Reconciling the Car and the City:
A Vision of Productive Urban Mobility

by

Ventzislav Pavlov

A thesis
presented to the University of Waterloo
in fulfilment of the
thesis requirement for the degree of
Master of Architecture

Waterloo, Ontario, Canada, 2011

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.
I understand that my thesis may be made electronically available to the public.

Abstract

The relationship between cars and cities is changing. The auto-centric development predominant in America in the 20th century is beginning to subside and disappear. It is being replaced by efforts to make cities more sustainable, enjoyable, and accessible by their citizens without the need to always own a personal vehicle. Given the issues inherent in building more infrastructure to support the ever-growing demand for automobiles, continuing to rely on fossil fuels to power them, or living in neglected spaces designed for machines, an alternative solution is needed. While entirely giving up the car today is socially, politically, economically, and physically impossible, new ways of dealing with it are becoming viable. These developments are currently in their nascent stages, but they hold immense potential to transform the way urban mobility operates in the near future.

This thesis explores architecture's response to this emerging reality and proposes that it is time for the car and the city to foster a productive relationship. In the past, architects and urban planners have designed and re-designed the built environment to accommodate the needs of the automobile. Today, there is a need for an architecture which integrates mobility and the means of powering it with vibrant and social urban space. Through the design of a networked mobility hub for Long Island City in Queens, New York, this thesis will re-imagine the relationship between cars and architecture, creating a new paradigm for dealing with the automobile in the city.

Acknowledgements

I would like to thank Jeff Lederer for his continuing support, guidance, and critical insight throughout the evolution of this thesis. I would also like to thank John Straube and John McMinn for graciously sharing their wisdom and enthusiasm with me. Your help has been invaluable, and I am grateful for the opportunity to have worked with all of you.

To my parents, my family, and to Jenn, thank you for your love, patience, and encouragement. Without your support, I could not have achieved this.

For my family.

Table of Contents

List of Illustrations


COLONIAL
SIGNAL AHEAD

Chapter 01:

Introduction

"We have experienced it ourselves, and suffered it almost to the point of self-denial: the car is a destroyer of our cities, an enemy of traditional architecture. And no wonder, for when the car was born those cities were geared to the dimensions and speed of an ox-cart, and not in the remotest prepared for the dynamism of the motor car. This encounter between archaic immobility and an impetuous longing for forward movement has not been without its consequences. The car threatens and disturbs/destroys our habitats. We do not defend ourselves: indeed - and this is where we have a screw loose, because we adore it - the car is one of the habitats we love most. To tell the whole truth: it is the Golden Calf of modernity. We have surrendered ourselves irredeemably to automobility. And one thing is clear: for a very long time to come, our societies north and south, east and west, will neither want nor be able to exist without the car, but only with it. What might peaceful co-existence look like?"

Dirk Meyhöfer, Motortecture
(Ludwigsburg: Avedition GmbH, 2003) 8.

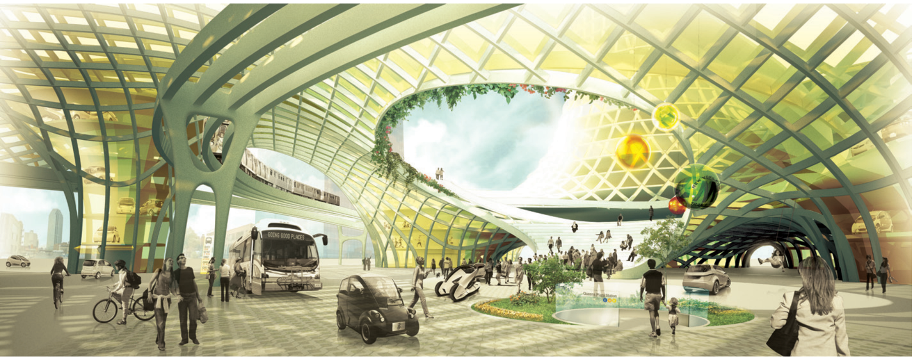


Fig. 1.1. Image of the proposed design for the Queens Plaza Mobility Hub in New York City.

Imagine a New York City where you never need to own a car and are still able to get anywhere. All your mobility needs, such as going to work in Midtown, getting groceries in Queens, dropping the kids off at soccer practice in Staten Island, visiting the folks upstate, and/or kicking back at home in New Jersey, can be achieved by a seamlessly integrated system of public and private on-demand transportation. There are a series of Mobility Hubs (Fig. 1.1) around the city where you cannot only hire a vehicle to drive around as you please (or hop from the subway onto the bus), but also spend time in, recreate, run errands, catch up with friends, and/or even live.

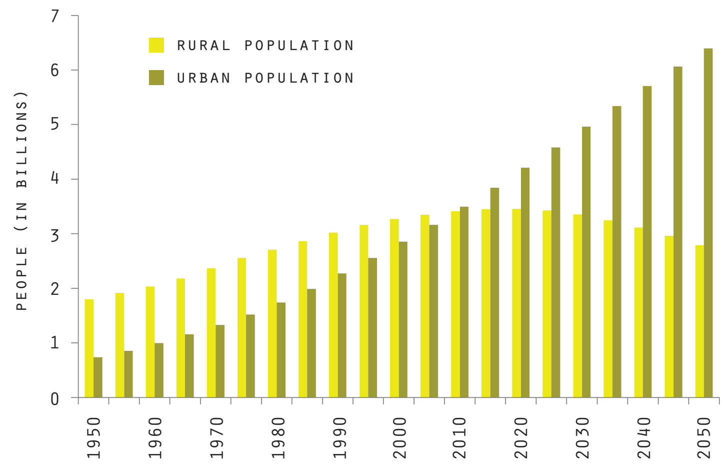
The cars here are not just left lifeless for the day in massive parking lots, waiting to be used again, as is largely the case today. They are charged, picked up by someone and then dropped off by someone else at any time and any place throughout the city. These vehicles are small, smart, fun, clean, quiet, and they do not need rare and damaging oil to run. They are recharged sustainably by electricity generated on-site by the Mobility Hub, using renewable sources like the sun and the wind. When needed, their stored energy can also be given back to the local grid. But most importantly, they create a sense of place, community, responsibility, integration and enjoyment.

While this scenario sounds incredulous, it is indeed closer to reality than most of us realize. The age of cheap oil, and consequently, the 3-car garage and 4-hour commute, is becoming increasingly challenged. Global resource, as well as environmental and economic crises are putting pressure on the current model of production and consumption - their effects are now apparent almost everywhere.

For the first time in history, humans have become a predominantly urban species, with 60% of us expected to move from rural to urban areas by 2030 (Fig. 1.2). By the same year, our population will rise from 6.9 billion to more than 8 billion people.[1] The dense metropolis - places like New York City - will become the territory of need for most architectural investigation. We will have to live more compactly, more sustainably, and be more aware of our needs, resources, and global impact if we want to survive.

Does this mean we will either have a lower quality of life, or give up some of our freedoms - such as our cars and mobility? It seems highly unlikely. The car is intrinsically tied to our culture and our everyday way of life. Its sudden extinction is unimaginable. The automobile has become a part of the urban fabric and the experience of a city as much as the artifacts of architects, builders, and engineers. As Roland Barthes states when writing about the Citroën DS (Fig. 1.3):

> *"Cars today are almost the exact equivalent of the great Gothic cathedrals: I mean the supreme creation of an era, conceived with passion by unknown artists, and consumed in image if not in usage by a whole population which appropriates them as a purely magical object."*[2]



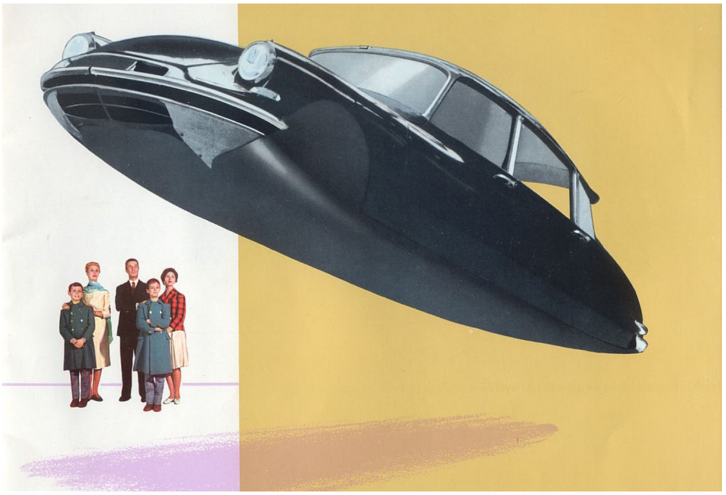


Fig. 1.2. (Top) The world's urban vs. rural population.
Fig. 1.3. (Bottom) The Citroën DS from a 1959 advertisement.

1 United Nations, *World Urbanization Prospects*, <http://esa.un.org/unup>
2 Roland Barthes, *Mythologies*, (New York: Hill and Wang, 1957) 88.

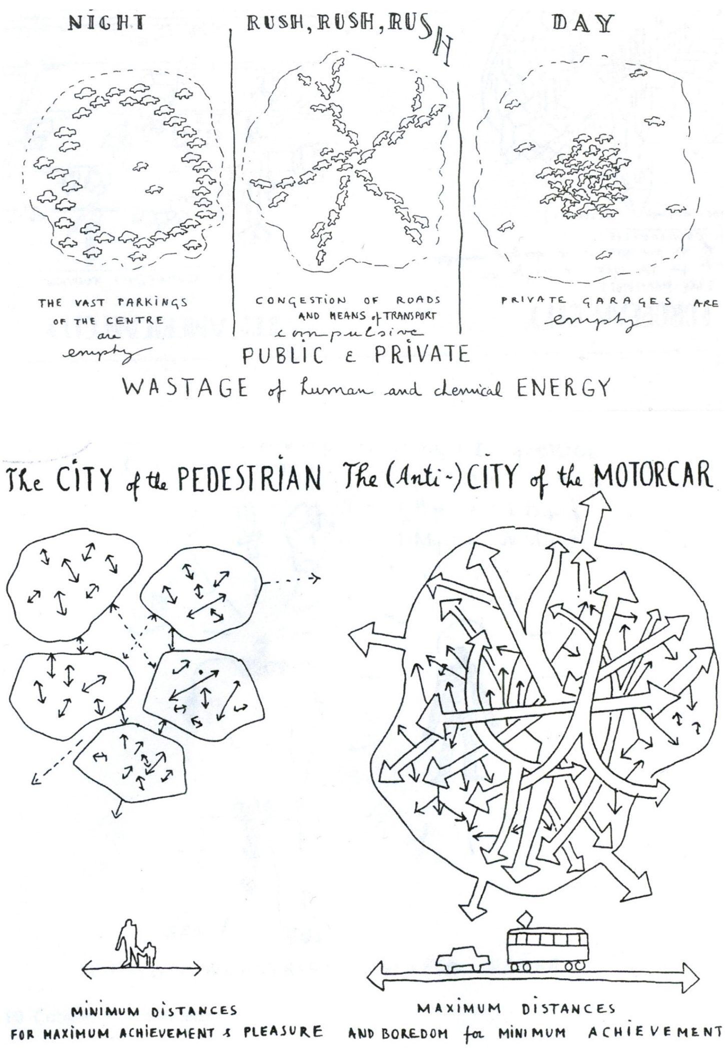


Fig. 1.4. Léon Krier's critiques on modern planning, zoning, and car-centric development.

This magic lies in the car's inherent promise of freedom and mobility. Since the dawn of time, mobility has been a driving force in the evolution of humanity. The invention of the wheel allowed for easier transportation of goods across distances. The horse-drawn cart multiplied that distance to enable greatly the expansion and evolution of cities. Once the car came into fruition, there was a limit on neither how far, nor how often one could travel. Mass production also meant that almost everyone could own their car. It allowed individuals to have ultimate freedom over their mobility - enabling life, work, and play in ways that were inconceivable just over a century ago.[3] With such progress, rapid expansion and reinvention became possible. The automobile greatly changed the city and way of life within it. It is now an irrefutable part of culture - one that architects and urban planners have had to respond to and complete through plan, policy, and design.

The challenges faced today from the proliferation of the automobile are undeniable and commonplace. The literature on the subject is also vast and extensive, with writings from Jane Jacobs to Maas, van Rijs, de Vries (MVRDV) commenting on the role and relationship between our cars and cities. We have seen the propagation of suburban sprawl, the separation and isolation generated by zoning, inefficient land use, and the lack of public space either created or left for human interaction. Modernist visions and ideals about designing cities for the car have proven to be inadequate and often destructive to the human experience. Cities, particularly those largely developed during the golden era of the automobile in the post-war period, have abandoned traditional notions of the street, the pedestrian and the public square in favor of the highway, the automobile, and the shopping mall - typically surrounded by a sea of parking. As distances become less and less

3 William Mitchell, et al., *Reinventing The Automobile: Personal Urban Mobility for the 21st Century* (Cambridge: The MIT Press, 2010) 2.

relevant in a “car-centric” city, so does the space between destinations, or any space not meant to be experienced with one’s own vehicle.[4] (Fig. 1.4)

In many cases, architecture has been reduced to grossly oversized signage, an empty asphalt lot, and/or an expressionless box. They are all designed to look similar in order to be easily recognizable everywhere by the travelling motorist. The parking garage is the only significant typological innovation, but just like most other architecture dedicated to the automobile, it puts human needs and amenity second.

Taking these realities as a given, this thesis focuses on the potential for architecture to synthesize a productive resolution, rather than dwell on the particular issues and effects of the automobile. Change is clearly needed and imperative. It is also close at hand, and in fact already in motion. The thesis, therefore, proposes that the car and architecture can – and should – achieve a mutually productive relationship.

The work neither fetishizes, nor romanticizes the automobile. More importantly, it does not demonize it. The aim is to expose both its merits and shortcomings, looking for opportunities to move forward. In so doing, this thesis explores the following three major drivers of change in the current paradigm: mobility, sustainability, and livability. It breaks down the work in terms of the challenges and opportunities presented by each. It then applies the lessons learned in a design proposal for a Mobility Hub in Long Island City, Queens, New York (Fig. 1.5). The project responds directly to the ideas and emerging realities outlined in the thesis. It synthesizes them into a productive urban site for people and their mobility.

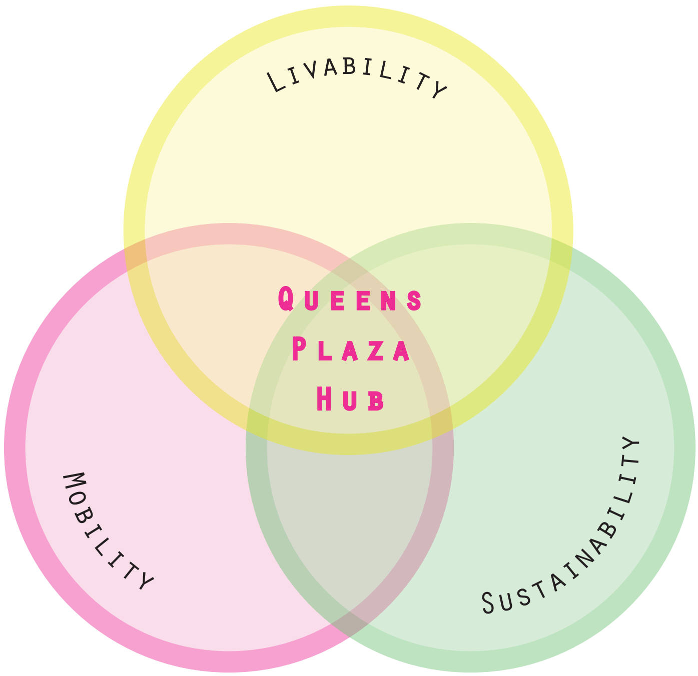


Fig. 1.5. The three major drivers in the conception of the thesis work.

4 Léon Krier, "Critiques" and "Urban Components", *The Urban Design Reader,* Micheal Larice and Elizabeth Macdonald, eds. (New York: Routledge Taylor and Francis Group, 2009) 232-250.

The first major driver – mobility – involves changing the very nature of personal transport. This component is achieved first and foremost by no longer prioritizing plans of cities for automobiles. Urban policy-makers are already beginning to realize that building more capacity and infrastructure only inflates the problems associated with automobiles. Money and other resources could be better directed toward improving public transit, providing bike lanes, and redesigning streets to be equally inclusive and welcoming to all inhabitants. Therefore, a key step in the process is synthesizing cars and transit in a sustainable manner. A well-connected system of mobility that includes public and private transport equally, is now seen as very desirable by city officials and policy-makers. It also leads to the possibility of wide-spread adoption of car-sharing instead of individual ownership of automobiles. With many such initiatives becoming more robust and accepted worldwide, the single vehicle can become much more useful and prudent.

Sustainability, the second driver, explores the potential in changing the way we power our mobility. The first step in this process is the move away from fossil fuels as primary energy carriers. Currently, the United States of America is by far the largest consumer of oil, accounting for a quarter of the world's total.[5] Most of this resource (71%) is used solely for transportation needs and 65% of it is imported from elsewhere, at a cost of about $1 billion a day.[6] With world reserves dwindling and becoming increasingly harder to obtain, the need to move away from fossil fuels is not only imperative, but more urgent than ever. The best and most promising alternative being explored today is the shift to electricity. Generated by renewable resources like solar and wind, coupled with upgrades to its grid, electricity can be smarter, more efficient and better

5 Nation Master, *Oil Consumption by Country,* <http://www.nationmaster.com/graph/ene_oil_con-energy-oil-consumption>

6 Wired Magazine, *Proving the Merits of Green Racing,* <http://www.wired.com/autopia/2010/10/argonne-national-laboratory-project-green/#more-28517>

integrated with cities. Ideas like micro-generation, localized production, and intelligent grids with real-time variable pricing are gaining much popularity already. So are Electric Vehicles (EVs) and the idea of using smaller, smarter and cleaner cars for the majority of our city driving and commuting needs.

The third driver – livability – is the shift in how we design, build for, and live with cars. This area involves accepting the automobile, embracing its potential, and celebrating opportunities to make it socially and physically desirable. To do so, there is a need to integrate and intermingle programme for cars with that for people. The two can no longer be dealt with separately, otherwise they will not be able to achieve a symbiotic relationship. As more people are moving to the city, there is also a growing need for amenity, social interaction and vibrant neighbourhoods. The work of the thesis aims to provide pleasant and enjoyable spaces for the community and actually create a sense of place.

The investigation focuses on North America and the United States in particular. The growth and evolution of American cities is uniquely influenced and driven by the proliferation of the automobile as the primary source of human mobility. As such, it serves as the most appropriate area to showcase the challenges and opportunities of car-centric development. At a more specific case study and design intervention level, there is a special emphasis placed on New York City throughout the work. As the most densely populated area in the U.S., it is a fitting example of the pressures facing future urban centers. Most of the congestion, energy, environmental, and quality of life challenges associated with the current state of today's automobiles are amplified. Subsequently, cities are placed in an ideal position to benefit greatly from the resolution of these challenges. Due to its high density and long-term investment in public transit, infrastructure, and public space, New

York is also an ideal situation where the co-evolution of mobility and the city has already started to take place. As such, N.Y.C. can readily accept new development such as the Mobility Hub and serve as a future model to other cities in the U.S. and abroad.

Chapter Outline

The thesis is presented in four parts – each examining the three drivers previously outlined (ie. mobility, sustainability, and livability), as well as one that culminates in a design proposal for a Mobility Hub in Long Island City, Queens, New York.

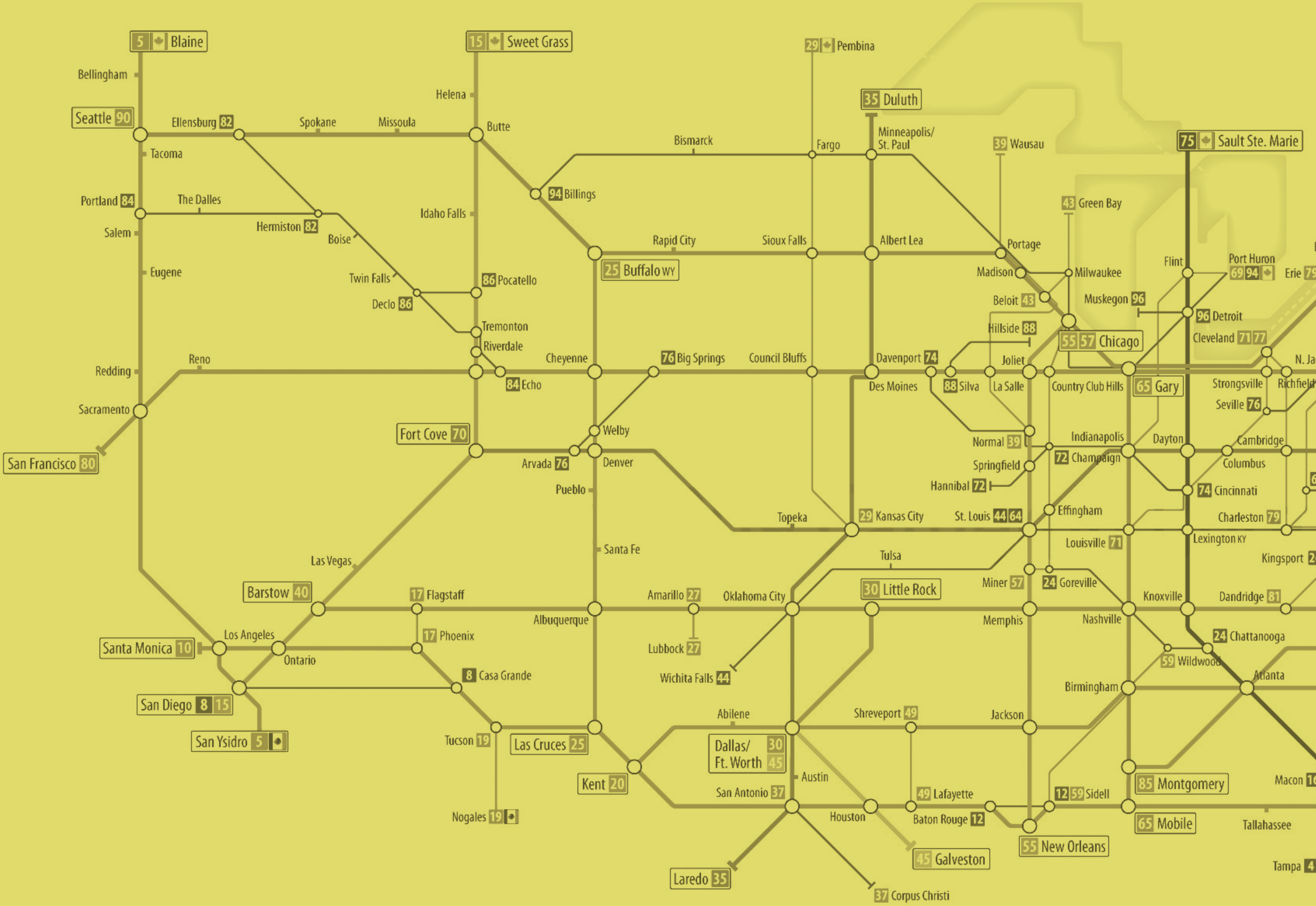
The first part – entitled "Mobility: Shifting the Nature of Personal Transport" – outlines the new role that the car has assumed in providing transportation. Chapter 02: "Yesterday's Tomorrow" analyzes some notable visions of "the future" of cities and automobiles. By learning from both their positive and negative qualities, a case is made for the need to envision a new reality and the importance of an integrated approach to mobility. Chapter 03: "Non-Auto-Centric Development" presents some specific strategies already being implemented around the world to increase public transit use, promote car-sharing, integrate different transportation systems, and give some of the neglected car-oriented spaces back to citizens. When combined together, such strategies have the potential to not only meet the growing demand, but actually evolve our system of mobility, as well as the very nature of personal transport and its role in developing our cities.

