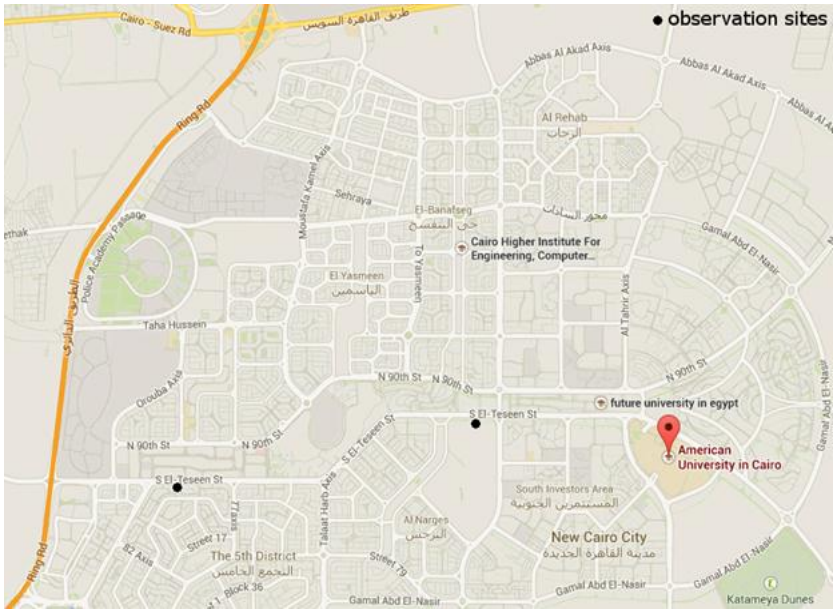


Figure 13: Road 90, (El-Teseen St.), New Cairo
(Google Maps, 2014)

As part of this study the research team carried out a traffic count at the head (close to the Ring Road) and the tail of Road 90, close to AUC (see locations on map above). On average the majority (71%) of traffic along Road 90 is private cars (see Figure 14). A significant number of microbuses operated along the road, making up 11% of the traffic. Taxis made up 9%, a difference since 2008 when hardly any operated in New Cairo. Other types of vehicles (8%) were mainly trucks and construction equipment, almost a quarter of this category was pickup trucks with passengers in their beds (mainly laborers). As one moves eastwards from the Ring Road intersection, there is a significant decrease in the volume of traffic. The number of taxis declined by 70% towards the tail end of the road. Other than that, no major differences were observed in terms of traffic composition between the head and tail of the road.

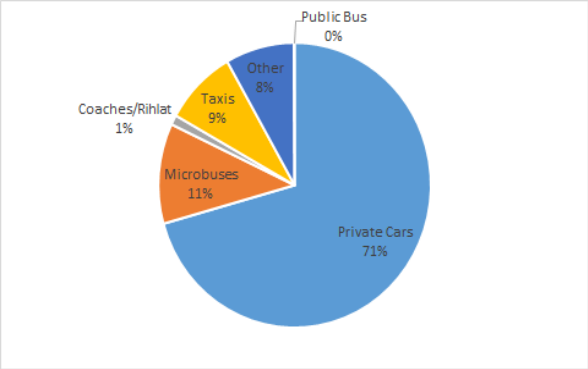


Figure 14: Road 90 Traffic Composition
(Research Team Observation, 2014)

Many similarities can be drawn from the current state of Road 90 and older streets in GC. Each side of the ten-lane road witness heavy traffic jams during rush hours. Essentially, issues associated with street vendors, informal microbus stops blocking several street lanes and other road hazards are happening on Road 90, considerably hindering traffic flow. Despite being a relatively new road, it is poorly maintained, containing a large number of hazardous holes. Moreover, the rising number of fatal accidents along Road 90 has led some to nickname it "the road of death" (Al-Atraqchi, 2010). Remarkably there is already a severe shortage of parking space and double or triple parking is commonplace on the sections close to the Ring Road. Cars are found parked all along the road and in service lanes, further obstructing traffic.