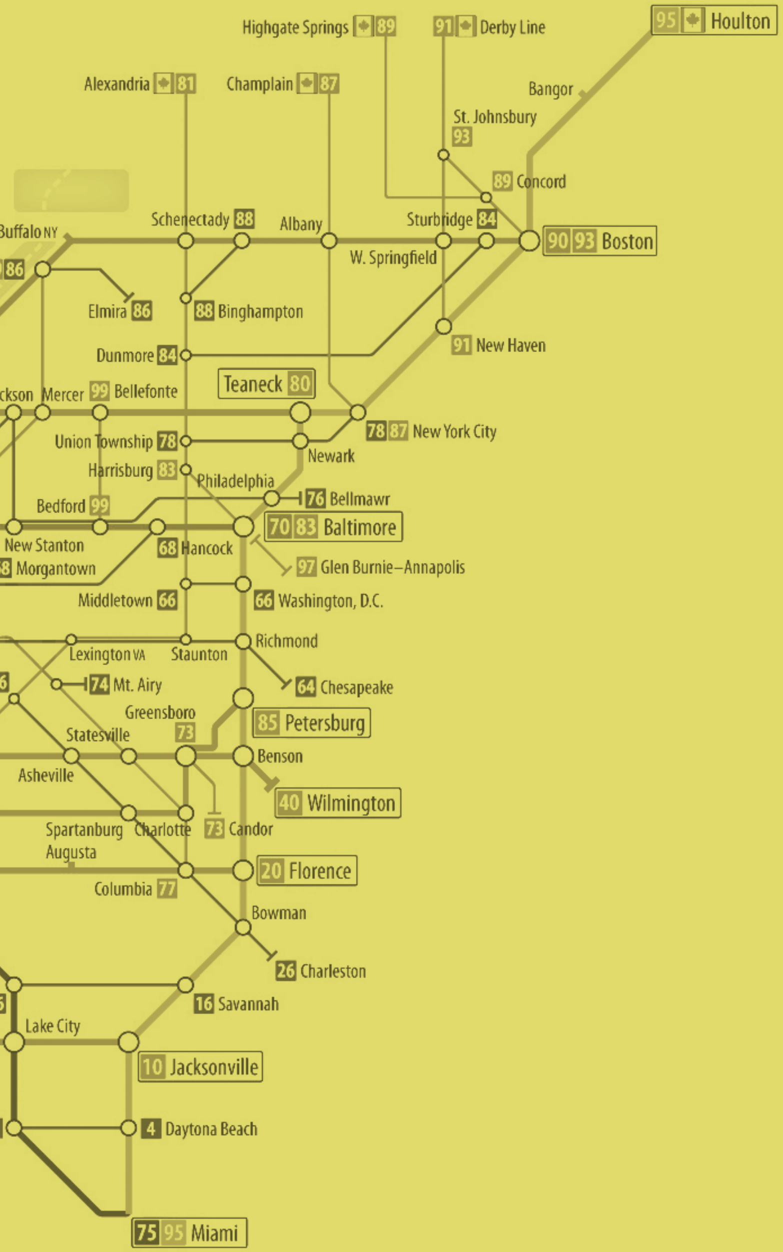
Part Two, entitled "Sustainability: Powering Tomorrow" demonstrates why the current model of auto dependence in America cannot continue and where opportunities for intervention lie. Chapter 04: "Leaving Fossil Fuels Behind" looks at the damaging effects of widespread automobile use in America - a phenomenon known as peak oil and the unsustainable nature of powering our mobility. By mapping and analyzing how Americans obtain and use their energy, sustainable opportunities are presented in the combination of renewable energy resources, micro-generation, smart grids and the electrification of the automobile. Chapter 05: ”Electrifying the Automobile” examines the potential in different types of EVs, how their operational characteristics could be utilized, and what are the current market realities. It also showcases some of the new concepts for a better integrated system of mobility.

Part Three, entitled “Livability: Reconciling Architecture and the Car” looks at how our built form has responded to the proliferation of the automobile and, more specifically, how architecture is dealing with the issues of mobility. Chapter 06: “Spaces for Cars” analyzes building typologies and programmatic needs that have emerged to accommodate the car and looks for opportunities to celebrate and integrate them. Chapter 07: “Architecture and the Automobile” showcases different design strategies and influential works that take on similar challenges and exemplify the themes investigated in the design.

Part Four, entitled “Synthesis: Envisioning Productive Urban Mobility” re-imagines the relationship among people, cars and cities by proposing a productive architecture to deal with their integration synergistically. Chapter 08: “Site Analysis and Mapping” examines the mobility and travel patterns in New York, in order to find opportunities for intervention. Queensboro Bridge provides an integral entry point into Manhattan, with Queens Plaza being the proposed site for architectural investigation. This location will integrate a future network of shared electric cars with the city’s public transit system, as well as bikers and pedestrians. It will also be a part of a city-wide system of Mobility Hubs aimed to achieve a productive relationship between cars and the city.

The “Design for the Queens Plaza Mobility Hub” is then explored in more detail in Chapter 09. Using the ideas presented in the previous chapters, the proposal synthesizes a well-managed idea of mobility with sustainable means of powering and using it, while creating vital and vibrant public space.


5 Blaine
15 Sweet Grass
29 Pembina
35 Duluth
75 Sault Ste. Marie
Bellingham
Helena
Seattle 90
Ellensburg 82
Spokane
Missoula
Butte
Bismarck
Fargo
Minneapolis/ St. Paul
39 Wausau
Tacoma
94 Billings
43 Green Bay
Portland 84
The Dalles
Hermiston 82
Idaho Falls
Salem
Boise
Rapid City
Sioux Falls
Albert Lea
Portage
Flint
Port Huron 69 94
Madison
Milwaukee
Eugene
Twin Falls
86 Pocatello
25 Buffalo WY
Beloit 43
Muskegon 96
Declo 86
96 Detroit
Hillside 88
55 57 Chicago
Cleveland 71 77
Tremonton
Riverdale
Redding
Reno
Cheyenne
76 Big Springs
Council Bluffs
Davenport 74
Joliet
Des Moines
88 Silva
La Salle
Country Club Hills
65 Gary
Strongsville
Richfield
84 Echo
Sacramento
Seville 76
Welby
Normal 39
Indianapolis
Dayton
Cambridge
Fort Cove 70
San Francisco 80
Arvada 76
Denver
Springfield
72 Champaign
Columbus
Pueblo
Hannibal 72
74 Cincinnati
Topeka
29 Kansas City
St. Louis 44 64
Effingham
Charleston 79
Lexington KY
Louisville 71
Santa Fe
Las Vegas
Tulsa
Kingsport
Barstow 40
17 Flagstaff
Amarillo 27
Oklahoma City
30 Little Rock
Miner 57
24 Goreville
Knoxville
Dandridge 81
Albuquerque
Memphis
Nashville
Los Angeles
17 Phoenix
Lubbock 27
24 Chattanooga
Santa Monica 10
Ontario
59 Wildwood
8 Casa Grande
Wichita Falls 44
Atlanta
Birmingham
San Diego 8 15
Abilene
Shreveport 49
Jackson
Tucson 19
Las Cruces 25
Dallas/ Ft. Worth 30 45
San Ysidro 5
Austin
Kent 20
85 Montgomery
Macon
San Antonio 37
49 Lafayette
12 59 Sidell
Nogales 19
Houston
Baton Rouge 12
65 Mobile
Tallahassee
55 New Orleans
45 Galveston
Laredo 35
Tampa
37 Corpus Christi



Part One

MOBILITY

Shifting the Nature of Personal Transport

Chapter 02:
Yesterday's Tomorrow

Fig. 2.1. If 2 billion cars were parked bumper-to-bumper, they would encircle the Earth over 200 times.

The challenges of mobility that today's American cities face are largely due to the predominantly car-centric developments of the 20th century. The automobile quickly rose to dominance in both transportation and urban planning agendas. While providing an unprecedented level of mobility and freedom, the negative effects of car-centric development are well-documented and in need of remedy. Today, there are over 850 million cars and trucks on the planet, with this number expected to reach 2 billion by 2030[1] (Fig. 2.1). This amount simply cannot be sustained without re-thinking the role of the car in the city. In order to move forward, the lessons from the past must first be understood.

The automobile has drastically transformed the city and the very idea of mobility. Before the car, streets and squares were solely inhabited by pedestrians, with little impediment by horses or carriages.

1 D. Sperling and D. Gordon, *Two Billion Cars: Driving Toward Sustainability* (Oxford University Press, 2009) 1.

This realm was the "locus of public life and the theater for human ritual."[2] It was reserved for people to wander around, stroll, converse, trade, and celebrate.

As the car started to infiltrate the streets, there became an ever-decreasing amount of space left for the public. A parked car requires thirty times more road space than a person standing, and a moving one sixty times more than a person walking.[3] Combined with the noise, pollution, and threat of injury or death, it was not long before the automobile effectively banished civic life from the streets. It was enacted to such a degree, that commerce was removed altogether from the future, limited-access roadways, in order to preserve their order, efficiency, and natural scenic beauty (Fig. 2.2). For Americans, "the right to mobility became a national preoccupation and appears to have superseded previous concerns for the right to assembly guaranteed by the First Amendment."[4]

As people surrendered themselves to the allure of horsepower, they demanded freedom to be able to do all their daily travels by automobile. All the amenity offered by the city no longer depended on proximity. Instead, it was based on adequate parking space and convenient connections to a high-speed road.[5] Whether it is to the workplace, cinema, department store, or front door of their home, people wanted to get there by car, elevating the personal vehicle to the highest priority when it came to transport. The automobile eventually became a status symbol and an object of desire, furthering the gap between those who own one and those who do not.

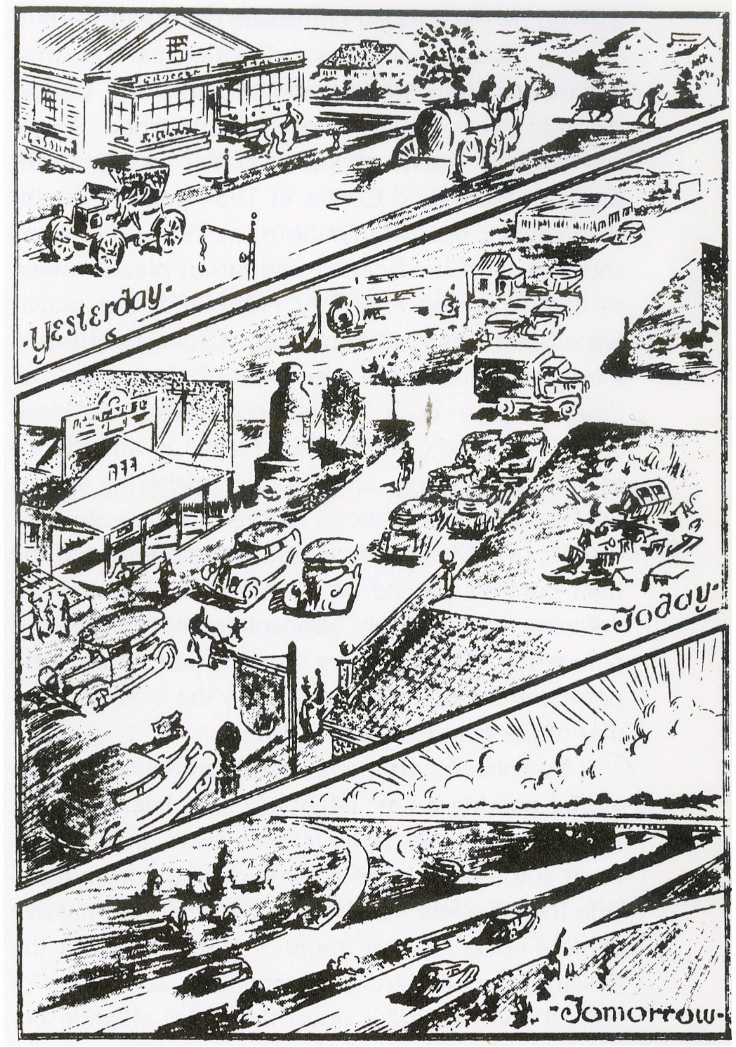


Fig. 2.2. Visions of Roadside Reform. New England Regional Planning Commission. 1939.

---

2 Jan Jennings, *Roadside America: The Automobile in Design and Culture* (Iowa: Iowa State University Press, 1990) 149.

3 Dietrich Klose, *Metropolitan Parking Structures: A Survey of Architectural Problems and Solutions* (New York: Frederick A. Praeger, Inc., 1965) 9.

4 Jennings, 149.

5 Klose, 9.

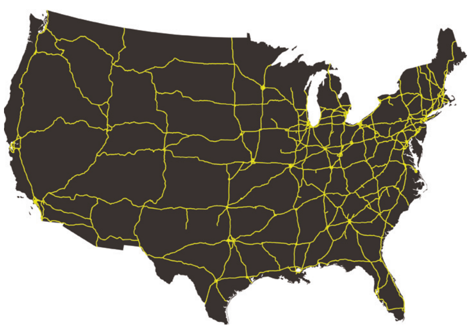


Fig. 2.3. (Top) The Interstate Highway System as envisioned by the industrial designer Norman Bel Geddes. His extensive and highly detailed "Futurama" exhibit for General Motors at the 1939 New York World's Fair captivated the imagination of thousands of Americans. It convinced them of the merits, wonders, and feasibility of a massive nationwide road network.
Fig. 2.4. (Bottom) The network of the Eisenhower Interstate Highway System today.

Naturally, public transit throughout America fell by the wayside. Prominent streetcar networks such as those in Los Angeles, Detroit, Houston, and New York City were gradually abandoned and dismantled, to better cater to the needs of the automobile. Public infrastructure became embodied by the Interstate Highway System (Fig. 2.3). Stretching over 75,000 km today,[6] it is both the largest highway system and the largest public works project in the world (Fig. 2.4).

These drastic transformations could not have come without the visions of architects and planners. Their often radical proposals for what the future of the metropolis in the automotive age held were largely totalitarian, heavy-handed, and inherently car-centric in their approach. As such, they are often regarded as important lessons in the challenges facing cities today and how to avoid them. However, some of their ideas, if implemented properly or from a different perspective, could provide great opportunities for the future.

6 Federal Highway Administration, "Question 3," *Frequently Asked Questions,* <http://www.fhwa.dot.gov/interstate/faq.htm#question3>

Much of Le Corbusier's early work dealt with envisioning the future reconciliation of cars and cities. His 1935 manifesto for the Radiant City was never actually built, but it did become a model for much of 20th century urban planning. His vision was especially inspirational in America. There was plenty of open space and, unlike in Europe, not much old city fabric that had to be demolished to make the plan work.[7]

Corbusier proposed consolidating density into towers, which were then spread out and connected via high speed roadways, elevated off the ground (Fig. 2.5). Everything was calculated, planned, zoned and separated, in order to achieve maximum efficiency. However, when put into practice across America, this often generated vast, empty, and inhumane spaces. They were devoid of any character or chance for human interaction and solely accessible by automobile.

Much of present-day critique of urban planning relates to developments like these ones. In the words of critic James Kunstler, we are creating "places not worth caring about."[8] That said, a lot of the ideas Le Corbusier presented in his vision can be either utilized or re-adapted with great success today.

Most notable is the idea of giving the ground plane back to humans (Fig. 2.6). Corbusier proposed lifting buildings and roads up on "pilotis" and creating a continuous park-like surface for human habitation. In his opinion, people and cars should never meet.[9] While such an extreme take on this vision has led to isolation and separation, the basic idea is of great importance. People should be free and comfortable to traverse the ground plane, much in the same way as in pre-automobile times.

7 James H. Kunstler, *The Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape* (New York: Simon & Schuster, 1993) 78-79.

8 James H. Kunstler, "James H. Kunstler Dissects Suburbia," *TED Talks,* <http://www.ted.com/talks/james_howard_kunstler_dissects_suburbia.html>

9 Corbusier, *The Radiant City* (New York: The Orion Press, 1967) 121.

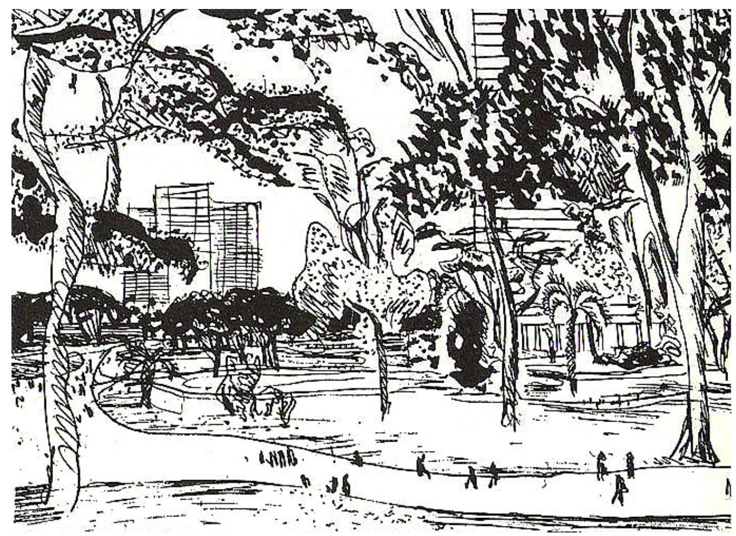


Fig. 2.5. (Top) Le Corbusier's "Voisin" plan for Paris, from his proposal for the Radiant City (1922-25).
Fig. 2.6. (Bottom) The ground plane in Le Corbusier's vision.

Fig. 2.7. Harvey Wiley Corbett's City Section. 1913.

Harvey Wiley Corbett's vision of future New York City in 1913 is for a much denser and bustling metropolis (Fig. 2.7). A notable characteristic is that it provides for the needs of all different kinds of transport (ie. varying speeds, privately, as well as publicly based) in the urban fabric. Even pedestrians feature prominently in Corbett's vision and help paint a picture of a potentially vibrant, exciting place.

However, Corbett saw the separation of all these different forms of mobility as the only way to resolve them. By giving each their own exclusive "layer" within the city, his vision can be seen as a model to what plagues most transportation systems today. The lack of integration and opportunities for interaction between different forms of mobility makes each much less desirable or effective. Similarly to Corbusier and many of his contemporaries, Corbett saw automobile traffic as needing to be isolated, channelled, and contained, like the flow of a river:

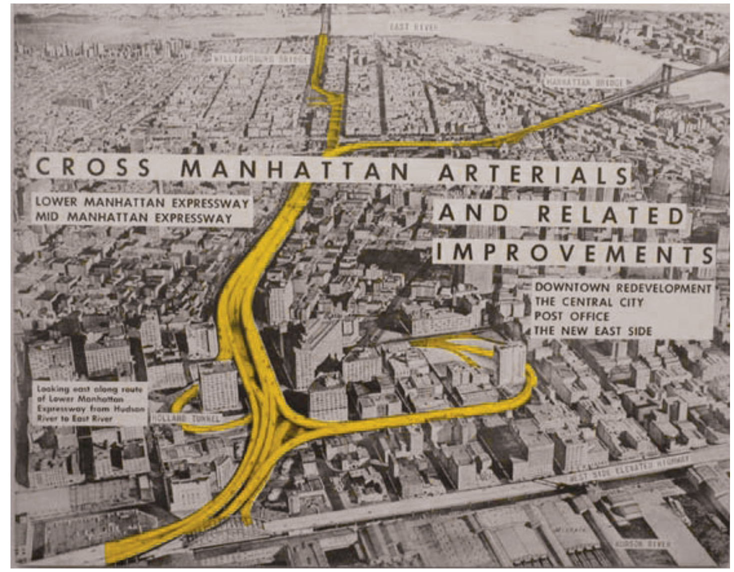
> "*... a very modernized Venice, a city of arcades, piazzas and bridges, with canals for streets, only the canals will not be filled with water but with freely flowing motor traffic, the sun glittering on the black tops of the cars and the buildings reflected in the waving flood of rapidly rolling vehicles*"[10]

10 Jennings, 153.

Robert Moses was a powerful figure who drastically transformed New York City in the 20th century. He built numerous parkways, highways, and bridges that were a part of his ambitious vision of a mobile metropolis. His work is generally regarded as heavy-handed, car-centric and the cause of many of the city's problems. However, in the context of his time, his planning practices were similar to those in the rest of America. His projects did connect the city and provide much-needed infrastructure for its growth and development.

His proposals for the Lower and Mid-Manhattan Expressways (Fig. 2.8 and Fig. 2.9) are significant, because, unlike most of his other projects, they did not just pass through slums and/or underdeveloped areas. They threatened the destruction of vital city neighbourhoods and disconnecting Manhattan. Moses asserted that urban agglomerations are created "by and for traffic". As a direct critique to his vision, Jane Jacobs wrote in "The Death and Life of Great American Cities" that they should instead be created "by and for neighbourhoods"[11].

Indeed, the significance of Moses' cross-Manhattan expressways is the fact that they were rejected and not fully realized. It was one of many similar occurrences across America at this time that signalled a shift in the way that the public viewed the autonomy of the automobile. The car was no longer seen as the single most important means of transport, to be just incorporated into the city. Different ways of thinking and envisioning the future of mobility became increasingly apparent.



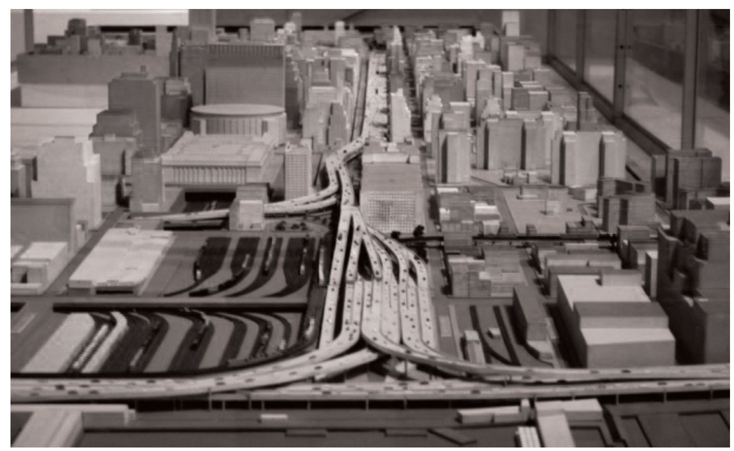


Fig. 2.8. (Top) Drawing of Robert Moses' proposal for the Lower Manhattan Expressway from the cover of a brochure. (1959).
Fig. 2.9. (Bottom) A model of the Mid-Manhattan Expressway.

11 Hilary Ballon and K. Jackson, *Robert Moses and the Modern City: The Transformation of New York* (New York: W. W. Norton & Company Ltd., 2007) 70.

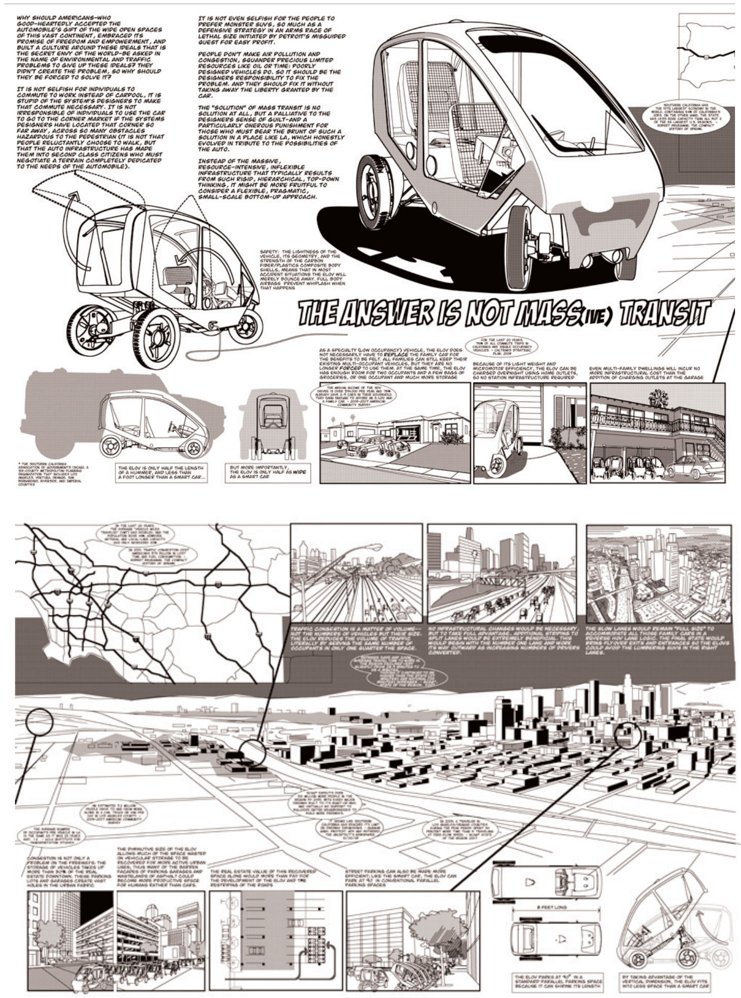


Fig. 2.10. Wes Jones' competition entry panels.

Starting in the 1960s, visions of the future focused on space and air travel as the dominant form of mobility. The car became the disenchanted reality and necessity of today. It hardly provided any more inspiration for fantasies of healthy future living.[12] It is not until recently that the potential of the automobile to transform cities for the better is beginning to be explored again.

Competitions, such as "A New Infrastructure: Innovative Transit Solutions for Los Angeles" are aimed at inspiring designs for a more sustainable mobility in the 21st century. While intended to focus on rail extension and public transport, the projects also showcase larger-scale, interrelated planning strategies.[13] These concepts are a key indicator as to the prevailing attitudes in the public and the design profession regarding the future of mobility in large cities, and the new role that the car is assuming in providing transportation.

One notable entry is by Wes Jones Partners (Fig. 2.10). Jones recognizes the fact that the automobile is not going away and Americans need to find more sustainable ways of using their vehicle, instead of being forced to give them up. He proposes that just by using smaller and more efficient cars, the urban fabric and daily life of citizens could be greatly improved.[14] His ideas are shared by many others and will be explored later in the chapter on "Electrifying the Automobile".

12 Gerald Silk, *Automobile and Culture* (New York: Harry N. Abrams, 1984) 298.
13 The Architect's Newspaper, *Announcing Winners: A New Infrastructure* <http://www.archpaper.com/e-board_rev.asp?News_ID=3320>
14 Jones Partners, <http://www.jonespartners.com/>

Another notable entry is by Odile Decq Benoit Cornette (ODBC), who envision a system of free electric cars for hire throughout the city. These would be available for pick up by anyone throughout Los Angeles, as well as from specialized hubs. These hubs would bridge over the highway and link the two sides, while providing amenities such as park space, commerce, and Free Car and Bike stations (Fig. 2.11).[15] These ideas will be investigated further in the following chapter, with examples of systems and planning principles currently in place around the world.

Fig. 2.11. Images of ODBC's proposal.

15 The Architect's Newspaper, *Announcing Winners: A New Infrastructure*

Chapter 03:

Non-Auto-Centric Development

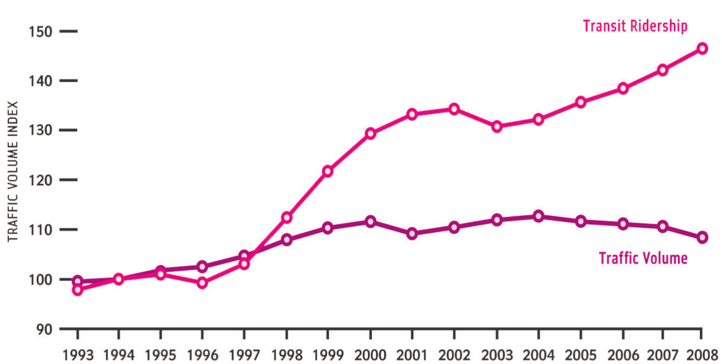


Fig. 3.1. Percent rise in the use of transit vs. traffic volume in New York City.

The trend of automobile dependence in America is beginning to reverse. The focus in the debate over transportation projects and visions today is not whether the car should yield its dominant spot in providing mobility, but how to make that a reality. The U.S. has begun countless new projects, from a National High Speed Rail plan to more localize TIGER (Transportation Investment Generating Economic Recovery) grants. The aim is to provide "innovative, multi-modal and multi-jurisdictional transportation projects that promise significant economic and environmental benefits to an entire metropolitan area, a region or the nation."[1]

New York City is on the forefront of such initiatives. Public transit use is continuously on the rise, while auto use has remained unchanged, and even decreased during the recent economic recession (Fig. 3.1). In its strategic growth plan (PlaNYC 2030), officials declare as one of their missions that the city "will encourage commuters to shift from their cars onto an improved transit system, while providing better service for those who choose to continue to drive."[2]

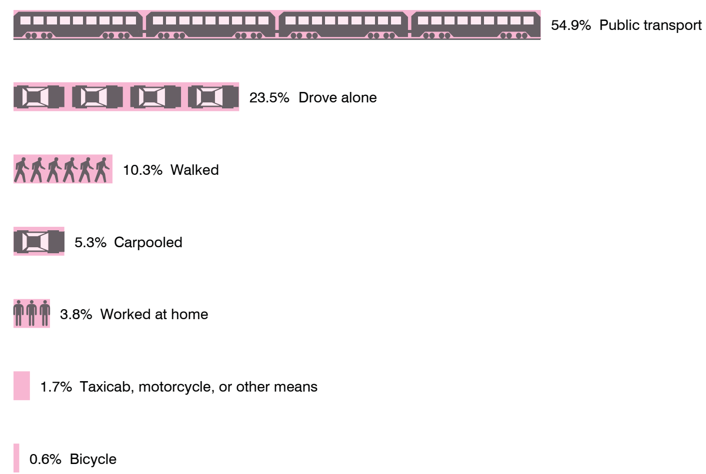
1 U.S. Department of Transportation, *Recovery Act-Funded Projects Will Create Jobs, Spur Lasting Economic Growth* <http://www.dot.gov/affairs/2010/dot3010b.htm>

2 The City of New York, *PlaNYC : A Greener, Greater New York* <http://www.nyc.gov/html/planyc2030/downloads/pdf/full_report.pdf> 88.

Indeed, New York City serves as a model for the success of non-auto-centric development. It has the highest proportion of its residents (55%) using public transport to get to work than anywhere else in the U.S. (Fig. 3.2). 44% of New Yorkers over the age of 16 do not own an automobile,[3] while the same is true for only 8% of American households.[4]

However, this comes at a price. As the most densely populated city in the U.S., New York has 26,403 people per square mile,[5] compared to the 80 per square mile national average.[6] It also has the highest commuting time in the country - 39 minutes on average (Fig. 3.3) - with a quarter of all trips taking more than an hour.[7] Heavy rush hour traffic in Manhattan has risen from 7 to more than 10 hours a day in the last 20 years. Congestion is estimated to cost $13 billion every year.[8] The question then is how to improve mobility in New York City, while taking advantage of its role as a leader in non-auto-centric development.

The density and vibrant character of the city's neighbourhoods are a big factor that enabled the rejection of the automobile as the dominant means of travel. Other factors are New York's long-term investment in public transit and infrastructure, as well as the recognition of its citizens' needs. This chapter will examine a few key projects and case studies from within New York, as well as abroad, that help set precedents for future development.



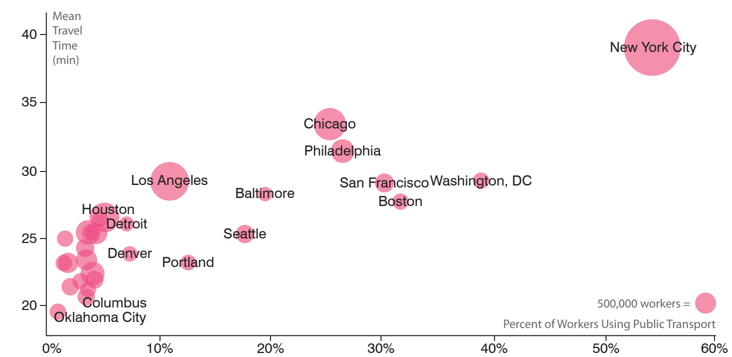


Fig. 3.2. (Top) Mode of transport used by New Yorkers to get to work.
Fig. 3.3. (Bottom) Average commute times and percentage of workers using public transit in major U.S. cities.

3 U.S. Census Bureau, "Table S0801 Commuting Characteristics by Sex," *2009 American Community Survey* <http://factfinder.census.gov/>
4 Bureau of Transportation Statistics (BTS), "Executive Summary," *The 2001 National Household Travel Survey* <http://www.bts.gov/publications/highlights_of_the_2001_national_household_travel_survey/html/executive_summary.html>
5 U.S. Census Bureau, "New York (City), New York," *State & County QuickFacts,* <http://quickfacts.census.gov/qfd/states/36/3651000.html>
6 U.S. Census Bureau, "USA," *State & County QuickFacts* <http://quickfacts.census.gov/qfd/states/00000.html>
7 U.S. Census Bureau, "Table S0801 Commuting Characteristics by Sex"
8 The City of New York, *PlaNYC,* 88.

Fig. 3.4. (Top) Times Square before and after becoming car-free.
Fig. 3.5. (Bottom) Greenwich street after sidewalk improvements.

In the last decade, New York has given some of its car space back to pedestrians. One such project is "Green Light for Midtown", which completely closed off certain sections of Broadway Avenue to motor traffic. Intersections at Herald Square and Times Square that were previously some of the busiest traffic spots in the city are now full of people and activities (Fig. 3.4).

These areas have become an incredible extension of the sidewalk, the public realm, and civic life - much like streets were in the pre-automobile era. Initially implemented as a temporary installation, the project's immense success has awarded it status as a permanent feature, with an official design by Norwegian architects Snøhetta to be carried out soon after.

Another similar project was completed in 2000 for Greenwich Street in Manhattan. Although not completely eliminating vehicle traffic, local streets were reduced from being 24m to 11.5m wide.[9] This reduction provided a lot of extra space for sidewalks, landscaping, and most importantly, public activity (Fig. 3.5).

By recognizing the importance of street and civic life, the city is changing the face of mobility. An example of this vision is New York City's "Street Design Manual". First published in 2009, the document outlines the new approach to the public realm and seeks to promote

> *"...a more balanced idea of street design, giving equal weight to transportation, community, and environmental goals. Practitioners (and the public) have learned that investment in high–quality street infrastructure can yield benefits well beyond simple mobility: public health,*

9 New York City Department of Design and Construction, *High Performance Infrastructure Guidelines, <http://www.nyc.gov/html/ddc/downloads/pdf/hpig.pdf> 22.*

improved physical environment, and (particularly relevant in lean fiscal times) economic benefits..."[10]

The idea of creating balanced, mixed use streets is explored through the wide-spread re-design of thoroughfares to include bike lanes, bus-only lanes, wider pedestrian sidewalks, planting, etc. (Fig. 3.6). Another interesting application of the idea is through the proposal for "shared streets" (Fig. 3.7). Taking cues from European cities like Brighton, London (UK), and Mainz (Germany), the roadway is to become a single curbless surface, "shared among pedestrians, bicyclists, and low-speed motor vehicles."[11] Currently in pilot consideration, shared streets could provide many benefits to smaller, more urban thoroughfares. This concept includes a higher quality of public experience, as well as opportunities to use permeable paving and greener ground cover[12] (Fig. 3.8 and Fig. 3.9).

10 New York City Department of Transportation, *Street Design Manual,* <www.nyc.gov/streetdesignmanual> 19.
11 New York City Department of Transportation, *Street Design Manual,* 59.
12 New York City Department of Transportation, *Street Design Manual,* 60.

Fig. 3.6. (Above) Sample street intersection with various road users.
Fig. 3.7. (Top Right) Shared street in a commercial area in Brighton, UK.
Fig. 3.8. (Top Middle) Demonstration of porous asphalt.
Fig. 3.9. (Top Left) Reinforced Grass pavers at the Orange Bowl Stadium parking lot in Miami, FL.

Fig. 3.10. (Top) Portland, Oregon's downtown streetcar system.
Fig. 3.11. (Bottom) Bus Rapid Transit boarding platform in Curitiba, Brazil.

New York is not alone in its initiatives to reduce car-dependence and promote more public transit use. Cities across the U.S. and abroad are seeking to respond to today's challenge of mobility, while simultaneously improving the quality of life of their residents.

Portland, Oregon was the first American city to re-introduce streetcars as part of their public transit system in 2001 (Fig. 3.10). Designed for short urban trips in the downtown area, the service also connects to the rest of Portland's transportation routes - buses, MAX rail, and the new aerial tram. The project is part of Portland's visionary master plan, which limits outward expansion and sprawl, and focuses on densifying and improving its core instead. The streetcar has enhanced the convenience and mobility of residents and spurred large investments into Portland's downtown.[13] In doing so, it has become an often-cited model of success.

The Brazilian city of Curitiba's Bus Rapid Transit (BRT) is another popular case study in effective transportation. Curitiba's BRT is also part of the city's master plan aimed at diminishing the reliance on personal automobiles. The system works much like a subway, but without rails and above ground, eliminating many of the costs associated with mass public transit. The buses run as often as 90 seconds apart, have exclusive bus lanes to run on, and enjoy traffic signal priority. Fare is collected prior to boarding and waiting platforms are level with bus floors, speeding up service (Fig. 3.11). All of this contributes to a well-used system serving more than 1.3 million passengers per day, or 70% of all commuters in Curitiba. In turn, development has flourished along the BRT corridor - instead of out into suburbs - and citizens enjoy convenience with less congestion or pollution.[14]

13 New York City Department of City Planning, *World Cities Best Practices,* <http://www.nyc.gov/html/dcp/pdf/transportation/world_cities_full.pdf> 37-41

14 U.S. Department of Transportation Federal Transit Administration, *Chapter 3: Curitiba Experience*, <http://www.fta.dot.gov/research_4391.html>

The rising advancement and use of technology today can also be employed to make public transit more attractive. Services aimed at providing riders with real-time information can take some of the uncertainty out of planning a trip without a car. The following are the most important things people need to know: when their next bus or train is coming, whether there are any service changes or delays, and how/where they should transfer or get off. This information can be provided by digital displays in and outside of transit stations. It can also be made available online and accessed by people through their smart phones.

San Francisco's Bay Area Rapid Transit (BART) was one of the first transportation agencies in the U.S. to make schedules and real-time information available to software developers.[15] The result today is countless applications for cities across the nation that let riders stay informed on-the-go (Fig. 3.12). Paris' Régie Autonome Transports Parisiens (RATP) has also started utilizing two-dimensional barcode technology to instantly point people to news and updates on their ride[16] (Fig. 3.13). New York City's Metropolitan Transportation Authority (MTA) is also testing out Global Positioning Systems (GPS) tracking on select buses in Manhattan, allowing customers to track the location of their bus on a map in real time.[17]

Another example of technology integrating transit is Hong Kong's "Octopus Card" (Fig. 3.14). It links a variety of transportation systems and fares under a single smart card, making transfers simple. The user can recharge the card at his or her convenience and is only charged for the distance travelled. In addition, the card can be used to pay for everyday purchases at supermarkets, convenience stores, and movie theatres.

15 Bay Area Rapid Transit, *Developer App Center,* <http://www.bart.gov/schedules/developers/appcenter.aspx>
16 New York City Department of City Planning, *World Cities Best Practices,* 67, 68.
17 Metropolitan Transportation Authority, *MTA Bus Time Pilot Project,* <http://bustime.mta.info/bustime/home.jsp>

Fig. 3.12. (Top Left) An iPhone app providing up-to-the minute travel estimates for San Francisco's BART riders.
Fig. 3.13. (Top Right) 2-D code on a RATP notice.
Fig. 3.14. (Bottom) An Octopus Card being used to pay for sodas at a movie theatre in Hong Kong.

Fig. 3.15. (Top) Christopher Bangle's sketches about identity, on-demand physicality, and sharing.
Fig. 3.16. (Bottom) The Vélib' bike sharing program in Paris.

A smarter, more integrated approach to street design and public transportation is going a long way to promoting better, healthier life for urban residents. So how does the automobile fit in this picture? The car is still very much an important means of transport and the need for personal mobility can never fully be replaced. Instead of competing with each other, cars and public transport can find ways to integrate. This can be achieved through robust car-sharing programs, and by shifting the role and the very nature of personal mobility.

As Generation Y is becoming more socially connected by digital gadgets, their interest in the traditional idea of owning a car is dropping.[18] To explore where the future of the automobile is headed, Christopher Bangle - a former Chief of Design at BMW - has conducted a study called PiNk with students from the Massachusetts Institute of Technology (MIT). In his work, he identifies three main lessons for any successful product in the future: that it should have an identity, that it should only be there when needed, and that it should be used for sharing and bringing people together (Fig. 3.15).[19] These concepts hardly apply to today's vehicles. But they're very appropriate for an upcoming idea of electric, shared, on-demand personal transport.

Car sharing builds on the idea and success of bike sharing in cities like Paris, Barcelona, Hangzhou and many other smaller community groups worldwide (Fig. 3.16). The basic principle is that vehicles would be available for hire in locations distributed around the city. The user can just get in when they need to, drive, then return the car at another designated location when finished. They would only be charged for either the time or distance driven, without having to worry about the car when not using it.

18 Allison Linn, "Carmakers' Next Problem: Generation Y," *MSNBC,* <http://www.msnbc.msn.com/id/39970363/ns/business-autos>

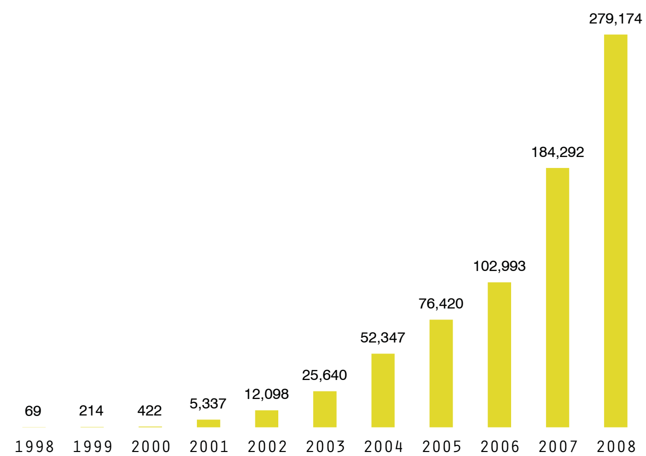
19 Christopher Bangle, "Chris Bangle - GINA meets PiNk!," *TEDx Munich,* <http://www.tedxmunich.com/talk/2010/chris-bangle-gina-meets-pink.html>

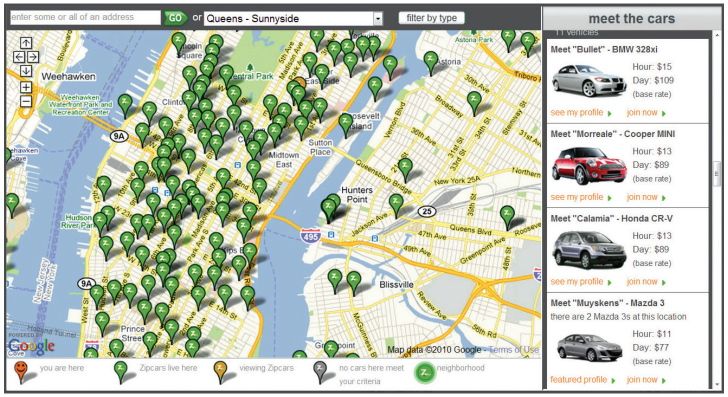
Today, there are about 18 nonprofit and for-profit car share operators in America, serving 30 states, more than 20 major urban centers, over 150 college campuses, and many commercial businesses.[20]

New York City is the largest car sharing market in the nation, with a growing number of memberships accounting for about one-third of the U.S. total (Fig. 3.17).[21] The three largest companies providing the service today are Zipcar, Connect by Hertz, and Mint. Connect by Hertz is also the first in America to offer electric vehicles such as the Nissan Leaf and Chevrolet Volt to customers (Fig. 3.18).[22]

The allure of car sharing is that it combines the best traits of the personal automobile with those of public transit. Users can enjoy increased mobility and easy access to areas not connected by buses, trains, or taxis. At the same time, they can use cars only when they need to, without having to bear the ownership, maintenance, and insurance costs all the time. A single vehicle can be used by up to 40 members, and national studies show that an average of 15% of members gave up a car of their own. They are also more likely to make less car trips, or combine a few trips into one.[23]

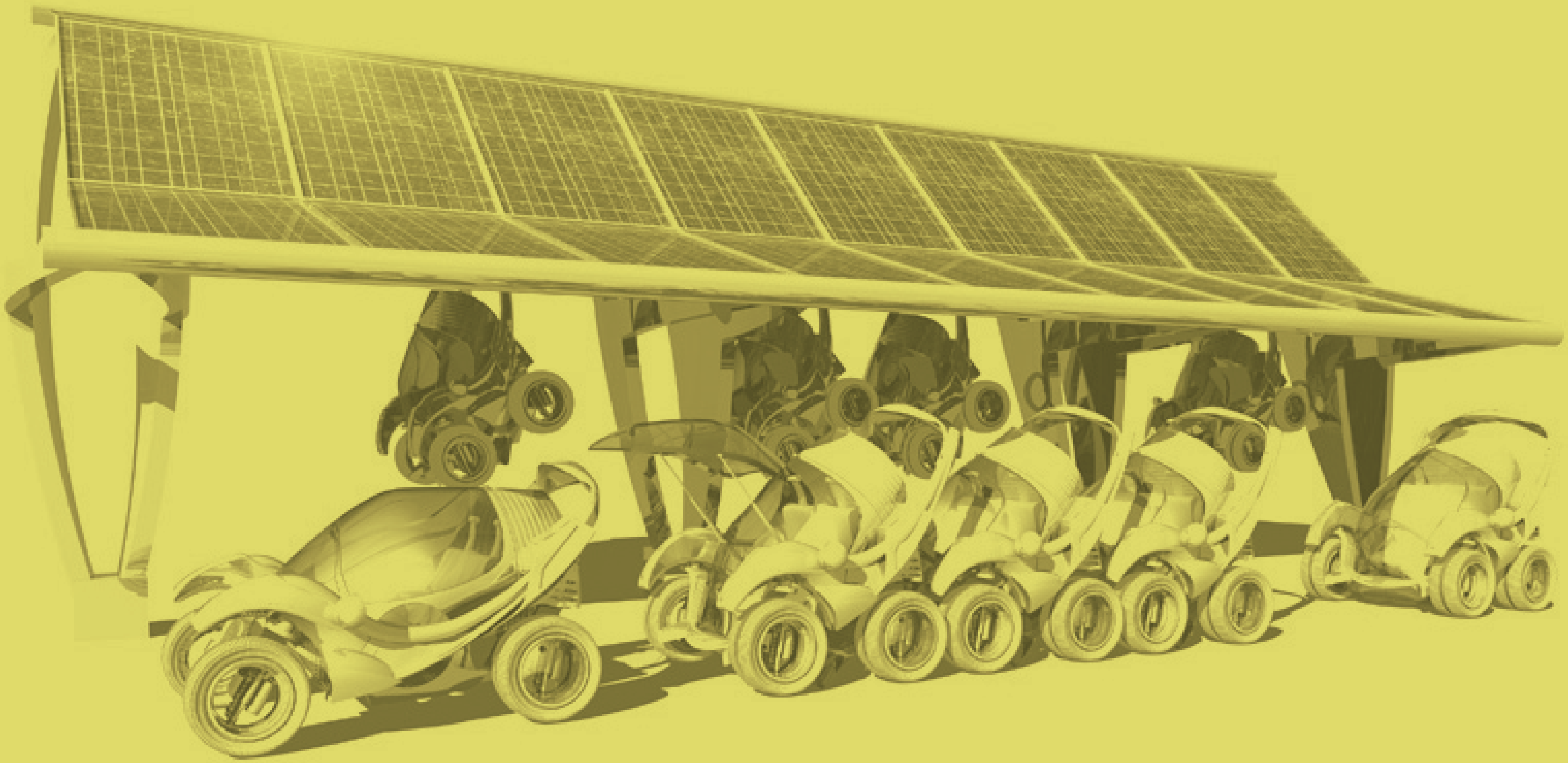
The benefits to the city are reduced congestion, parking needs, and air pollution. Another important change is a shift in the idea of personal mobility and the way people use cars. This notion and its integration with smarter, cleaner vehicles will be explored further in a later chapter, entitled "Electrifying the Automobile".