Socioeconomic divisions are also visible from the differences in vehicle types and passengers along the road. This is illustrated by the contrast between battered microbuses and pickup trucks packed with daily laborers commuting to and from construction sites along the road, and the expensive luxury sedans and SUVs favored by the corporate executives and upmarket consumers who frequent the commercial and financial district close to the Ring Road. Microbus operators have formed their own informal stops, attracting street shops and food vendors catering to the needs of the daily laborers. Fancy cars make up more than half the automobile traffic, along with buses operated by private schools, banks and multinational companies. Far from being the exclusive domain of upscale upper-middle class living and working there, Road 90 appears at this point in time a reproduction of the heterogeneity that characterizes much of GC.

3.3 Case Study Conclusions

After six years, AUC is still a commuter community with only two main options for transport: the University-supplied bus service and privately owned vehicles. Although students are being charged a modest fee (equivalent to about 2.5% of tuition) for the bus service, faculty and staff are not charged, and this amounts to a considerable subsidy. The university has greatly expanded its administrative and operational staff (from around 1,000 to around 3,000) since the move. Increased operational costs, employee salaries and benefits, inflation, in the context of constrained tuition and other forms of income have all contributed to a serious operational deficit in 2013. The current bus service is financially unsustainable and the University is faced with a predicament, raising revenues through the bus service or through parking fees, each with potentially negative trade-offs. It could increase the costs of the bus service, or reduce the service by consolidating routes or the schedule, or it could increase the parking fees. Reducing the quality and extent of the bus service would potentially push bus riders to commute to campus by private vehicle. This would lead to increased congestion along Road 90, create more problems with campus parking and lead to increased university GHG emissions. The issue of parking fees was already met with hostility from community members. The number of community members commuting to campus by car appears to be increasing. The dilemma faced by the University is that without a viable public transport alternative, it has had to bear costs that it is unable to pass along to individual community members without resistance.

4. Alternatives

The AUC case study suggests that any public policy for sustainable mass urban transport should put priority on enhancing the mobility of people before the mobility of vehicles (CTMP, 2002). One of the clearest methods towards achieving this goal is to move away from the construction of new motorways or expanding pre-existing roads. Emphasizing people rather than vehicles implies recognizing the importance of the diversity of the human population, and in particular, differences in socioeconomic status and preferences. No one solution will satisfy the needs of all, and a range of alternative solutions will be needed to ensure sustainability of the transportation system. The AUC case highlights the importance of recognizing the significance of an intra-urban commuter culture in GC. For the new settlements, the geographic location of one's place of work is often separated from one's residence. People choose to commute rather than spatially integrate where they live and work. This has put increasing pressure on an already overburdened public transport system and, in the case of the satellite settlements, an overwhelming dependency on private vehicles, either personal vehicles for those who can afford them, or informal group taxis for those who cannot. The end result is often surprisingly high levels of traffic congestion, time delays, excess fuel consumption, and higher levels of pollution in public areas that were designed to be spacious, clean, and congestion-free.

As indicated above, an important lesson learned from the AUC case study is that the public being served by public transportation systems needs to be adequately understood and appreciated in order to design sustainable systems that serve a variety of social, economic, and cultural functions. Addressing the commuting preferences of the more affluent should encourage a transition to mass transit. AUC has welcomed the recent initiative to build and operate a tramline between Heliopolis and the New Cairo campus. Research among the AUC community indicates that such a tram would offer options to a significant proportion of the AUC community, but by no means all of the community members. Other options that should be considered would be a Bus Rapid Transit (BRT) system of express buses linking major centers in the urban core to New Cairo and the new campus. An ideal BRT route would connect with the tram at the junction of Road 90 and the ring road to serve the AUC campus. Extending the Cairo metro lines to reach New Cairo is another highly efficient alternative that would capture a considerable amount of transport demand. In addition to these infrastructural projects, sustainable transportation in New Cairo is largely dependent on avoiding the major pitfalls that characterize other parts of Cairo. Among these are improving traffic management, the adequate policing of intersections, managing parking spaces, creating appropriate taxi and micro-bus stops, and efforts to improve drivers' behavior within New Cairo and especially along the already congested and over-crowded Road 90.

Congestion along Road 90 is in part a result of the shortage and non-use of above and underground parking structures where they do exist in the commercial areas. This may be a result of the public's expectation that transport to and from work should be provided by the employer, or expectations by car owners of free and unrestricted parking. Consequently, causing people to park on the sides of the service drives and roads constrains the flow of traffic. With the proposed metro and tramlines years away, increasing parking capacity via under and above ground structures will help ease bottlenecks due to unregulated street parking. However, the downside of such a policy is that it dis-incentivizes people from forgoing the use of their own car. Improving parking regulations and their enforcement offer a key method towards limiting traffic congestion due to unauthorized parking practices, pushing people to park in authorized locations and limiting the use of private car travel.

4.1 Cairo Metro Expansion

The Cairo metro plays an important role in reducing pressures on transport demand and roads in GC, while consuming less energy than other modes of transport. It is used by travellers from many social and economic classes, as opposed to public buses, which makes the metro a fairly sustainable option for commuting. Expanding the metro network thus offers a partial solution to traffic issues, with positive energy impacts (Huzayyin and Salem, 2013). In efforts to reduce road congestions, GHG emissions and energy consumption from Egypt's transportation sector, there are a number of newly established national plans and public-private partnerships under construction that aim to expand metro coverage through GC. While national projects are working on expanding the metro lines to cover a larger area, including linking some of Cairo's satellite cities to the network, New Cairo is not yet part of those established near future plans.

The UNDP/GEF Sustainable Transport Project, which was planned to start in 2009, is designed to achieve a range of sustainable transport outcomes across the country. The first project outcome is to integrate Cairo's new satellite cities into the public transportation system. Rather than expanding the metro network itself to these areas[1], the project suggests that a new high quality bus service system needs to be coordinated with existing metro lines, including integrated fares, and synchronized schedules, to facilitate connection and encourage more use of the bus and metro systems. The pilot project in this first phase aims to connect *6th of October* satellite city to the existing metro lines (Lines 1 and 2, and possibly 3 upon its completion) via public buses, before replicating the model to connect five additional satellite cities, including New Cairo, to those metro lines in the same way (UNDP, 2008).

The expansion of the Cairo metro network includes a third line under construction connecting the east of Cairo to its west. It is expected to cover 45.5 kilometers, has been under construction since 2005 (UNDP, 2008; NAT, 2013b). When all four phases are completed, the last station on this line (Cairo International Airport Station) will be the closest metro station to New Cairo via the Ring Road. Yet, even though the third line will extend metro access to more AUC community members (those who live in Heliopolis, Nasr City and Zamalek), the Cairo International Airport Station is still not close enough to the AUC New Campus to induce AUC commuters to take the metro in the near future. The latest approved project, a first phase of a fourth metro line, which is to link the satellite city 6th of October west of Cairo, to the metro network is due to start in 2014 (NAT, 2013c). Unfortunately, the approved phases of this line do not include linking New Cairo to the metro network either.