20 New York City Department of City Planning, *Car Share Zoning Text Amendment,* <http://www.nyc.gov/html/dcp/pdf/car_share/presentation_2010_0426.pdf> 5.
21 N.Y.C. Department of City Planning, *Car Share Zoning Text Amendment,* 6.
22 Stuart Schwartzapfel, "Hertz Is Betting Big on Cars With Cords," *Wired Magazine: Autopia,* <http://www.wired.com/autopia/2010/12/hertz-is-betting-big-on-cars-with-cords/#more-30598>
23 N.Y.C. Department of City Planning, *Car Share Zoning Text Amendment,* 9, 10.

Fig. 3.17. (Top) Car share memberships in New York City 1998-2008.
Fig. 3.18. (Bottom) Zipcar locations in midtown Manhattan.



Part Two

SUSTAINABILITY

Powering Tomorrow

Chapter 04:
Leaving Fossil Fuels Behind

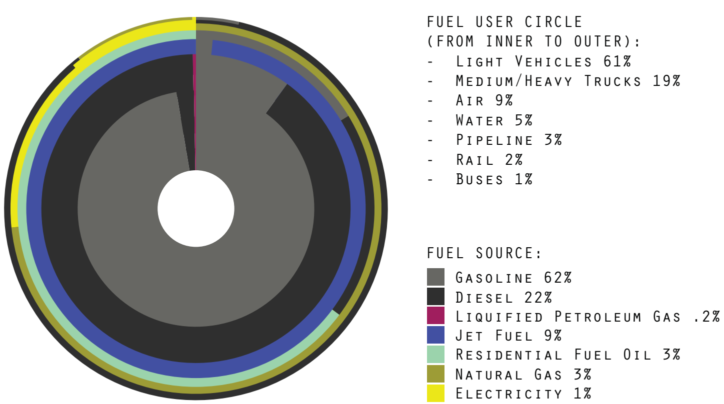


Fig. 4.1. U.S. Consumption of Transportation Energy by Mode and Fuel Type.

"Modern American life is premised on the assumption that inexpensive oil will always be available to fuel our transportation system. Our vehicles, our jobs, and even the structure of our communities all depend on reliable supplies of affordable oil. Yet growing worldwide demand for oil and tightening supplies strongly suggest that the days of cheap, plentiful oil are over."[1]

There are two inherent challenges with America's current state of fossil fuel dependence: the extraction and consumption of oil. The world today consumes more than 84 million barrels - or 3.5 billion gallons - of petroleum per day. The United States alone is responsible for almost a quarter of this total. The majority of this oil - 72% - goes directly to the transportation sector.[2] 81% of it is then used up by cars, trucks, and buses (Fig. 4.1).[3]

The fact that widespread automobile use has caused serious health and environmental damage all over the world is well-known and documented. The majority of issues stem from the dominant use of the

1 Electrification Coalition, *Electrification Roadmap,* <http://www.electrificationcoalition.org/reports/EC-Roadmap-screen.pdf> 23.

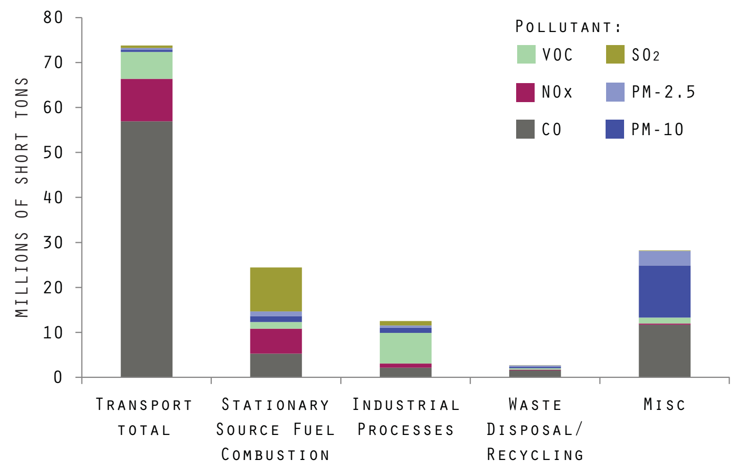
2 U.S. Energy Information Administration, *Petroleum Statistics,* <http://www.eia.doe.gov/energyexplained/index.cfm?page=oil_home#tab2>

3 U.S. Department of Energy, *Transportation Energy Data Book: Edition 29,* <http://cta.ornl.gov/data/download29.shtml> 50.

internal combustion engine. By burning such vast amounts of oil, mostly in the form of gasoline, a lot of harmful emissions are released into the air. Carbon Dioxide (CO_2), Carbon Monoxide (CO), Nitrous Oxide (NOx), Volatile Organic Compounds (VOC), Sulfur Dioxide (SO_2), and various Particulate Matter ($PM_{2.5}$-PM_{10}) are among the most common pollutants. The effects of these are spread wordwide, but are most acute in large metropolitan areas, such as New York City, due to its high density and concentration of automobiles.

The immediate effects can be seen in air pollution and the formation of smog. In New York City, smog has killed between 170 and 260 people in 1953.[4] It is also considered the cause of 200 more deaths in 1963 and another 168 in 1966.[5] Related to numerous other health risks, air pollution is primarily caused by the transportation sector (Fig. 4.2).

Another major cause is the emission of Carbon Dioxide (CO_2). While not directly related to illness or health problems, CO_2 is the leading Greenhouse Gas contributing to global warming. China has recently surpassed the U.S. in CO_2 emissions, and projections estimate this to double by 2035. However, the majority of this is not due to the transportation sector. The U.S. accounts for 20% of worldwide emissions, with almost half (43%) directly stemming from oil use (Fig. 4.3).[6] Therefore, efforts to reduce air pollution and Greenhouse Gas emissions in America must focus on improving our mobility and minimizing the use of fossil fuels.



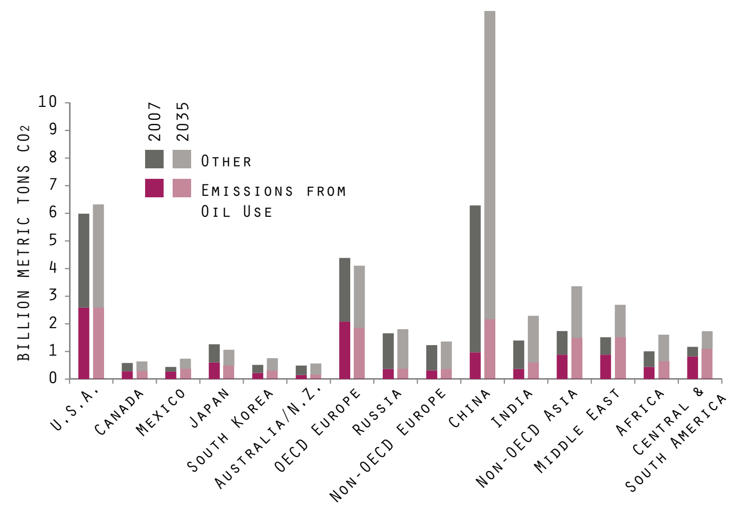
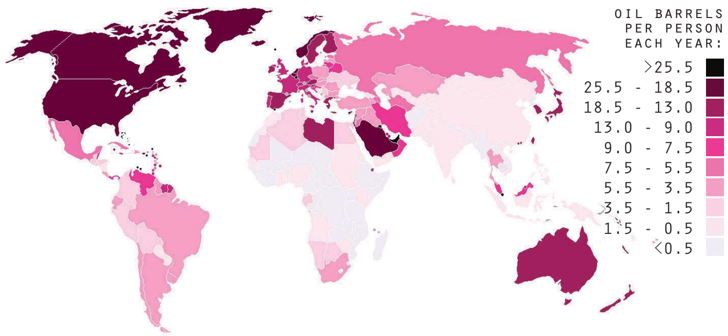


Fig. 4.2. (Top) Total U.S. emissions of air pollutants by sector.
Fig. 4.3. (Bottom) Wordwide CO_2 emissions from oil use and other uses in 2007, with projections to 2035.

4 Radford University, *Environmental History Timeline,* <http://www.radford.edu/~wkovarik/envhist/7forties.html>

5 The Washington Post, " No. 99-1257," *Supreme Court Briefs,* <http://washingtonpost.findlaw.com/supreme_court/briefs/99-1257/99-1257fo5/text.html>

6 U.S. Energy Information Administration, *International Carbon Dioxide Emissions and Carbon Intensity,* <http://www.eia.doe.gov/emeu/international/carbondioxide.html>



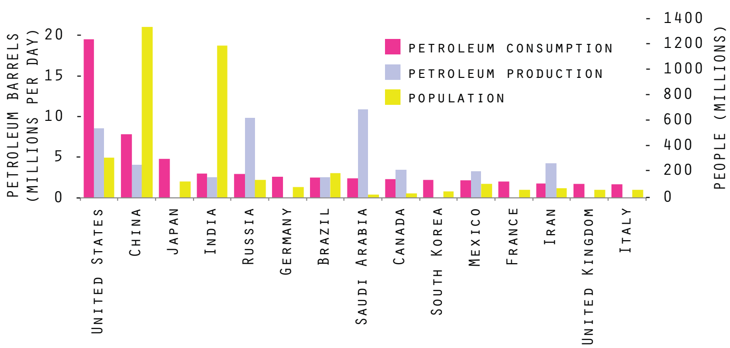


Fig. 4.4. (Top) World map of annual oil consumption per capita.
Fig. 4.5. (Bottom) International petroleum consumption, production, and population.

Another issue with the use of oil is its production. Currently, the U.S. produces less than 40% the amount of petroleum it consumes. At the same time, it is also the largest consumer of oil in the world. It might not be as alarming if America had the population of either China or India to sustain. However, at less than 5% of the world total,[7] the U.S. population is disproportionately dependent on oil it does not have the capacity to produce (Fig. 4.4 and Fig. 4.5).

A reliance on imports to fill the majority of demand creates a high competition for resources. Studies are also suggesting that oil production has already peaked, or is approaching peak.[8] Harder to obtain and increasingly more scarce resources will inevitably push oil prices past the point which makes internal combustion-based personal mobility viable. Therefore, an alternative is needed.

This is where electric vehicles come in. Shifting away from petroleum for America's transportation needs can have a huge impact on the current energy mix (Fig. 4.6). Fully electric vehicles also produce no tailpipe emissions, equating to no pollution (tank-to-wheels). To power them, however, electricity should also be produced with no pollution (well-to-tank). Electricity generation has the largest potential to use renewable sources and eventually substitute petroleum-based transportation with one that is powered by sustainably produced electricity.

7 U.S. Census Bureau, *U.S. & World Population Clocks,* <http://www.census.gov/main/www/popclock.html>
8 Olivier Ludwig, "Weeden's Maxwell: Brace For $300/Barrel Oil," *Index Universe,* <http://www.indexuniverse.com/sections/interviews/8360-eedens-maxwell-brace-for-300barrel-oil.html>

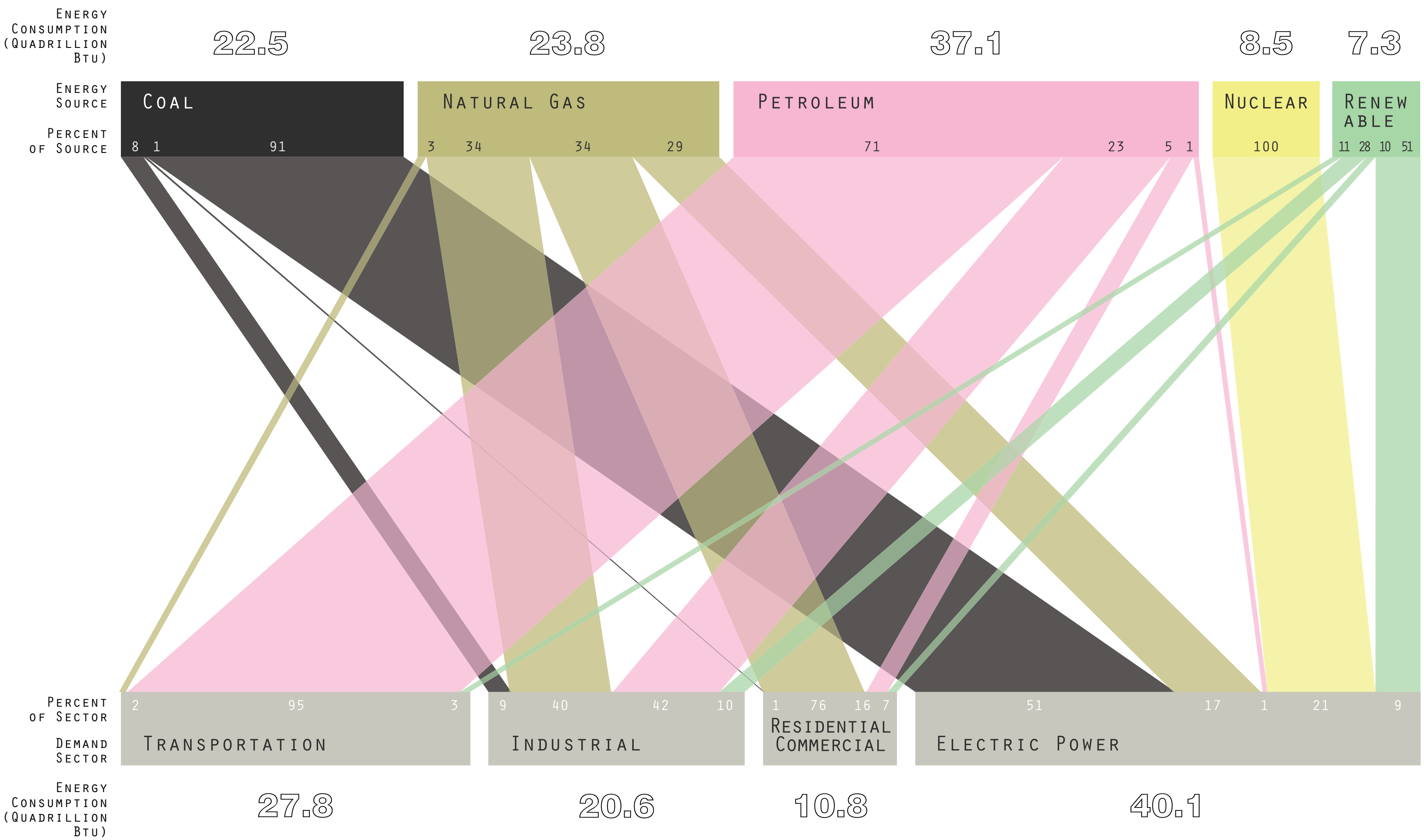
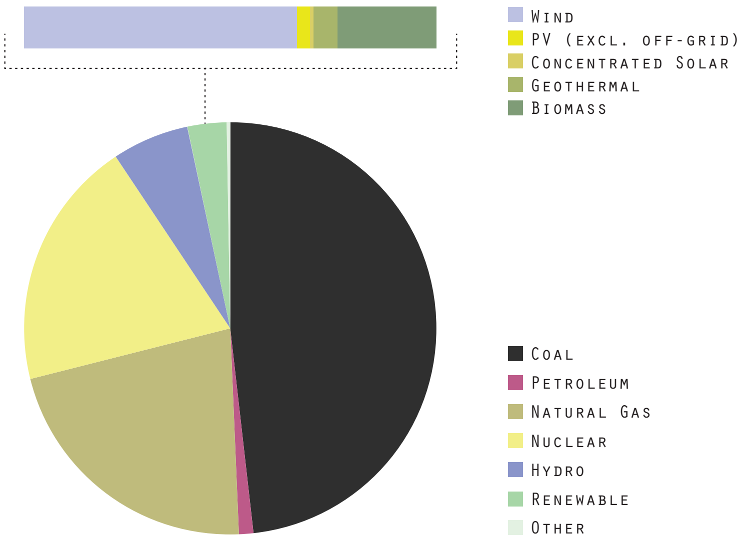


Fig. 4.6. USA energy consumption by source and end-use sector.



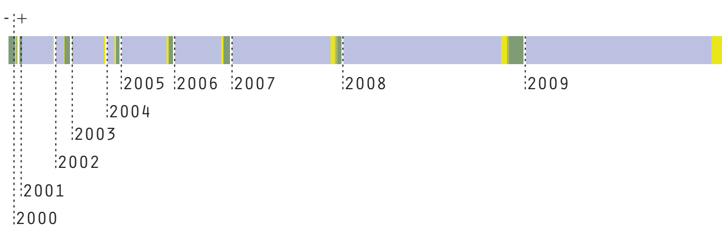


Fig. 4.7. (Top) U.S. electricity generation by source.
Fig. 4.8. (Bottom) U.S. renewable generation capacity added in the last decade.

The challenge today is that electricity generation in America is still largely dominated by fossil fuel resources, such as coal and natural gas, as well as nuclear material. The U.S. produced 4,119,387,760 MWh of electricity in 2008. The top 10 producing states alone make up half of that total. Renewable sources of energy still account for only 9% of the national average (Fig. 4.7).[9]

However, interest in renewables has been growing rapidly. Capacity to generate renewable energy has more than tripled in the last decade, both in America and worldwide (Fig. 4.8). In 2009, renewable energy accounted for more than half (55%) of all new electrical capacity installations in the U.S. In the same year, cumulative wind capacity has increased by 39%, while photovoltaic (PV) capacity grew almost 52% from 2008. This trend is signifying an "ongoing shift in the composition of the nation's electric supply."[10]

Since the natural resources available differ in each state, the type of energy produced can vary significantly across the U.S. New York state, for example, has a significant amount of hydro available (the 4th largest in the nation), while its capacity for wind or solar-generated electricity is far less than states like Texas or California. In 2009, however, New York led the Northeast in installed wind capacity, and was second only to New Jersey in installed PV capacity (Fig. 4.9).

9 U.S. Energy Information Administration, *Electric Power Annual, Tables EIA-906, EIA-920, and EIA-923,* <http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html>

10 U.S. Department of Energy, *Renewable Energy Data Book,* <http://www1.eere.energy.gov/maps_data/pdfs/eere_databook.pdf> 3,4.

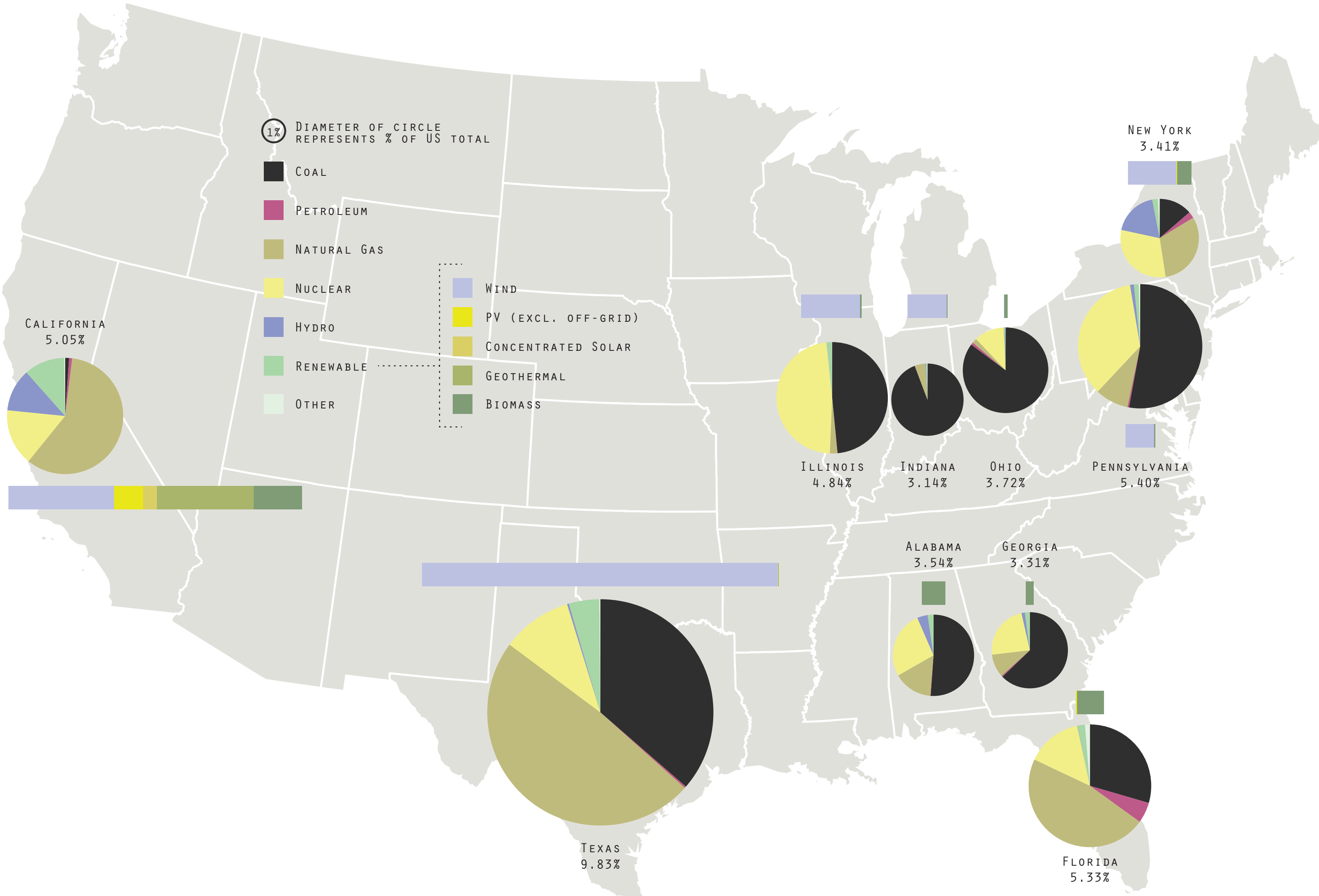


Fig. 4.9. U.S. electricity generation by source - top 10 states.

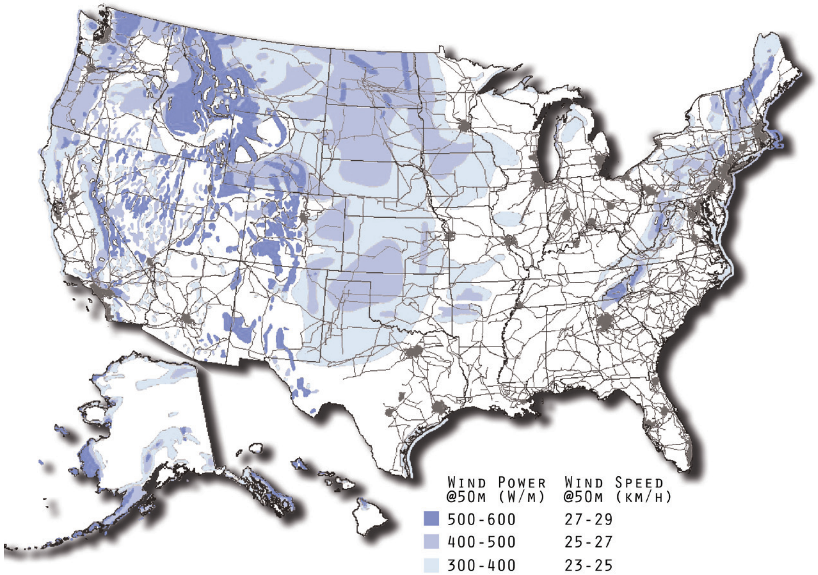


Fig. 4.10. U.S. wind resource.