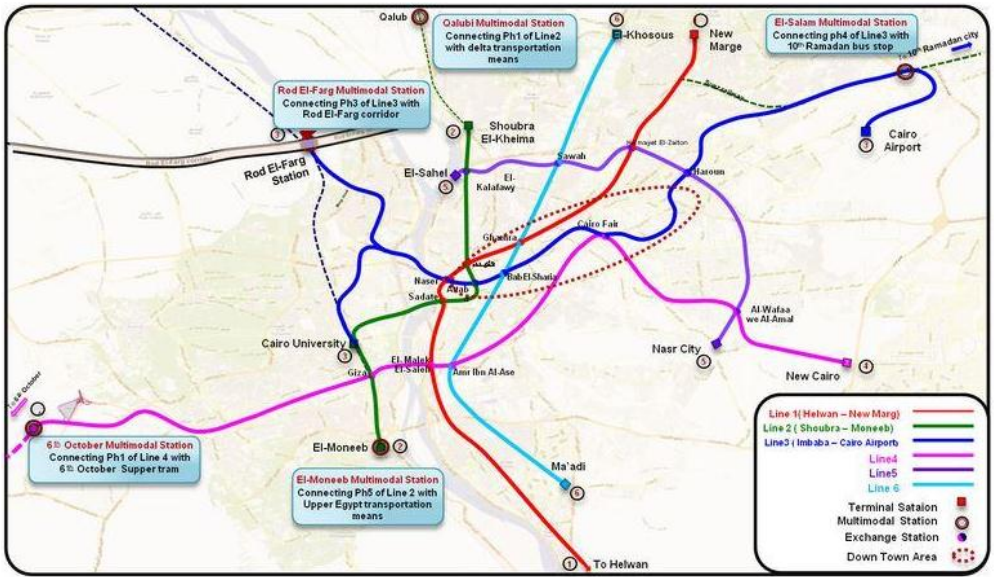


Figure 15: Greater Cairo Metro Lines
(Systra, 1998; JICA, 2000-2002; Ministry of Housing, 2010)
Source: National Authority for Tunnels, 2013.

According to the National Authority for Tunnels, future projects envision a New Cairo station to be established among other metro line extensions by 2050 (see Figure 15). This plan is part of the "Strategic Urban Development Master Plan" conducted by the Japan International Cooperation Agency (JICA) for Egypt's Ministry of Housing, Utilities and Urban Development, which proposes measures to improve public transport connections to New Cairo, by extending a metro line to New Cairo (JICA, 2008). The target year for the JICA plan is 2027, which leaves New Cairo unconnected to metro lines or public transport in the near future. If any of these future plans come to fruition, and even if the New Cairo metro station is located at the Ring Road, then AUC shuttle buses could shift to operate along Road 90 only instead of serving all 30 routes across GC, which would considerably reduce financial and environmental cost.

1. Other components of the project aim to expand the metro lines in other directions.

4.2 The Heliopolis - New Cairo Tram Project

The Heliopolis - New Cairo Tram Project entails the establishment of a tramline that connects Cairo's metro line 3, at the Stadium and Girls College stations, crosses Nasr City and parallels the Ring Road to New Cairo at Road 90. Then it goes along Road 90 to AUC. There would be 43 stops along the way, one every 600-800 meters ("Upgrading" 20). The tram would have the capacity to transport 30,000 passengers on a daily basis and is planned to be about 30km in length moving at the speed of 23km/hour (Mena Rail Company 2014). The project costs a total of about 600 million USD, half funded by the World Bank and the Egyptian government, with the remainder coming from private investment.

This project would have a favorable environmental impact by achieving the long-awaited connection of New Cairo with Cairo's public transportation system, and facilitating access in and out of the city's urban core. With a three year and two-phase time-frame for completion success of this project will largely depend on adequate financing, demand and utilization. While it has been established that there is a widespread need to connect New Cairo to outside areas, a suggested ticket price as high as 10 LE per ride ("Upgrading" 77) should not be seen as catering to, nor attracting people who ride on microbuses, coaches or the back of a truck to get in and out of Cairo. Reliance on the tram for commuting would cost on average 440 LE per month; calculated at 20 LE per day for 22 working days in an average month.

In the case of AUC the question is whether or not students, faculty and staff would consider using the tram instead of private cars or the AUC bus service. The same goes to employees of the businesses located along Road 90. While it would be a step towards encouraging private car owners to use public transport, and it would somewhat relieve AUC from such heavy reliance on its bus system, the tram still would not mitigate points-of-congestion caused by unorganized microbus stops, or street parking for example. In fact, it could cause more points-of-congestion as microbuses and cars and other vehicles attempt to park at tram stops.

Time is also a strong factor that could attract people to use the tram instead of private vehicles. A regular commute from Heliopolis or Nasr City to New Cairo takes about 40 minutes to an hour and a half during the morning rush hour and 1-2 hours in the evening. According to MENA RAIL and HTM Consultancy, the companies designing the project, it would take the tram about 50 minutes to complete the same journey, with discussions about express shuttles that only stop at main stations during the morning and evening rush hours. With regards to the evening commute this could make a significant enough difference so as to encourage commuters to use the tram, especially for those going to or coming from areas further away from campus than Heliopolis.