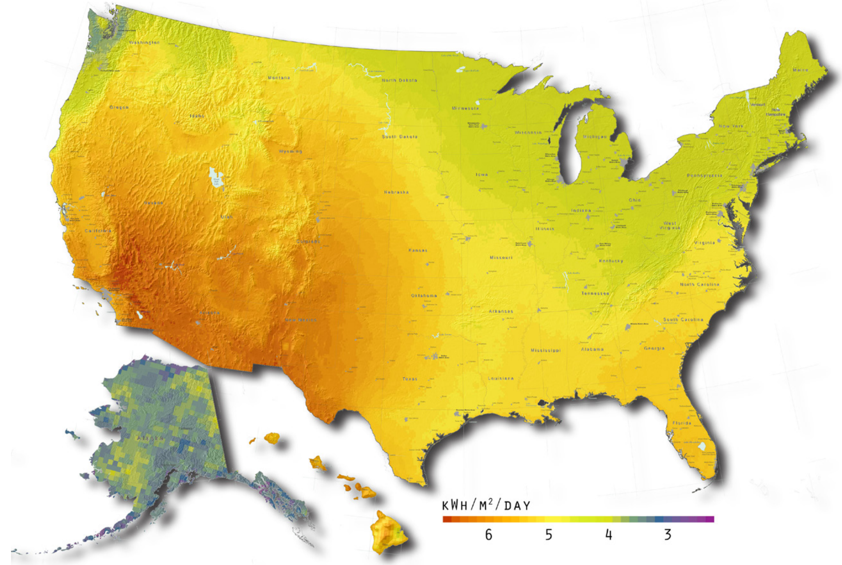


Fig. 4.11. U.S. solar resource.

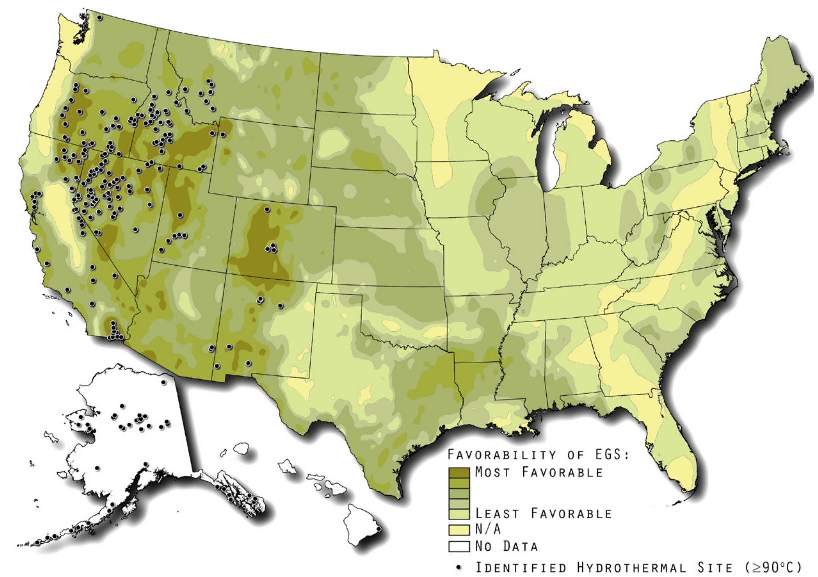


Fig. 4.12. U.S. geothermal resource - deep Enhanced Geothermal Systems (EGS).

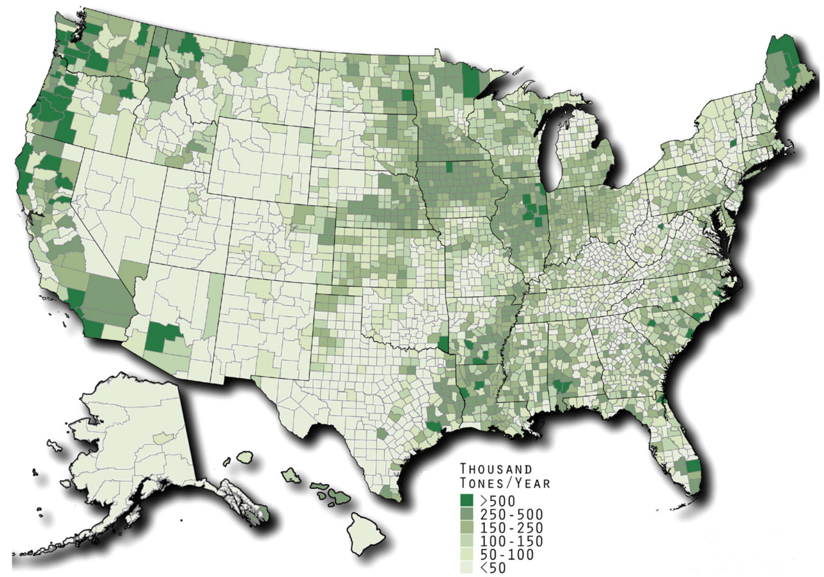
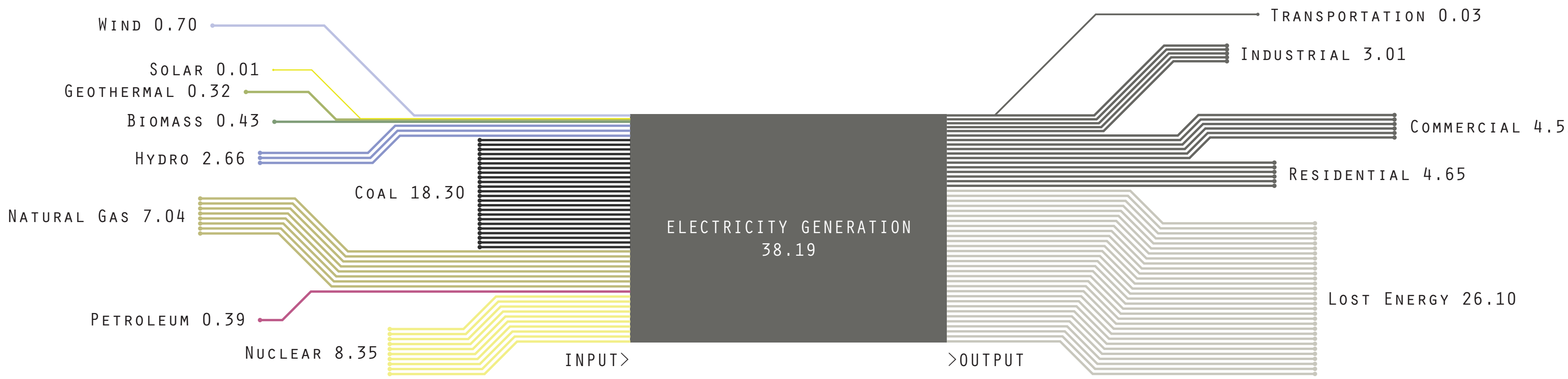


Fig. 4.13. U.S. biomass resource.



Natural resources in the U.S. can dictate the placement and scale of new electricity generation plants (Fig. 4.10 - Fig. 4.13). However, no matter how ideal the conditions, more than two-thirds of the electricity generated in America is lost through conversion and transmission today (Fig. 4.14). A way to address this challenge is by moving towards more small-scale, localized generation. By providing and consuming energy on-site, or within a well-connected urban fabric, electricity can become much more efficient. "Collections of these small, networked installations can serve, under unified control, as virtual power plants" (Fig. 4.15).[11]

This development is the foundation of smart grids and two-way energy trade. The electricity produced within the networked system can be shared and traded as needed to help level out demand and ensure a steady supply.

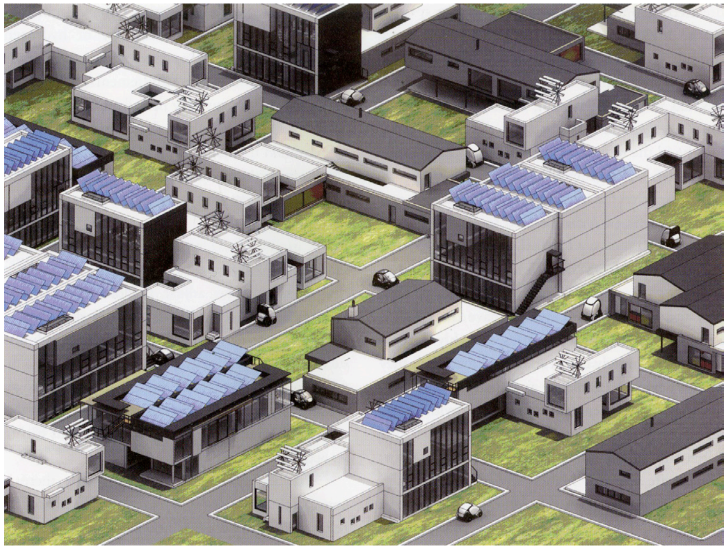


Fig. 4.14. (Top) U.S. energy flow for electricity generation (units in quadrillion BTU).
Fig. 4.15. (Bottom) William Mitchell's vision of a distributed urban energy system.

11 William Mitchell, et al., *Reinventing The Automobile: Personal Urban Mobility for the 21st Century* (Cambridge: The MIT Press, 2010) 122.

Chapter 05:
Electrifying the Automobile

Fig. 5.1. Thomas Edison's EV circa 1914.

The idea of using electricity to power cars is not new. Between the 1890s and 1910s, electric vehicles (EVs), were equally competitive for the dominant spot in the newly emerging automobile market, along with steam and internal combustion engines (ICEs) (Fig. 5.1).

Each propulsion system had its advantages and disadvantages. Steam power was popular and well-understood, being in use before in industrial applications for more than a hundred years. However, it required a long time for steam to build up and start the car. Moreover, it could only operate it for a very limited time before having to be recharged with more water. Flash boilers and exhaust condensers were consequently invented, but too late to save the steam-powered car from disappearing off the market.

Electric-powered cars suffered a similar fate. They were praised for being clean, quiet, reliable, and simple to operate. However, their batteries took a long time to recharge, were expensive, and had limited range. EVs, like steam cars, were largely used for city driving.

The story of the eventual takeover by the internal combustion engine is all too familiar. Despite being complex, noisy, and dirty, ICEs dominated the market by the 1920s. The invention of the electric starter eliminated the dangerous task of crank-starting the engine. Henry Ford's assembly line drove down prices and made gasoline-powered cars available to the mass non-elite. Roads were built and paved to facilitate longer-distance travel. Oil was readily available and cheaper than other fuels. All of these factors combined drove EVs to virtual extinction.[1]

The electric car appeared again briefly during the 1990s and early 2000s, as concerns over oil supply and environmental damage began to rise. The General Motors EV-1 was the most successful, but production was eventually cancelled and all vehicles crushed (Fig. 5.2). Chris Paine's film "Who Killed the Electric Car?" explores the reasons behind the sudden disappearance of the EV.

Today, electric cars are making a strong comeback. The Nissan Leaf - the first fully-electric mass-market production car - is already on America's streets (Fig. 5.3). So is Chevrolet's Volt, although considered a plug-in hybrid (PHEV) (Fig. 5.4). Every major automaker has announced plans to build their own EV, or advanced PHEV within the next 5 years. U.S. president Barack Obama has set a nationwide goal of 1 million plug-in hybrid and electric vehicles on America's roads by 2015.[2] Of course, this concept is still a long way from significant market penetration, let alone domination. Still, the electric vehicle seems to have made a considerable impact and holds great potential for the future of personal mobility.

There are certain challenges and opportunities presented by these different types of vehicles. Understanding them is important to being able to incorporate them into future cities and architecture.

Fig. 5.2. (Top) The GM EV-1 recharging its battery.
Fig. 5.3. (Middle) The Nissan Leaf from a television advertisement, highlighting the car's environmental friendliness.
Fig. 5.4. (Bottom) The Chevrolet Volt with its 2011 Motor Trend Car of the Year Award.

1 Mitchell, et al., 10-12.
2 The White House, *State of the Union 2011: Winning the Future.* <http://www.whitehouse.gov/state-of-the-union-2011>

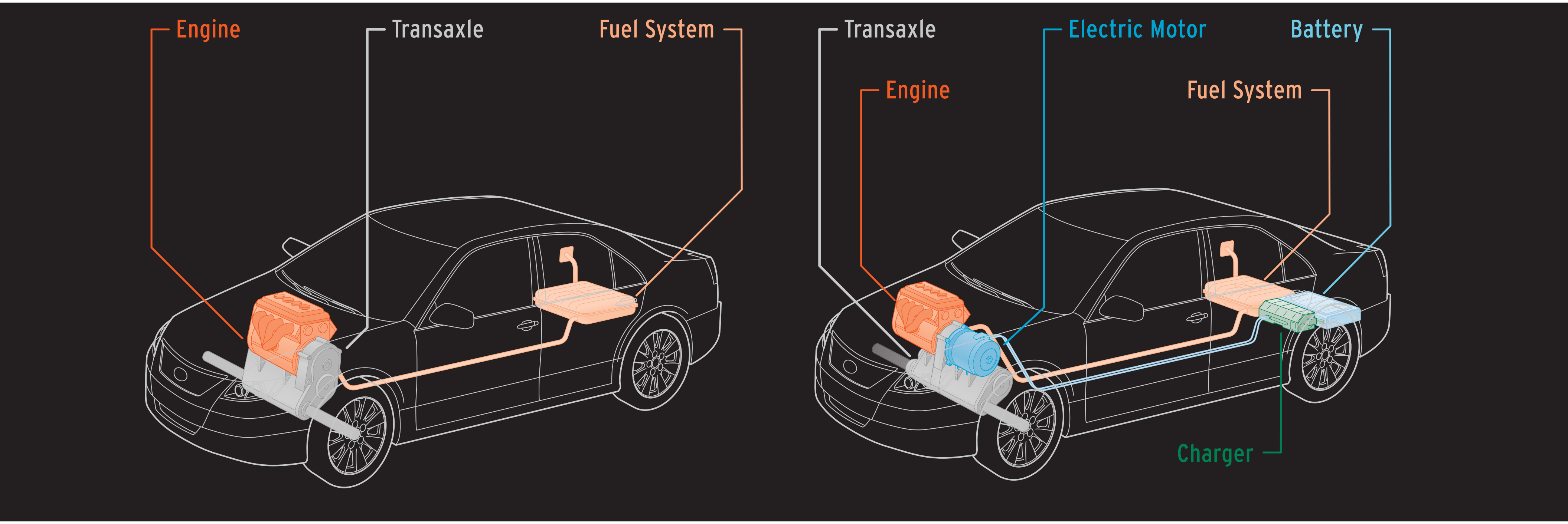


Fig. 5.5. ***Internal Combustion Engine (ICE) Vehicle***

Fig. 5.5 illustrates the dominant form of automobiles in use today. Energy is stored in liquid form - mostly gasoline, but can also be diesel or biofuel. This fuel is then burned in the engine to produce mechanical energy and turn the wheels. Due to the high energy density of gasoline, relatively modest amounts of storage can propel the vehicle for hundreds of kilometers. However, only 20% of this energy is actually utilized. The rest is lost as heat, drivetrain mechanics, and idling. The burning of fossil fuels also produces harmful emissions.

Fig. 5.6. ***Hybrid Electric Vehicle (HEV)***

Hybrid vehicles still use an ICE, which requires liquid fuel as energy storage (Fig. 5.6). However, they also utilize an electric motor to help supplement the gasoline engine. This motor converts electrical energy into mechanical energy to provide torque, or even turn the wheels autonomously at low speeds. To power the motor, HEVs need electrical energy storage, which is provided by a battery pack. Its size and capacity may range, and is kept charged by the gasoline engine. Hybrid vehicles behave and need to be refueled like regular ICE cars, but are more efficient and burn less fuel.

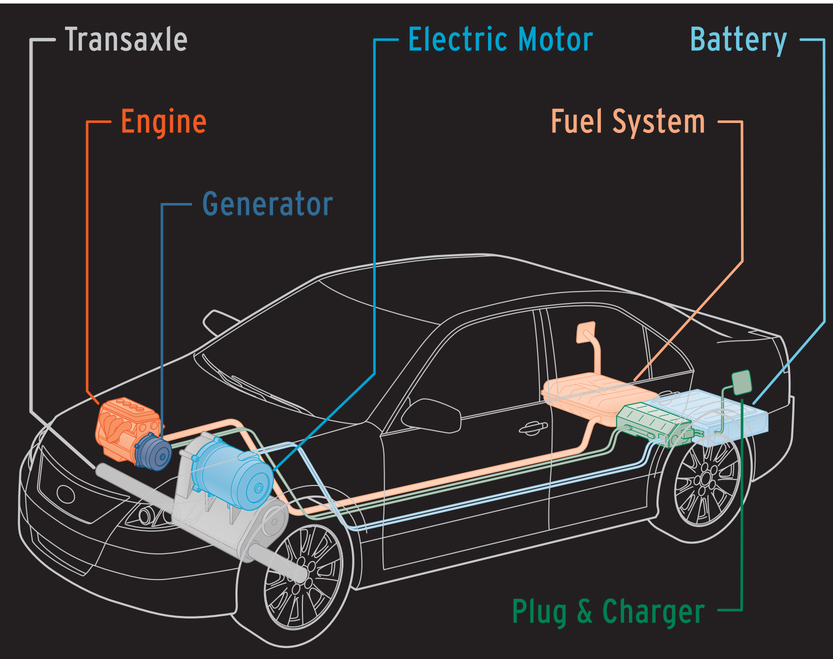


Fig. 5.7. ***Plug-In Hybrid Electric Vehicle (PHEV)***

Like HEVs, plug-in hybrids still use an ICE, which requires liquid fuel as energy storage (Fig. 5.7). They also add an electric motor and batteries to supplement the gasoline-burning engine. However, batteries in a PHEV are much larger and can be recharged by plugging in to the electrical grid. This provides another form of energy storage, which has the potential to be sustainably replenished. PHEV batteries can power the car purely on electricity for considerable distances (over 50km). After depleting the batteries, the car uses its ICE to power the motor and continue driving using gasoline.

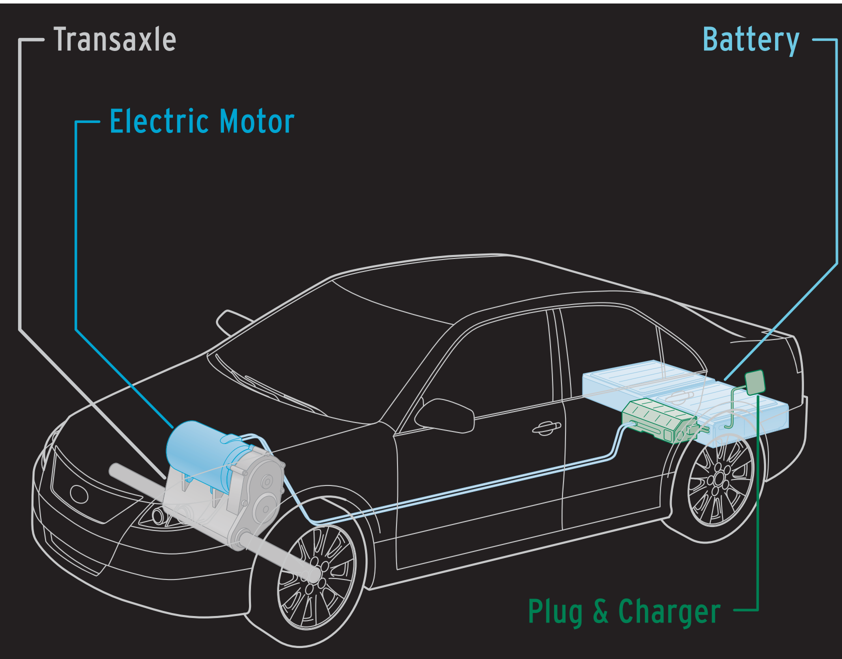
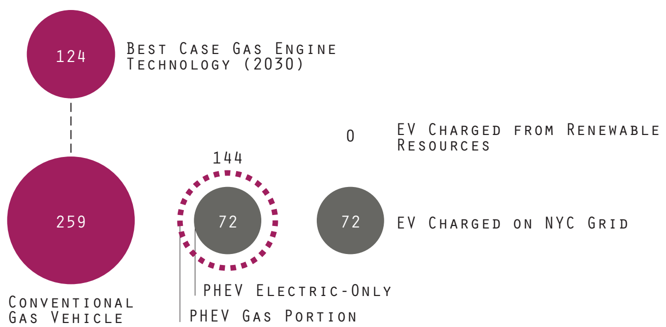


Fig. 5.8. ***Electric Vehicle (EV)***

EVs do not use an ICE or liquid fuel as energy storage (Fig. 5.8). They contain only an electric motor (one or more) to provide mechanical propulsion and operation of the vehicle's components. A battery pack is also used to store electrical energy, much like in HEVs and PHEVs. However, the battery pack in an EV is much larger, allowing for better range - especially since that cannot be supplemented by gasoline. To be recharged, it has to receive electrical energy. Since an EV utilizes only electricity, it never produces any tailpipe emissions.[3]

3 The City of New York, *PlaNYC: Exploring Electric Vehicle Adoption in New York City, <http://www.nyc.gov/html/planyc2030/downloads/pdf/electric_vehicle_adoption_study_2010-02.pdf>* 70, 71.



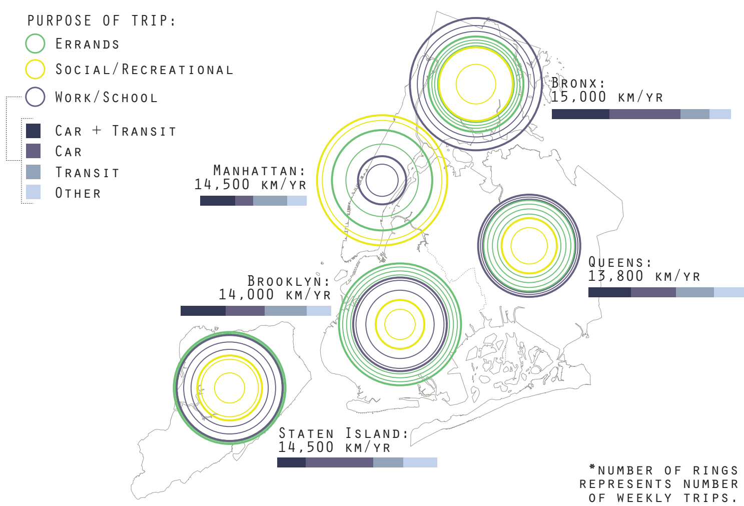


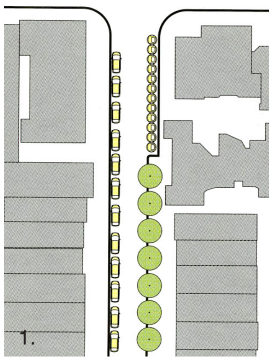
Fig. 5.9. (Top) Well-to-wheel CO_2 emissions for a variety of vehicles in New York City (in g CO_2 / km).
Fig. 5.10. (Bottom) Share of vehicle travel by use in the five boroughs.

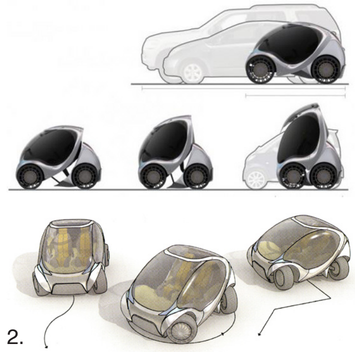
Electrifying the automobile offers immense potential for the future of mobility and urbanity. Using no oil means there is no tailpipe (tank-to-wheels) emissions. No emissions means cleaner cities. EVs are responsible for producing significantly less CO_2 than their gasoline counterparts, even when recharged with electricity from the grid. Currently, more than 20% of New York's electricity is generated from non-polluting and sustainable sources. The potential of using local renewables - such as solar or wind - is even greater, as electricity can be produced at a much smaller scale with a large variety of resources. This would completely eliminate even well-to-wheel emissions (Fig. 5.9).[4]

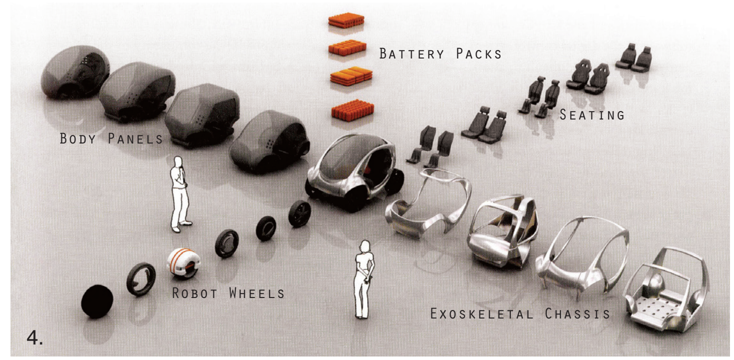
Cities across America are now looking for ways to implement this. EV adoption is a significant part of New York City's official plan for the future - the PlaNYC 2030. The research in the plan projects that "by 2015, up to 14-16% of all new vehicles purchased by New Yorkers could be electric vehicles."[5] EVs would be sufficient for most trips made by car in New York. The average daily travel in the city is around 40km, which is well within the range of an electric car even today. EVs would enhance personal mobility around town, and could also serve as feeder service to public transit for longer trips (Fig. 5.10).[6]

The future of EVs looks even more promising. With new and exciting concepts of mobility come new opportunities for architecture and urbanism to respond. For example, smaller and more maneuverable cars could free up valuable street space for other programme and activities (Fig. 5.11 and Fig. 5.12). They can also travel to places other cars cannot. Since driving mechanics in an EV are much simpler and

4 The City of New York, *PlaNYC: Exploring Electric Vehicle Adoption in New York City,* 4.
5 The City of New York, *PlaNYC: Exploring Electric Vehicle Adoption in New York City,* 3.
6 The City of New York, *PlaNYC: Exploring Electric Vehicle Adoption in New York City,* 6,7.







require almost no mechanical linkages, they are also easier to modify (Fig. 5.13). This component allows for much greater design freedom and ability to customize one's automobile. It could feed a whole new car culture of personalizing and accessorizing available to everyone (Fig. 5.14). Cars will be able to be adapted more closely to specific user needs. People would no longer have to own a car that can do everything all the time.

Cars in the future could also be more intelligent and employ a range of sensors, as well as information and response systems. They would be able to communicate with their surroundings and integrate with people, other mobility systems, the energy grid, and buildings (Fig. 5.15).

All of these innovations are not very difficult to imagine, and are in fact already on their way to becoming a reality. With this reality will come the most important change of all - the very way we use and perceive the automobile in the future. As technologies converge, the car will not only interface with roads and transportation systems, but also with energy generation and distribution, as well as buildings, public spaces, and the human domain.

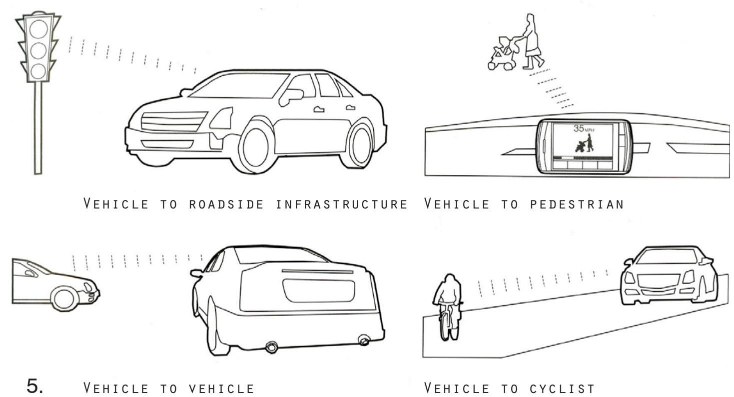


Fig. 5.11. (1) The amount of on-street parking taken up by a dozen regular-sized cars vs. the same number of MIT Media Lab's CityCars.
Fig. 5.12. (2) The size and maneuverability of the MIT CityCar.
Fig. 5.13. (3) The GM Hy-Wire and its removable chassis. All the driving components are located in the wheel platform, or "skateboard", allowing easy and complete customization.
Fig. 5.14. (4) Customization opportunities with MIT's CityCars.
Fig. 5.15. (5) Vehicle communication with various surrounding elements.

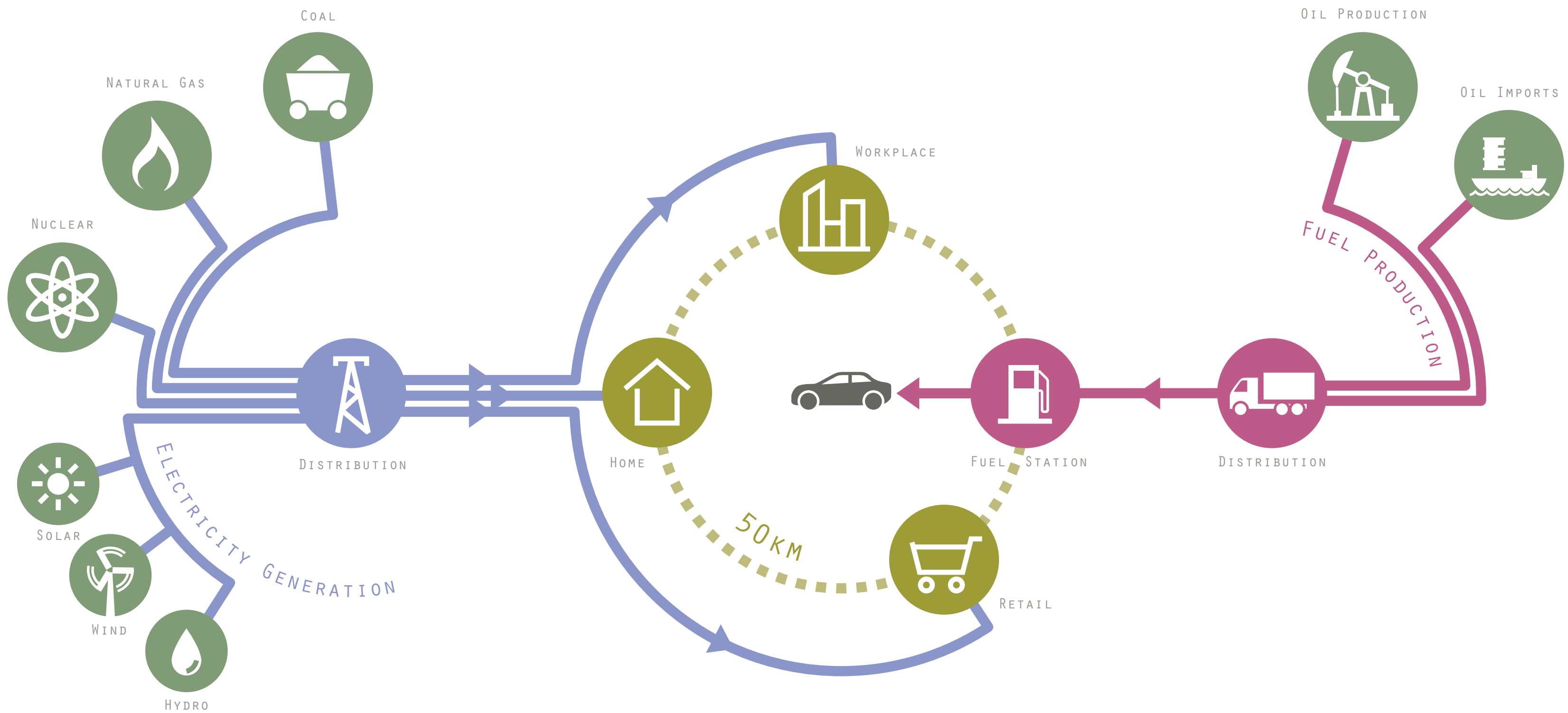
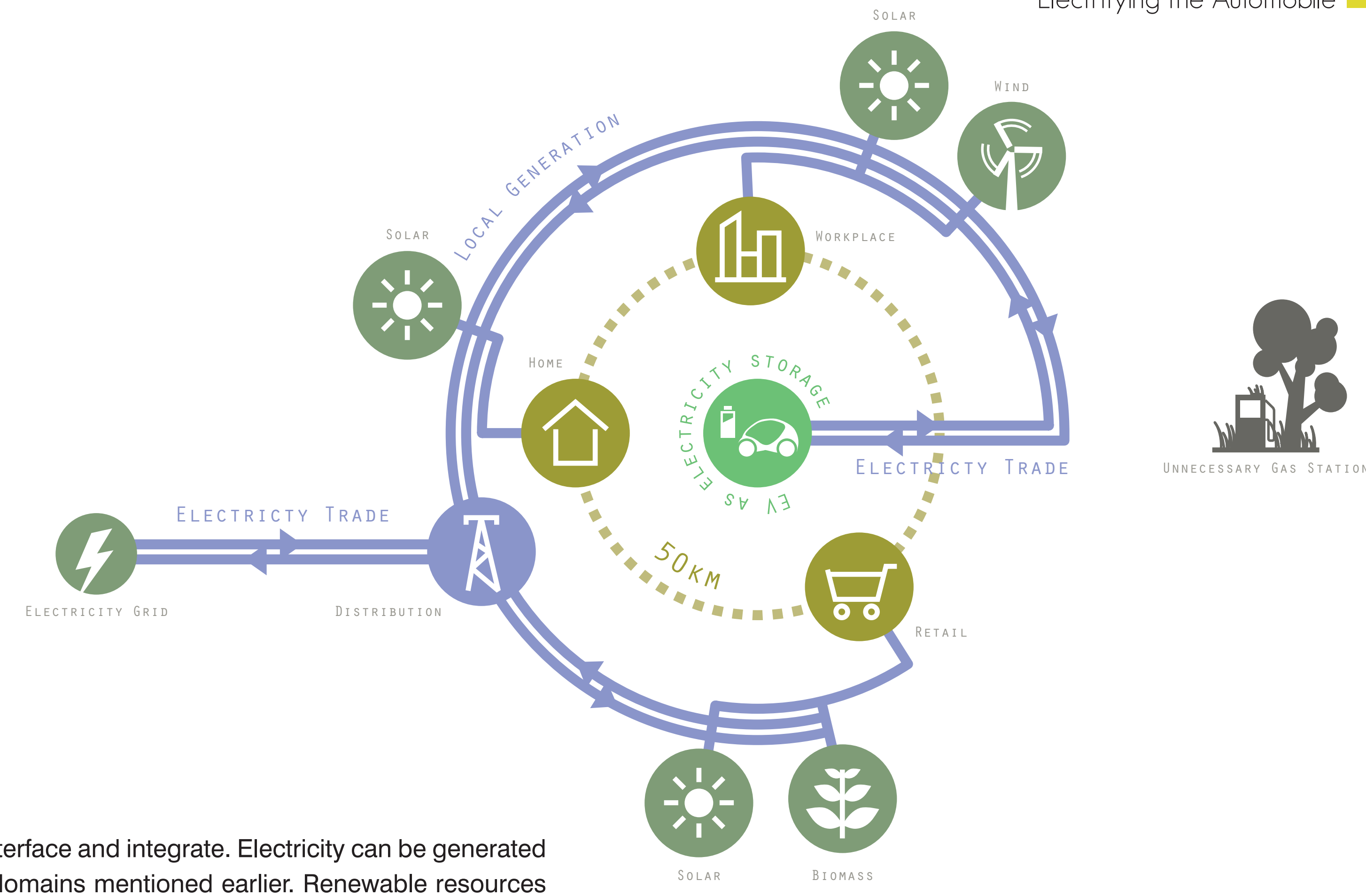


Fig. 5.16. *Automobile use, the public domain, and energy generation today.*

Currently, the car operates in isolation from its surrounding systems. Its domain is typically the home, workplace, retail, and entertainment grounds. The distance between these is usually small - 90% of daily driving in the U.S. is less than 50 km.[7] Electricity generation operates as a separate sphere, and energy is delivered one-way to individual destinations. The same goes for oil production and supply. The fuel station is the only direct interface with the car, which is a one-way consumer (Fig. 5.16).

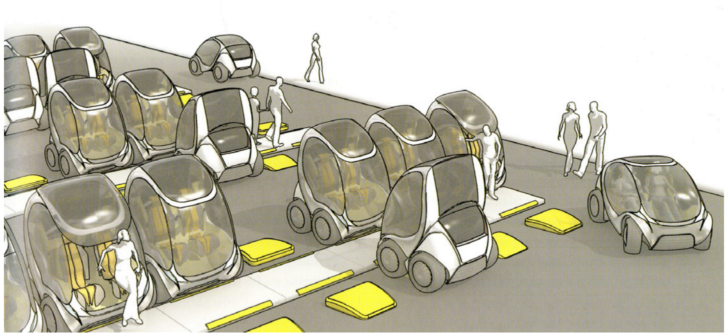
With the electrification of the automobile, these separate spheres

7 The City of New York, *PlaNYC: Exploring Electric Vehicle Adoption in New York City,* 42, 43.



have the potential to interface and integrate. Electricity can be generated locally at each of the domains mentioned earlier. Renewable resources that are best suited to each site will be used. However, due to the intermittent nature of this kind of electricity generation, large amounts of energy storage must be introduced into the system. This need for storage capacity is where EVs can become integral. Their batteries can take in and be recharged with the energy produced in their local domain. They can also hold on to this energy and sell it back to the grid when needed. This system can then be tied in a two-way relationship with the rest of the national grid, buying and selling energy as needed to meet and level out supply and demand (Fig. 5.17).

Fig. 5.17. Future integration of cars, energy, and the public domain.



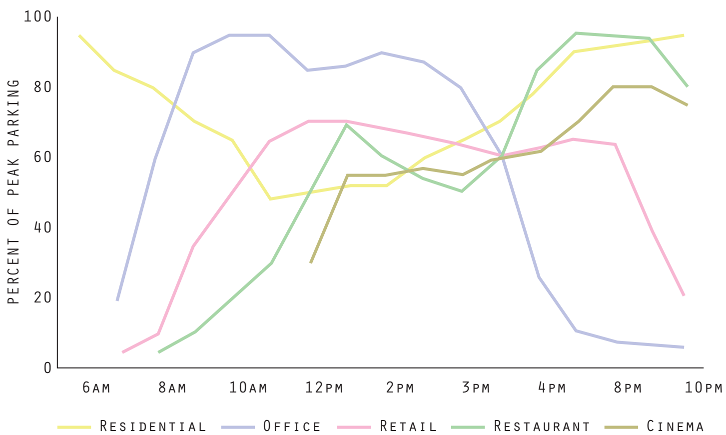


Fig. 5.18. (Top) Inductive charging pads installed in community parking lots.
Fig. 5.19. (Bottom) Illustrative variations in parking demand at different locations throughout the day.

As EVs become integrated with the urban environment, the idea of car-sharing becomes even more attractive. As discussed earlier, car-sharing is an excellent way to make the best and most sustainable use of automobiles, without the hassle of owning a car when not using it. Therefore, popular locations where a lot of car trips either begin or end - such as dense residential areas, offices, transit stations, shopping malls, university campuses, etc. - can become EV hubs.

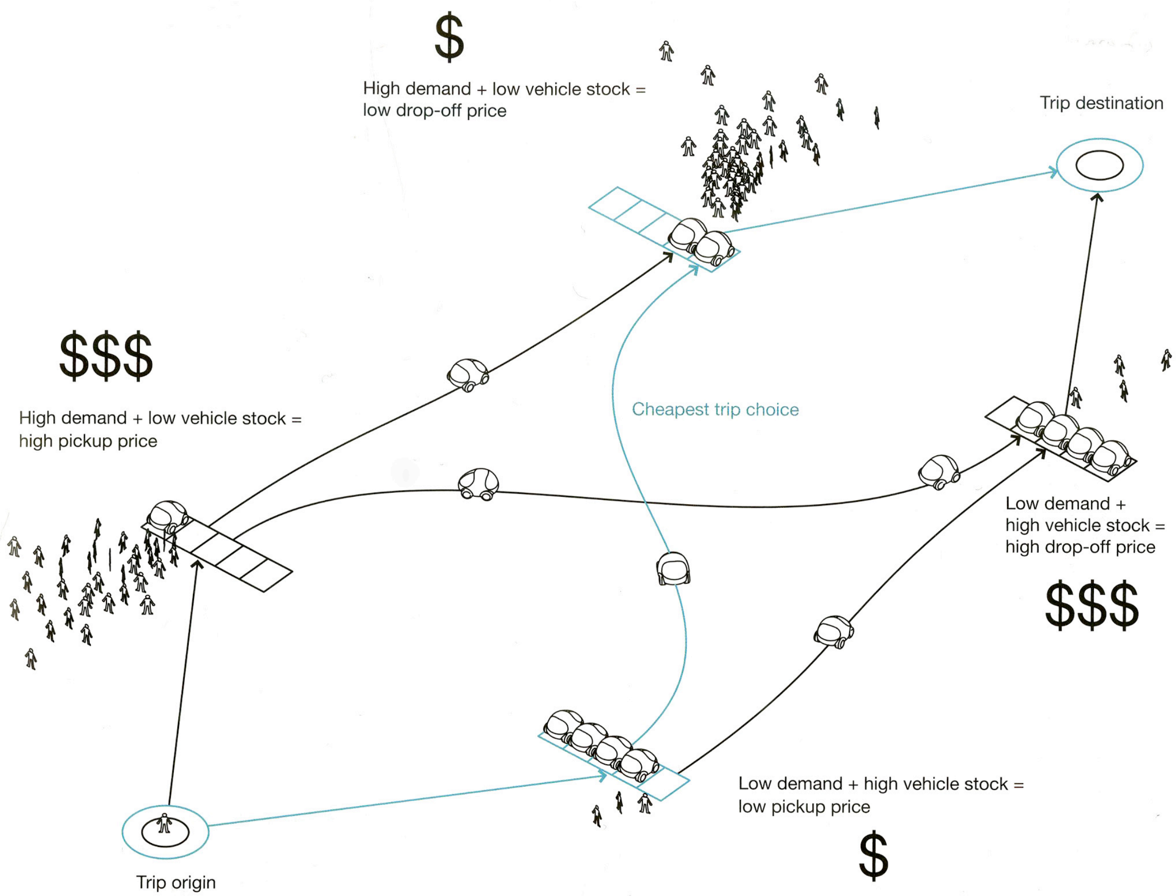
This idea is explored by William Mitchell in his book "Reinventing the Automobile" as mobility-on-demand systems. The premise is similar to some car-sharing systems in practice today. Any member can get into a vehicle and drive to where they need to, then leave it at another designated location. With the integration of EVs, smart grids, and micro-generation, the car will then be able to recharge or help level energy demand, until picked up by someone else (Fig. 5.18). The vehicle will neither sit idle, nor be useless, as is indicative of the majority of parked cars today.

As supply and demand for vehicles at different locations fluctuates (Fig. 5.19), incentives for leveling the imbalance are introduced. With variable pricing systems, people will always be able to make the smartest choice for their trip (Fig. 5.20).[8]

These innovations in the way cars operate within the city will have a profound effect on architecture and the way buildings negotiate with automobiles. Static and mono-functional parking garages will no longer be needed. Buildings for cars will have to provide a continuous pick-up and drop-off of vehicles. They will also have to take part in powering them with clean renewable energy. In addition, they will have to create social and exciting spaces for people to enjoy. The hub will become more than just a trip origin or end point, but a vibrant and vital

---

8 Mitchell, et al., 131-155.



part of the neighbourhood. This idea will be explored in the following part of the thesis.

Fig. 5.20. Real-time information and variable pricing allows customers of mobility-on-demand systems to make the smartest trip choices.

Part Three

LIVABILITY

Reconciling Architecture and the Car

Chapter 06:
Designing Spaces for Cars

Fig. 6.1. (Left) Commercial development along Hespeler Road in Cambridge, Ontario today.
Fig. 6.2. (Right) A critique of the Las Vegas strip by Robert Venturi, 1968.

The automobile age of the past century has not given the city much in terms of pleasant, enjoyable spaces for its citizens. As the car allowed people to travel farther and more often, distances between destinations grew significantly. People spread out and ventured away from the city, giving rise to the suburban developments that are all too common and familiar today. In addition to creating environments that are inhospitable to the human dwellers within them, suburban sprawl also created another kind of problem - the shopping, or "commercial" landscape (Fig. 6.1 and Fig. 6.2). Situated in the areas between urban and rural life, this development

> *"arose from the idea, rather peculiar in America, that neither the city nor the country was really a suitable place to live. [...] The devices in civic design that had adorned Europe - derived chiefly from the notion that the space between buildings was as important as the buildings themselves - did not jibe with American property-ownership traditions, which put little value in the public realm."*[1]

1 James H. Kunstler, *The Geography of Nowhere,* 39.

These in-between landscapes became devoid of any real sense of place or location. They are characterized by signage, rather than built form, and are designed to be experienced through one's vehicle, rather than any means of human or social interaction.[2]

However, the car was meant to do exactly the opposite. Being able to go anywhere at any time was envisioned to bring people together and facilitate social interaction. The automobile was a means to connect people with friends, activities, and the surrounding world.

Some of the first spaces designed for cars were based on this premise. The drive-in movie theatre became the epitome of this ideal (Fig. 6.3). It provided entertainment and brought people together via their cars. However, the idea of never having to leave one's vehicle to experience one's surroundings eventually got applied to everyday life. While the negative effects of this are well-known and documented today, the importance of the car's social potential should not be undermined.

In his design for the Kar-a-sutra - the world's first minivan - the architect Mario Bellini exemplified this potential. He created a space for activities, interaction, and play (Fig. 6.4). In his words, it was a "mobile human space intended for human and not automotive rites."[3] This notion is integral to addressing the challenges imposed on cities by the prevailing treatment of today's car spaces.

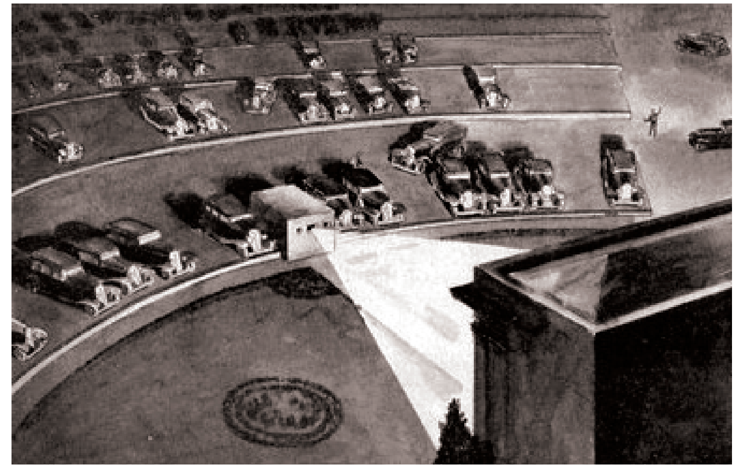


Fig. 6.3. (Top) The world's first drive-in movie theatre in Camden, New Jersey, 1933.
Fig. 6.4. (Bottom) Mario Bellini's design for the Kar-a-sutra, 1972.

2 James H. Kunstler, "James H. Kunstler Dissects Suburbia," *TED Talks.*
3 Ivan Margolius, *Automobiles by Architects* (Chichester: John Wiley & Sons Ltd., 2000) 119.

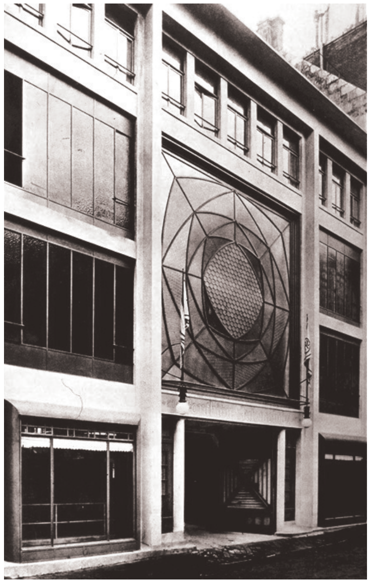


Fig. 6.5. (Top) The exterior of Auguste Perret's garage in the rue de Ponthieu, Paris, 1905.
Fig. 6.6. (Bottom) Robert Law Weed's parking garage in Miami, 1948.