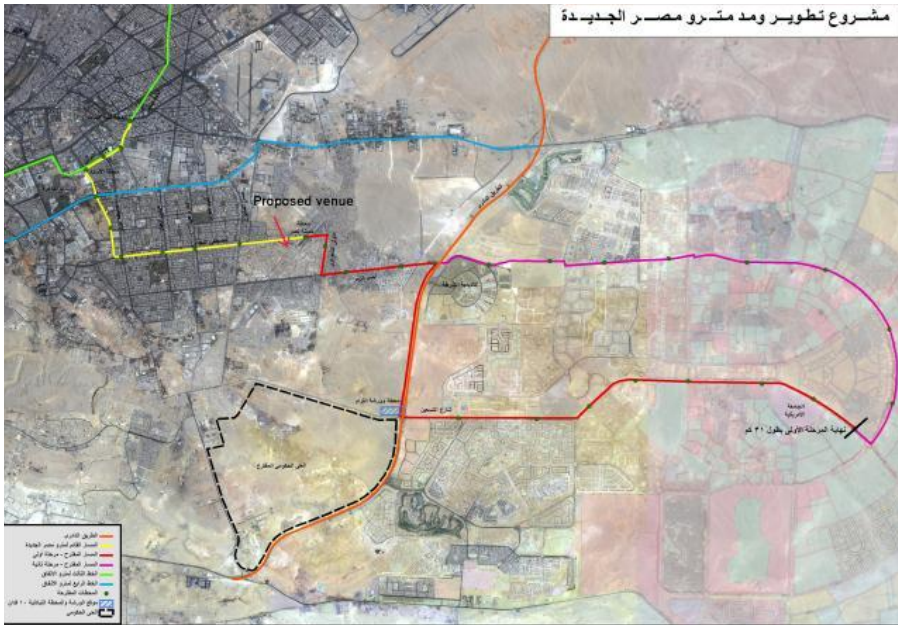


Figure 16: The Heliopolis - New Cairo Tram Project
(Upgrading and Extension of the Heliopolis Tram, Mena Rail, 2014)

No market demand study was conducted by MENA RAIL, HTM Consultancy or EcoConServ Environmental Solutions (environmental and social impact assessment studies consultants) assessing demand among the target group. As such, predictions that the tram would successfully and significantly act as a substitute mode of transport for private-vehicle owners are based on the conceptualization that these companies have of the "average user" among their chosen target group; those of a higher socioeconomic standing with the ability to afford a 10 LE per ride ticket. However the heterogeneity of even that target group, in terms of their different needs and value for time, is not acknowledged, indicating a disconnect between suppliers and customers. The tram would only travel up and down Road 90 and would thus still mean that many riders would have to find another mode of transport to take them to their place of work, study or residence, in the areas surrounding Road 90; where walking is not an option due to distance or the absence of sidewalks. AUC has welcomed the call for the tram in hopes that it would relieve it, somewhat, from the bus subsidy and the consequent financial deficit. For those living in the dorms or the faculty housing across the street, it would also give them a much needed transportation option, though ticket price may discourage many from using it regularly.

The Heliopolis - New Cairo Tram Project's success at lowering congestion would depend on a number of factors, which require further research on the side of the design, implementation and operations companies. These include the questions of what is the purpose, who are the target groups and how to best respond to the need. Perhaps a differentiating price system could be better suited to attracting a larger number of people of varying socioeconomic status to use the tram, but would drive private car owners out of their cars. Given the privacy factor and the presence of the fuel subsidy, would the tram provide any incentive for not buying a private car? And what about the potential for congestion around main tram stations caused by unregulated parking or microbuses scrambling to pick up riders? Neither cars, nor any other type of vehicle, are charged for congestion, causing roads to fill up sooner.

4.3 Bus Rapid Transit (BRT)

Bus Rapid Transit or BRT is a mass transit service that is an increasingly popular policy alternative for implementation. In many contexts worldwide BRT transit offers express bus service in a dedicated lane with minimal to no stops between points of service. This mode of mass transit is appealing to policy-makers because it does not require massive infrastructure investments as with metro or light rail transport options. It can even operate without a dedicated service lane; however the use of a dedicated lane is favorable. The CREATS program conducted a pre-feasibility study on this mode of transport for GC (UNDP, 2008), and suggested implementing small scale public-private partnerships (PPP) to demonstrate their potential success on a trial basis. As a feeder system BRT is the most logical choice, connecting the satellite cities to the outer ring where the physical space requirements are less restrictive. However, moving within the first ring and central core where physical space requirements are increasingly less and congestion greater, BRT loses its appeal and becomes less feasible.

5. Recommendations and Conclusions

New Cairo and other new satellite towns are not connected to the rest of GC by a mass public transportation system. Most Cairenes live in the city's urban core or the suburbs created at the turn of the 20th century, and they commute in order to work or study. The currently established transportation system is unable to keep up with population growth or increased demand and changes in the demographic structure of the city. There is little to no connection or communication channels between city transportation planners and the public. Expanding the transportation system would encounter problems whether it is the physical environment when it comes to construction or society, when it comes to establishing new routes and patterns of behavior ("Greater Cairo"67). Cairenes tend to view public transport options as less convenient or desirable than using their private cars in commuting to work or simply moving around the city.

A people-centered and multi-faceted approach, with a variety of options offered and with a focus on reliability, efficiency, and mutual benefits for all stakeholders (travelers, transport operators, employers, and government), is necessary for the success of sustainable transportation. There are a number of strategic initiatives that could be implemented right away, particularly in New Cairo, while delivering immediate results. These include improved traffic management at intersections along Road 90, enforcing parking measures that facilitate on and off-street parking without encroachment onto one or two lanes of road ("Greater Cairo" 13), and demarcating spaces for taxi and micro-bus stops along the major arteries, in addition to supporting pedestrian movement. Longer term sustainable solutions relate to broader structural institutional issues; they include an expansion of the public transport system, both vehicular and non-vehicular in addition to a revision of the urban transportation institutional structure, a revision of transport pricing (Hussein 39), and the development and training of qualified staff so as to effectively enforce traffic regulations and ensure road safety ("Traffic" 1).

Statements by officials regarding the improvement of public bus services in addition to their introduction in areas currently not served are welcomed, as is the approved plan for the Heliopolis-New Cairo tram project - though many strategic issues surrounding the latter remain unclear yet instrumental to the project's success. Affordability, for example, is a determining factor in the success of many public transportation projects, therefore it could be advisable to have targeted subsidies directed at "those who need them most rather than on overall low fares" ("Greater Cairo" 72), whether in relation to the tram project or otherwise. Creating a multi-priced, multi-level service system could address the issues that come with covering costs. Efforts to improve public transport should be coupled with measures to make the use of private vehicles more of a luxury than a necessity. Fuel subsidies still remain some of the highest in the region at around 20 billion USD (in 2012/13). In 2004, 14% of Egypt's state revenues were spent on fuel subsidies, and although they decreased in 2006, they still remain high (Huzayyin and Salem, 2013). As long as people are paying below market prices for gas, they will continue to drive private vehicles in increasing numbers. The objective is to facilitate the movement of all categories of travelers to move easily within and between New Cairo and the rest of the metropolitan area, given the limited available road space.

The AUC community experienced an overall increase in commuting distances and costs in the new campus. This has negative implications for the financial and environmental sustainability of the AUC transportation system. Within the AUC community, fostering a culture of carpooling and bus commuting offers a way towards reducing the negative environmental consequences and road congestion associated with said means. Raising prices and enforcing parking regulations may be a way towards increasing bus ridership and decreasing subsidy cost. However it may also result in more car commuters parking outside the campus gate and constraining the flow of traffic. AUC is part of a larger community of universities in New Cairo, and so there is a potential in the future for jointly operated bus services. Such an option might provide a comfortable commuting alternative for students, faculty and staff and reduce costs to the participating institutions. A mass transit option among peer groups would seemingly provide a safer environment. With regards to mass public transportation, increasing the comfort, quality and route options available to the public may increase ridership, especially among those from higher socioeconomic groups, drawing people away from private car commuting.

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