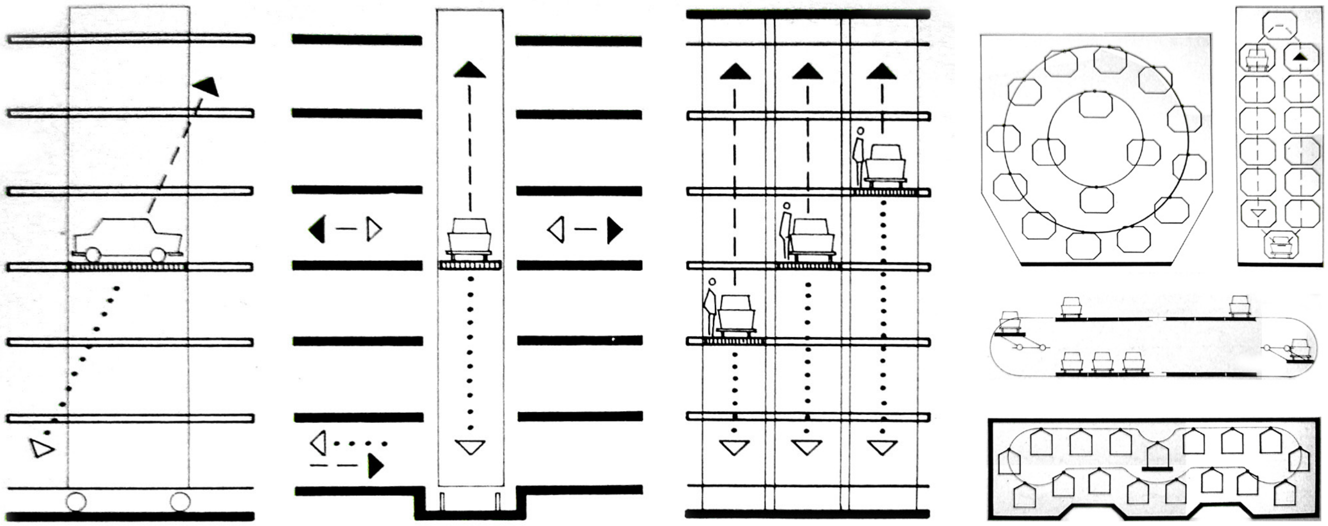
The subject of car spaces made its way into architecture immediately after the automobile became an everyday occurrence in the city. The need to "house" the car when not in use gave rise to a new building typology - the parking garage.

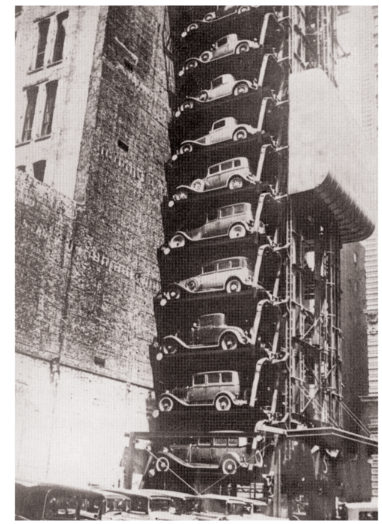
Initially, parking garages in the city took on the characteristics of other, more familiar typologies, such as the warehouse, office block, or department store. The word itself was adapted from the French word for "storage space", or "shelter", like in a warehouse. These enclosed spaces had windows, regular façade treatments, and were sometimes even heated to protect the oil-paint finishes of the cars (Fig. 6.5).[4] They became important additions to the urban fabric. Garages accommodated the ever-growing influx of automobiles in the city and allowed people to get to the places they needed.

However, the parking garage eventually gained autonomy as an architectural typology. Its expression was drastically reduced to the bare essentials needed to fulfill its purpose. In 1948, architect Robert Law Weed designed a parking garage in Miami, which had no windows, walls, or classical details. The façade was completely gone and so were any remaining associations with other building types (Fig. 6.6).[5] This development signalled a trend that continues to this day. Architecture for cars has been divorced from context, history, and/or any other relation with the human habitat. Its design provided only one function - to store automobiles.

This pursuit of functionality over all other concerns resulted in largely inhospitable architecture. However, it also created a lot of practical advancements and solutions related to the issues of parking, such as the use of stacked and automated parking systems (Fig. 6.7).[6]

4 Simon Henley, *The Architecture of Parking* (New York: Thames & Hudson Inc., 2007) 8,9.
5 Henley, 12.
6 Klose, 27-29.



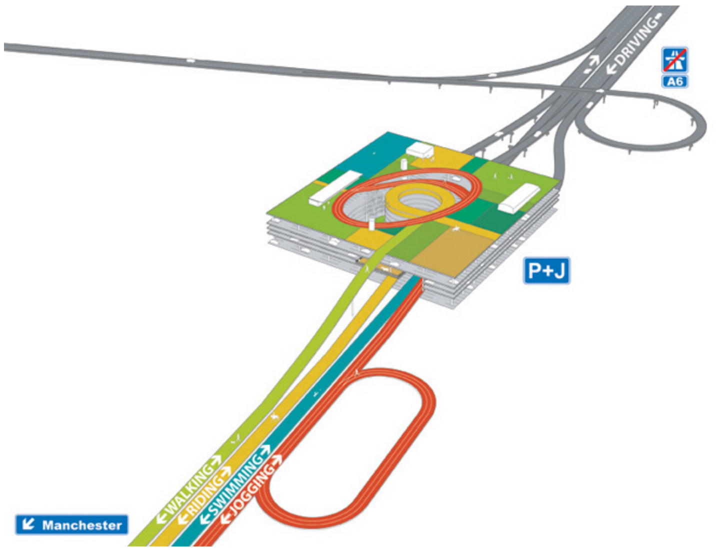


Appearing as early as the 1920s, this type of garage demonstrated the potential to save a lot of valuable space in the city, while also providing for its cars (Fig. 6.8).

Of course, when treated in isolation and with no other design intentions (but pure functionality), this type of garage is problematic. Indeed, the parking garage as a typology fell into disrepute in the latter part of the 20th century. It was later replaced by vast surface parking, sympathetic with the use of wide open spaces in the suburbs. It is only since the mid-1990s that the parking garage has re-emerged as a practical and viable solution to the congestion of cities.[7]

Fig. 6.7. (Top) Drawings for various types of automated parking configurations.
Fig. 6.8. (Top Right) A parking "shelf" in Chicago from the 1920s.

7 Henley, 8.



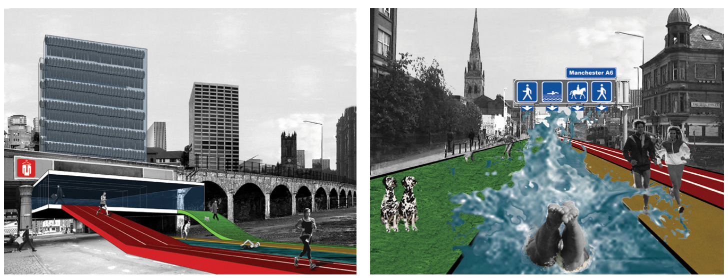


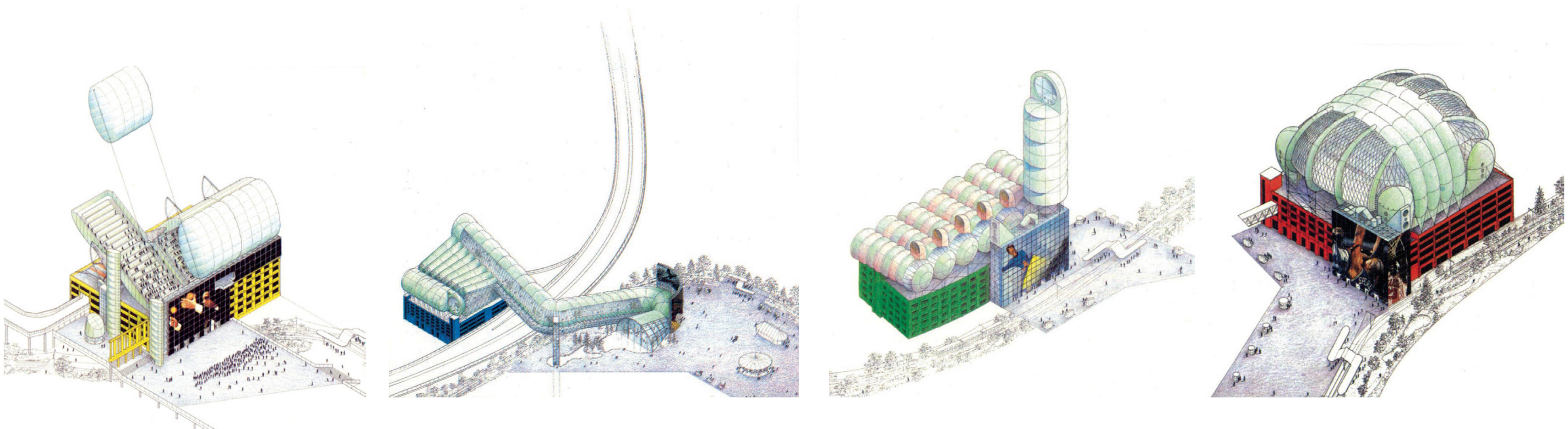
Fig. 6.9. (Top) Diagram of the "Park+Jog" parking garage with its programmatic connections.
Fig. 6.10. (Bottom) Vignettes of the activity tracks.

To remedy some of the issues inherent in designing for cars, architects have been re-introducing the human elements to their buildings. Questions of representation and/or the style that architecture should adopt are not the most important concerns anymore. Instead, the focus is on context, programme, and engagement with the public realm.

One such project is "Park+Jog" by Henley Halebrown Rorrison architects. They envisioned a car park on the edge of Manchester, UK, where commuters can leave their vehicles and continue into the city by walking, jogging, cycling, rollerblading, horse riding, swimming or rowing (Fig. 6.9). They would be provided with tracks on which to perform these activities, as well as change rooms, showers, coffee shops, and other facilities (Fig. 6.10). The proposal is not only an idea on how to deal with cars in the urban fabric, but also on how to provide and integrate more than just parking amenity. In the words of the architects:

> *"Park + Jog regenerates its surroundings, bringing activity and value to blighted sections of the city, and it radically alters the political situation for the suburb and the heartless commute it makes inevitable."*[8]

8 Henley Halebroan Rorrison Architects, "*Park + Jog" Manchester / Salford,* <http://www.hhbr.co.uk/projects/urban/004.htm>



Another similar project is Birds Portchmouth Russum architects' vision for future Croydon, UK. This proposal deals directly with the benign and uninviting nature of existing car parks. It seeks to integrate and invigorate their spaces with new public amenity. Lightweight structures would be added to the tops of four parking structures (Fig. 6.11). These would house spectacular public events and leisure activities. The buildings would then be connected through a linear park which incorporates a city tramway (Fig. 6.12). The project is intended to "revitalize and give identity to Croydon."[9]

Infusing spaces for cars with social and public activity is an important step in creating a positive relationship between mobility and the city. The following chapter will explore some examples of different programme that could support this resolution.

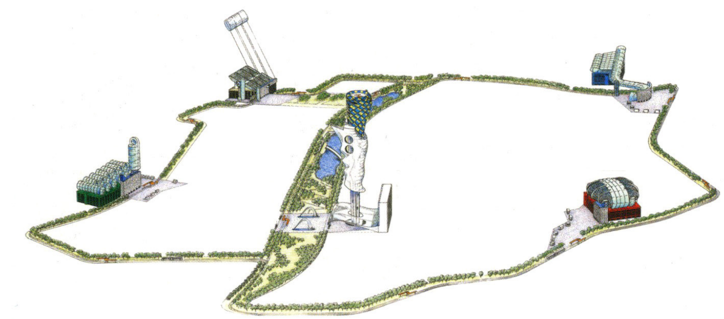


Fig. 6.11. (Top) Drawings of the four parking garages with "dromes" containing new public amenities.
Fig. 6.12. (Bottom Right) An overall diagram of the linked proposal.

9 Birds Portchmouth Russum, *Croydon The Future,* <http://www.birdsportchmouthrussum.com/bpr/pr-croyden-future.html>

Chapter 07:
Architecture and the Automobile

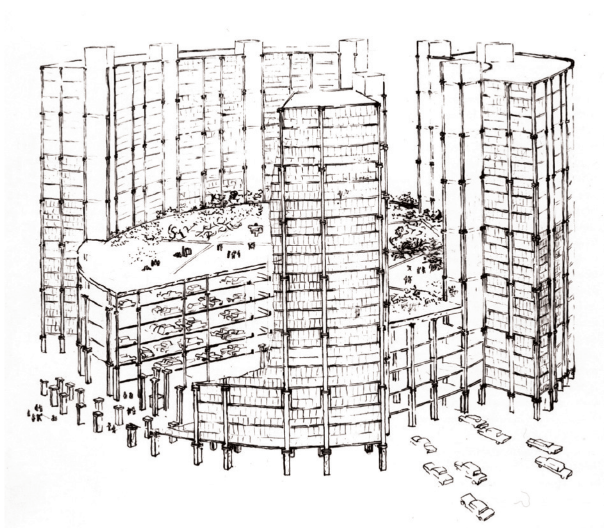


Fig. 7.1. Louis Kahn's drawing for a vehicle hub in Philadelphia.

Between 1947 and 1962, Louis Kahn did a number of studies on traffic and ways to integrate the car into downtown Philadelphia, Pennsylvania. One of his proposals was for a hub where cars could be parked, leaving a fully pedestrian core in the center (Fig. 7.1).[1] This idea has been adopted by many other architects, including Henley Halebrown Rorrison in their "Park+Jog" proposal discussed earlier.

The hub has the potential to handle a lot of the automobile traffic entering an area of the city, especially if the cars parked there are part of a sharing program. What Kahn realized is that these spaces can become hubs of public activity as well. By integrating shops, dwellings, and offices into his project, he created a much more vibrant place than a mere car park. Unfortunately, his schemes never came to fruition.

1 Henley, 12.

Bertrand Goldberg's Marina City complex in Chicago is an example of architecture accepting the car into the city and finding ways to live with it. Goldberg's project was a reaction against the flight of Chicagoans to the suburbs. He saw the negative effects this brought to the city and the urban spaces that ended up neglected by a population of commuters.

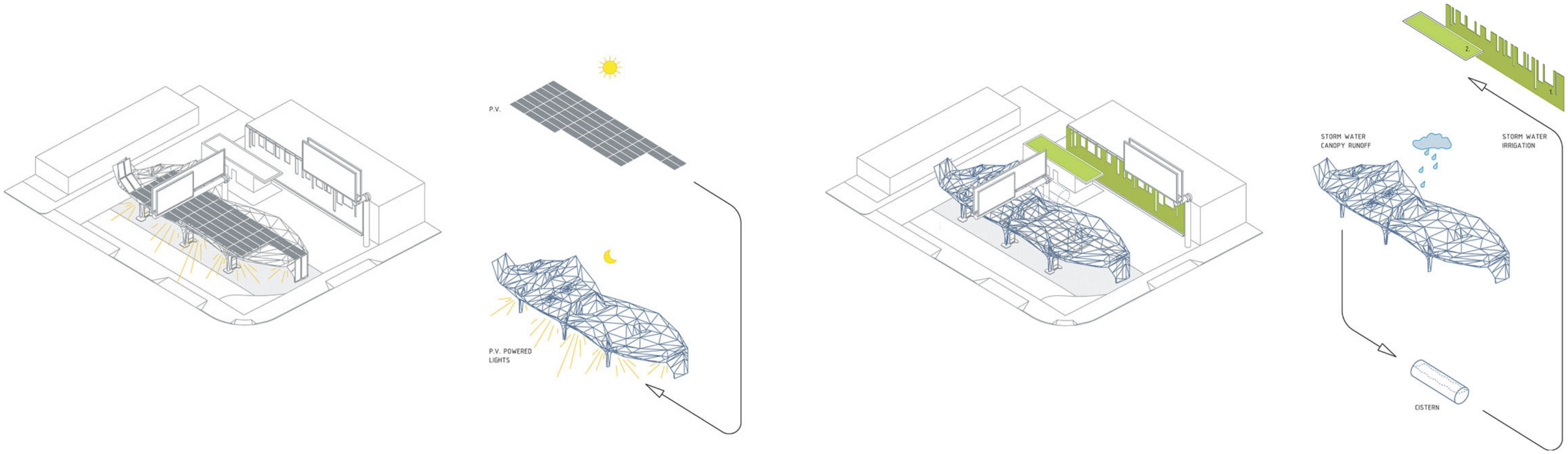
With Marina City, Goldberg sought to bring people back to the urban centre. He provided plenty of amenities - housing, offices, shops, a theatre, a marina, and multi-storey parking - within five buildings. His project still serves as a model for high-density living in the U.S. With it, he "reversed the American ideal of space, making the idea of proximity central to building a community."[2]

However, Goldberg was still very aware of the importance of the automobile in the American city. Even with amenity in close proximity, people will still use cars. He expressed this by integrating the spiral parking ramps directly into the residential towers (Fig. 7.2). Parked on the edge, the vehicles even enjoy similar views to the city as the dwellers. This scheme was so successful that it is, at least in principle, still used in almost every high-density development in cities worldwide.

Goldberg fully understood this integration and proximity to be fundamental to urban buildings in the automobile age. This enhanced the social experience and human aspect of the project. He believed that "people need to communicate personally with each other... a primitive instinct which architecture must understand, even if governments don't always understand."[3]

Fig. 7.2. Bertrand Goldberd's Marina City in Chicago, completed in 1964.

2 Henley, 225.
3 Henley, 227.

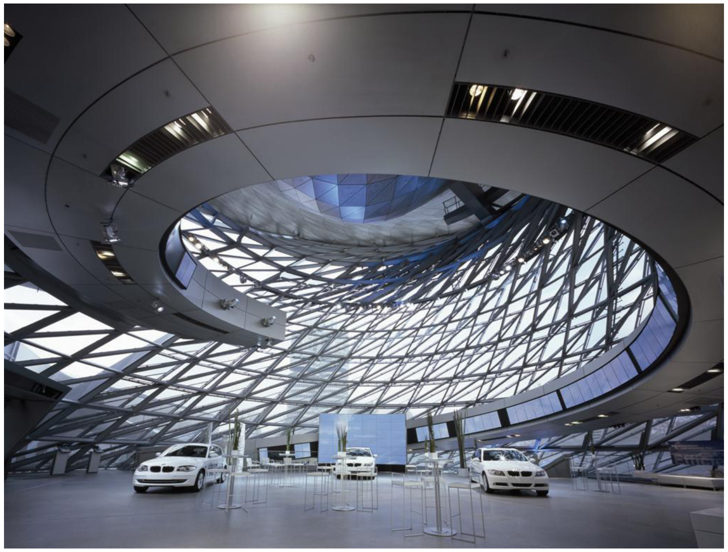


The Helois House, built in Los Angeles, California by Office dA, addresses the challenge of powering cars sustainably. While still providing gasoline for conventional internal combustion engines, the project employs many strategies to reduce its environmental impact. A green roof and landscaping employing native plants help absorb CO_2 from exhaust emissions. A rainwater collection system, as well as extensive site run-off collection, directs water to an underground cistern. The water is filtered and used to irrigate the vegetation. Solar panels on the roof of the canopy structure help provide power, further reducing the carbon footprint of the project (Fig. 7.3).

The most important aspect of the Helios House, however, is that it is envisioned as a "learning lab." Its objective is to "stimulate dialog, promote education, and foster discussion on the topic of environmental stewardship."[4] By showcasing the possibility of a more responsible way of "filling up", the project is a small step towards sustainable mobility.

Fig. 7.3. (Top) Diagrams of environmental strategies employed in the Helios House.
Fig. 7.4. (Bottom) An image of the gas station canopy.

4 Office dA, *Helios House*, <http://www.officeda.com/>

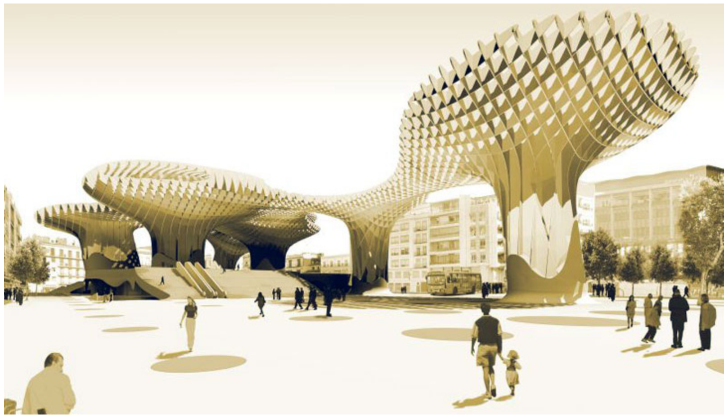


Coop Himmelb(l)au's design for the BMW Welt (BMW World) is intended as a showcase of cars, as well as unrestricted freedom. The building itself is a result of an international competition. The main objective was to create an exhibition, as well as a meeting place, where the auto maker can interface with its customers. As a reason for winning the competition, the judges wrote that "this work is informed by a grand design: a marketplace under a wide roof. This image has associations of openness and communication (Fig. 7.5)."[5]

The roof of the BMW Welt also performs functionally. Its double-skin system controls ventilation and cooling. It also generates electricity through the use of integrated solar panels (Fig. 7.6). Underneath this "clean energy cloud", as dubbed by Coop Himmelb(l)au's spokesman, is a space for a "permanent performance" by BMW's products (Fig. 7.7).[6]

Fig. 7.5. (Top Left) The seemingly floating roof of the BMW Welt in Munich, Germany.
Fig. 7.6. (Top Right) An aerial view of the roof's solar panels.
Fig. 7.7. (Bottom) The interior of the "Double Cone" with exhibition spaces.

5 Meyhöfer, 186.
6 Meyhöfer, 187.



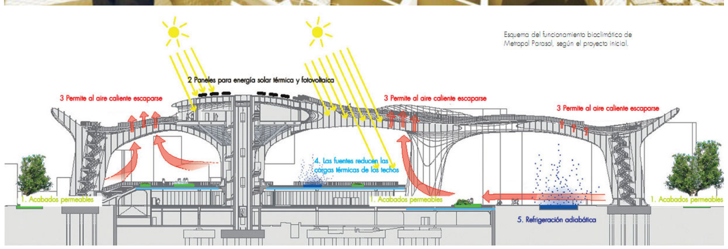


Fig. 7.8. (Top) The approach to Metropol Parasol.
Fig. 7.9. (Middle) Pathways on the roof connect various programme, as well as provide views to the city.
Fig. 7.10. (Bottom) Diagram of the project's passive conditioning strategies.
Fig. 7.11. (Top Right) Large public events taking place in the new plaza.

The Metropol Parasol is a project by Jurgen Mayer for the revitalization of Plaza de la Encarnación in Sevilla, Spain. The history of the site is akin to the one of many similar places in America. Once a bustling marketplace, the plaza eventually fell into disrepair in the latter part of the 20th century and became used as a car park.[7]

Meyer's proposal envisions the revitalization of the plaza into a highly active public space and an icon for the city of Sevilla. He employs "Parasols" as an infrastructure, providing and linking spaces of activity and amenity (Fig. 7.8). Lifted off the ground, they shelter the space below, while also providing panoramic views of the city from above (Fig. 7.9 and Fig. 7.10). In addition, there is an archeological site, a farmers'

7 City of Sevilla, *Plaza de la Encarnación,* <http://www.sevilla.org/impe/sevilla/detalleParque?idParque=19&idActivo=C11688&idSeccion=C190&vE=D4268>

market, and multiple bars and restaurants. These elements all work to create a "dynamic development for culture and commerce in the heart of Sevilla" (Fig. 7.11 and Fig. 7.12).[8]

Fig. 7.12. Site plan of the Metropol Parasol.

8 Jurgen Mayer, *Metropol Parasol*, <http://www.jmayerh.de/home.htm>

Part Four

SYNTHESIS

Envisioning Productive Urban Mobility

Chapter 08:
Site Analysis and Mapping

Fig. 8.1. (Opposite) Daily bridge and tunnel traffic in New York City.

To synthesize ideas of productive urban mobility, an appropriate site for architectural intervention must be investigated. Places with large volumes of vehicular traffic are of particular interest, since they are likely to suffer the most from the effects of car-centric development. They are also in a position to benefit greatly from their resolution.

Bridge and tunnel traffic counts provide a clear picture of where most of New York's cars travel through (Fig. 8.1). These points are also ideal locations for mobility hubs, since they are natural nodes of traffic concentration and congregation.

Queensboro Bridge is chosen as the most highly travelled thoroughfare that directly connects to dense midtown Manhattan. On the other side of the bridge lies the neighbourhood of Long Island City (L.I.C.), Queens. Unlike Brooklyn Heights or Williamsburg, L.I.C. has not yet been developed into a vibrant area with an identity of its own. Despite its proximity to Manhattan, it has been largely by-passed by motorists in favor of other parts of the borough, or the suburbs of Long Island.

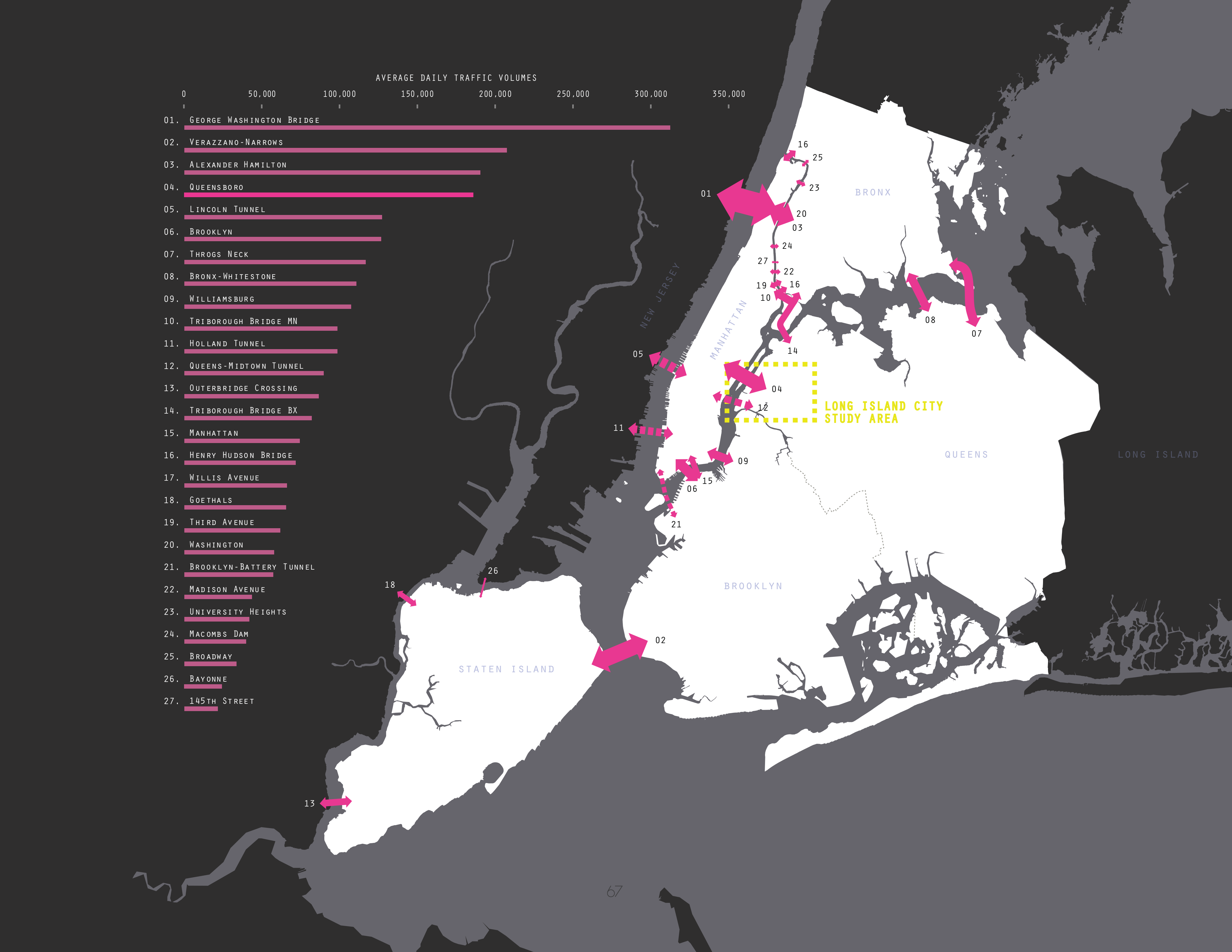
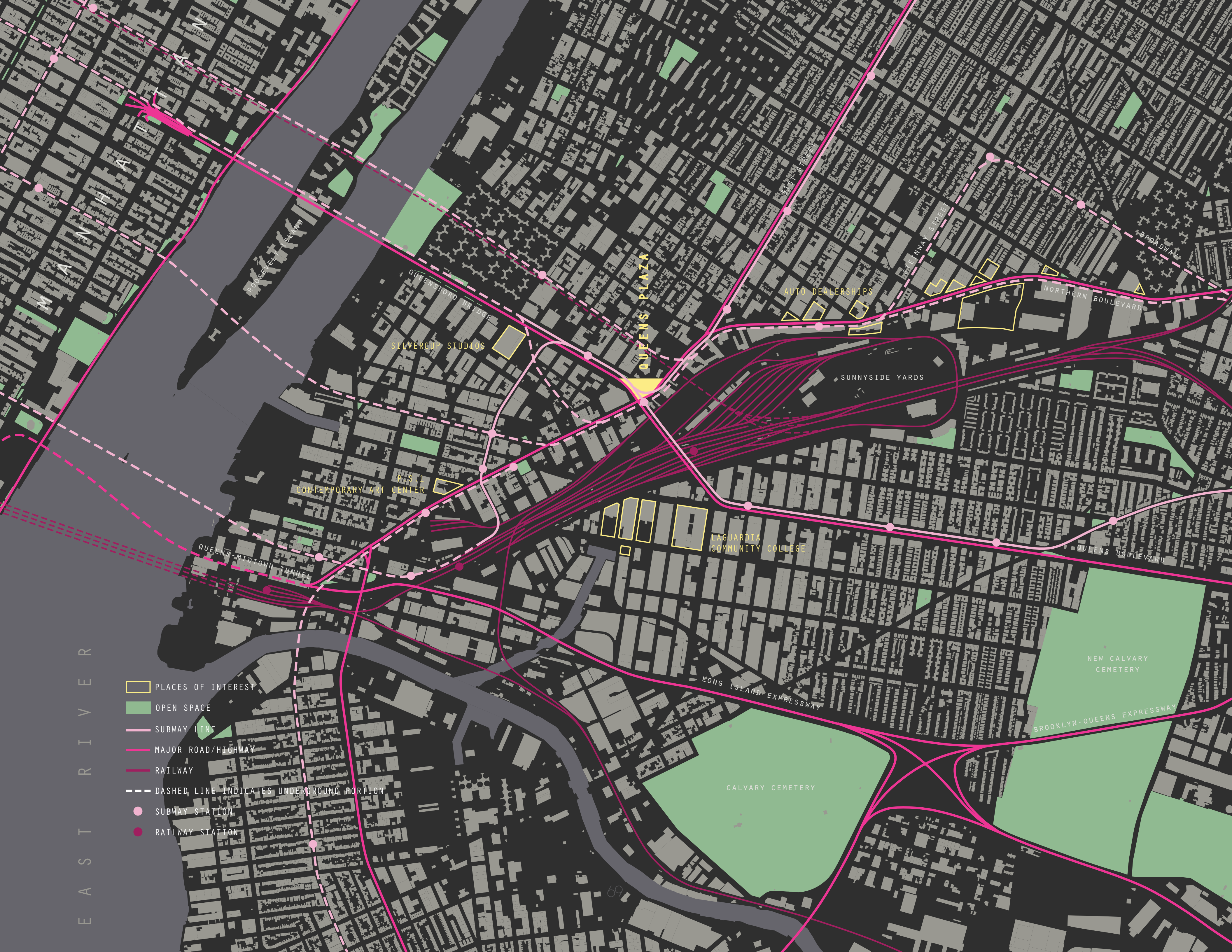

AVERAGE DAILY TRAFFIC VOLUMES
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
01. George Washington Bridge
02. Verazzano-Narrows
03. Alexander Hamilton
04. Queensboro
05. Lincoln Tunnel
06. Brooklyn
07. Throgs Neck
08. Bronx-Whitestone
09. Williamsburg
10. Triborough Bridge MN
11. Holland Tunnel
12. Queens-Midtown Tunnel
13. Outerbridge Crossing
14. Triborough Bridge BX
15. Manhattan
16. Henry Hudson Bridge
17. Willis Avenue
18. Goethals
19. Third Avenue
20. Washington
21. Brooklyn-Battery Tunnel
22. Madison Avenue
23. University Heights
24. Macombs Dam
25. Broadway
26. Bayonne
27. 145th Street
NEW JERSEY
MANHATTAN
BRONX
QUEENS
BROOKLYN
STATEN ISLAND
LONG ISLAND
LONG ISLAND CITY
STUDY AREA

Fig. 8.2. (Opposite) L.I.C. context and major transportation routes.
Fig. 8.3. (Above) View looking east toward Queens Plaza in the early 1900's.
Fig. 8.4. (Top) A view of Queens Plaza today looking south.

Queens Plaza enjoys a prime location in L.I.C. Sitting at the foot of the Queensboro Bridge, it is the first public space that motorists, pedestrians, bikers, and transit users experience when coming from Manhattan. It is the most significant entrance into L.I.C., Queens, and the rest of Long Island to the east. For travellers going west into Manhattan, Queens Plaza serves as a node, consolidating all traffic journeying across the river, regardless of their means of transport (Fig. 8.2).

The original design for the plaza was built in the early 1900's and embraced its role as a gateway. It featured wide grassy malls with an inherently public character (Fig. 8.3). Today, most of the millions of people passing through Queens Plaza every year are unaware of its existence. The construction of the elevated subway and the vast increase in traffic in the beginning of the 20th century have resulted in the site's highly deteriorated state today. The plaza is characterized by a "chaotic tangle of eight traffic lanes, assorted medians and parking islands, and noisy but fascinating elevated subway tracks curving overhead" (Fig. 8.4).[1]

1 New York City Department of City Planning, *Queens Plaza Bicycle and Pedestrian Improvement Project.* 5.


MANHATTAN
ROOSEVELT ISLAND
QUEENSBORO BRIDGE
SILVERCUP STUDIOS
QUEENS PLAZA
31ST STREET
STEINWAY STREET
BROADWAY
AUTO DEALERSHIPS
NORTHERN BOULEVARD
SUNNYSIDE YARDS
P.S.1
CONTEMPORARY ART CENTER
LAGUARDIA
COMMUNITY COLLEGE
QUEENS BOULEVARD
QUEENS MIDTOWN TUNNEL
LONG ISLAND EXPRESSWAY
NEW CALVARY
CEMETERY
BROOKLYN-QUEENS EXPRESSWAY
CALVARY CEMETERY
EAST RIVER
PLACES OF INTEREST
OPEN SPACE
SUBWAY LINE
MAJOR ROAD/HIGHWAY
RAILWAY
DASHED LINE INDICATES UNDERGROUND PORTION
SUBWAY STATION
RAILWAY STATION

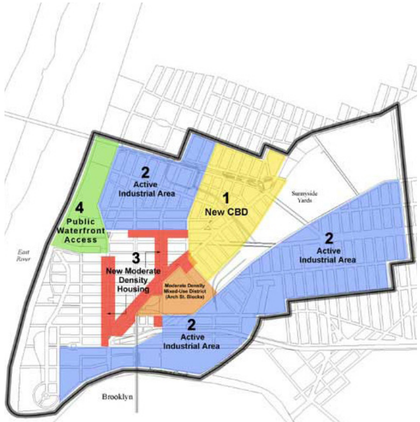


Fig. 8.5. (Opposite) Long Island City zoning and context.
Fig. 8.6. (Top Right) Major zones in NYC's plan for L.I.C.'s redevelopment.
Fig. 8.7. (Top Upper and Lower) Existing vs. planned conditions (respectively) at Queens Plaza.
Fig. 8.8. (Bottom) View of proposed landscaping for Queens Plaza.

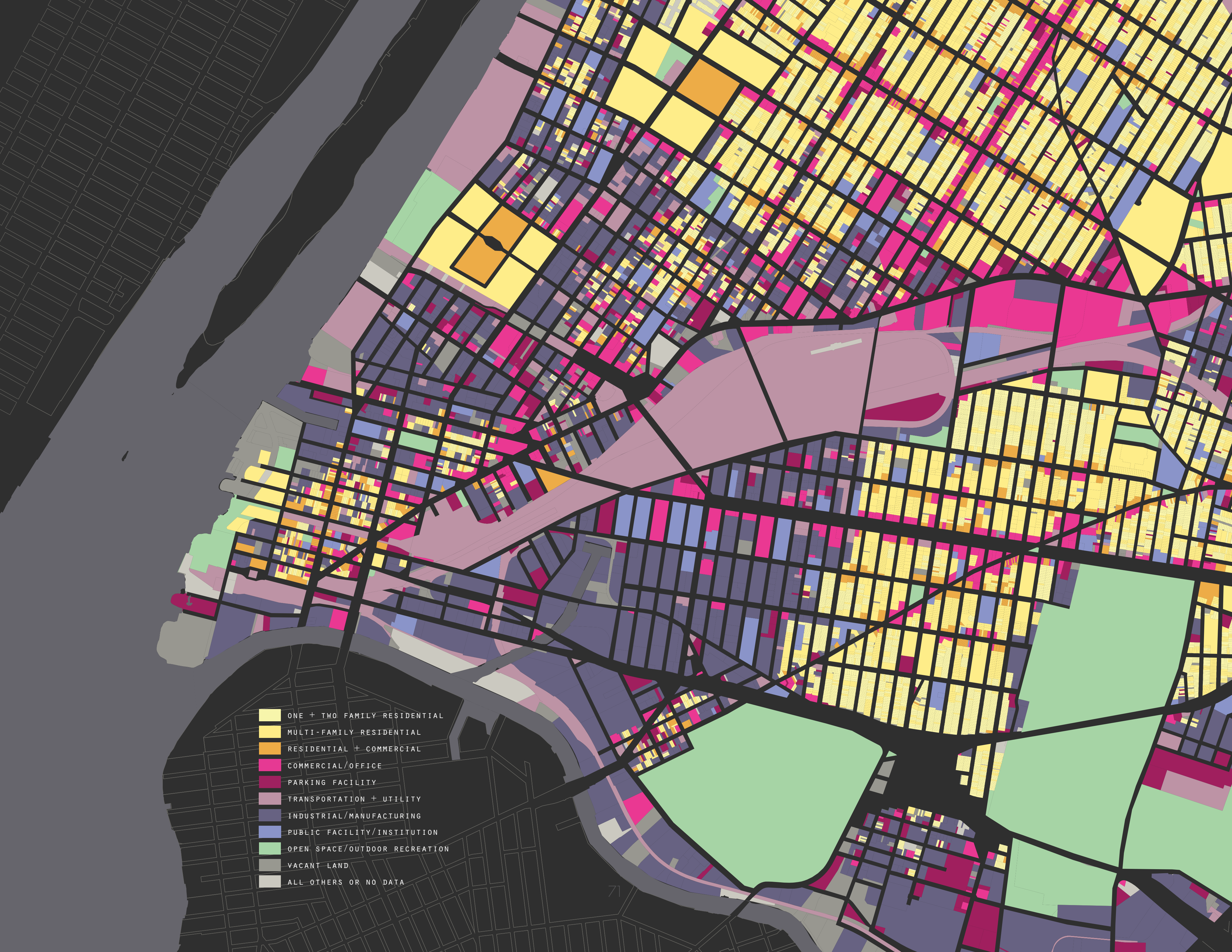
Unlike the rest of its surroundings, Long Island City is an area still predominantly occupied by industrial buildings. A lot of these buildings are no longer in use and are being slowly either converted or rebuilt into residences and offices (Fig. 8.5). The area's industrial character is becoming more refined and forward-thinking. New York City's Department of Planning and the Economic Development Corporation recognized the importance of Queens Plaza and are currently undertaking significant improvements to the area. In the words of EDC President Andrew Alper:

> "*Queens Plaza is the gateway to Queens. As the City moves forward with initiatives to create new central business districts in Long Island City, Downtown Brooklyn and the Far West Side of Manhattan, projects like this have a very high priority. Improving the public spaces and traffic flow of Queens Plaza is important to the millions of people who live or work in the area, or pass through daily on foot, in cars, busses and subways.*"[2]

As part of L.I.C.'s new Central Business District (CBD), Queens Plaza is zoned to be rebuilt more dense and vibrant (Fig. 8.6). However, current plans only include landscaping and redesigning of planting, street patterns and furniture (Fig. 8.7 and Fig. 8.8). While converting the plaza itself from a municipal parking lot into a small green park space is an improvement, Queens Plaza has the potential to become much more.

---

2 N.Y.C. Department of City Planning, *Development of Streetscape and Landscape Design for Long Island City,* <http://www.nyc.gov/html/dcp/html/about/pr111502.shtml>


ONE + TWO FAMILY RESIDENTIAL
MULTI-FAMILY RESIDENTIAL
RESIDENTIAL + COMMERCIAL
COMMERCIAL/OFFICE
PARKING FACILITY
TRANSPORTATION + UTILITY
INDUSTRIAL/MANUFACTURING
PUBLIC FACILITY/INSTITUTION
OPEN SPACE/OUTDOOR RECREATION
VACANT LAND
ALL OTHERS OR NO DATA

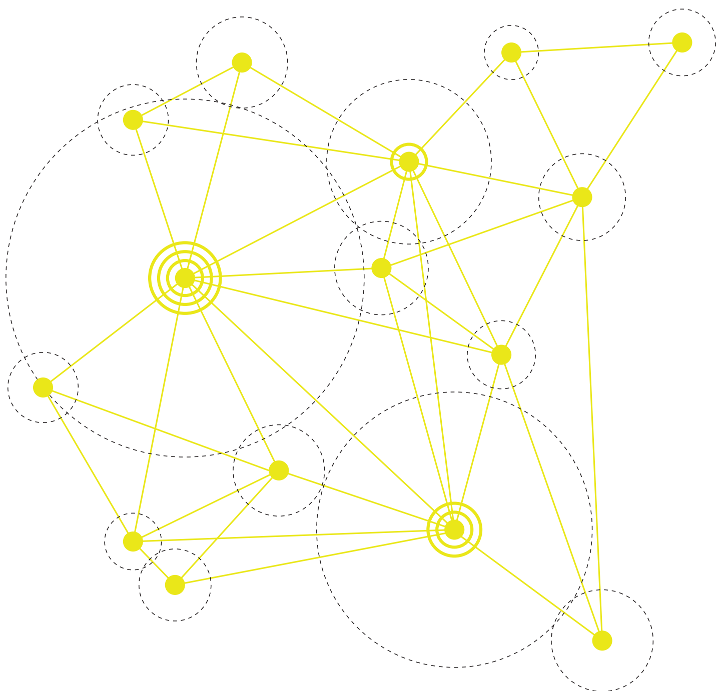
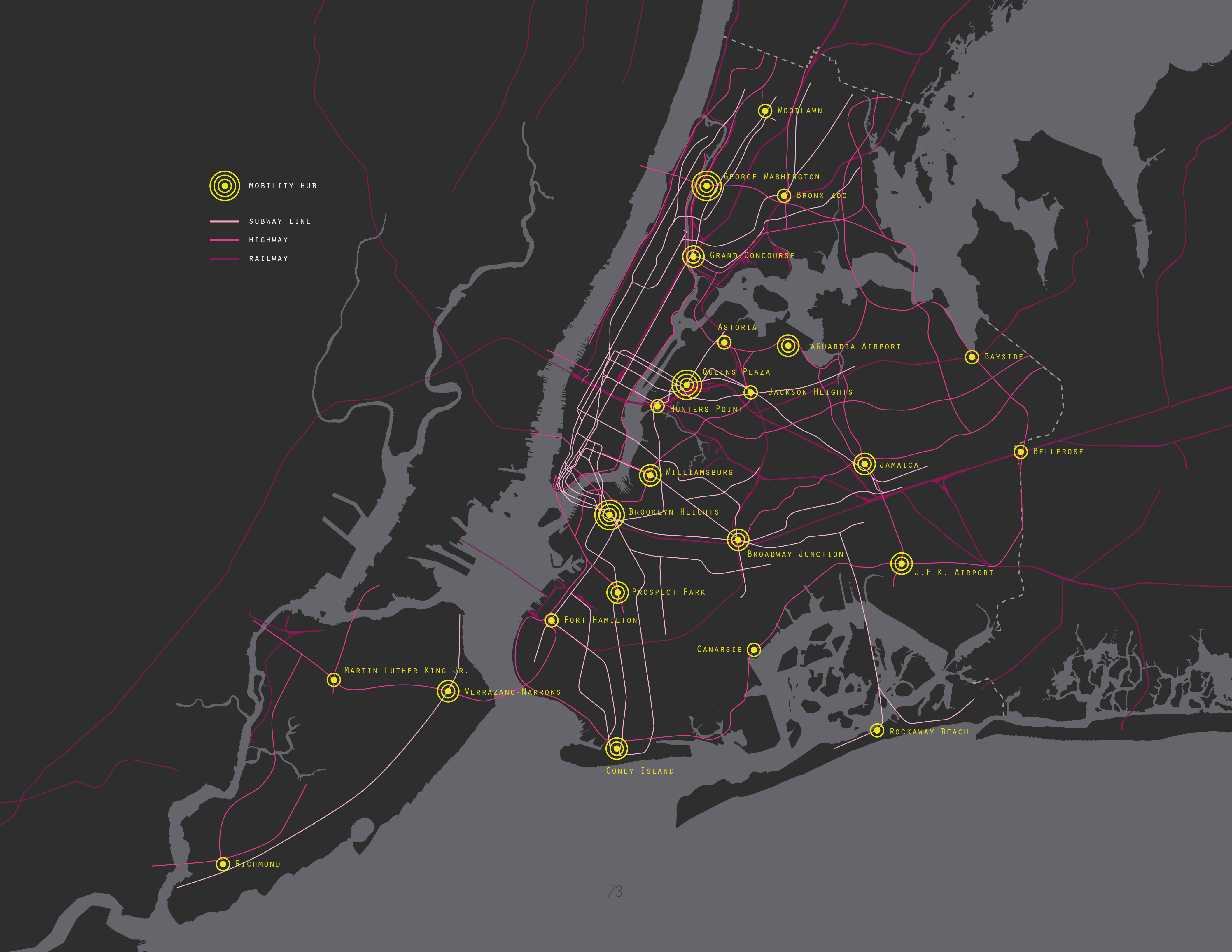


Fig. 8.9. (Opposite) Proposed network of Mobility Hubs in New York City.
Fig. 8.10. (Above) Diagram of the various scales of the network's operation.

Ultimately, Queens Plaza is envisioned as part of a city-wide network of Mobility Hubs, all intended to facilitate and promote electric car-sharing. These hubs would be located at strategic points throughout the boroughs, where transportation infrastructure and/or populations converge, creating natural nodes (Fig. 8.9). Each of these locations will provide a significant number of electric vehicles, which can be easily rented out as needed. They will also generate enough electricity to power these cars by using renewable resources most easily available at each site. Last, but not least, the hubs will provide amenity, public space, and entertainment, creating a local destination with a unique identity.

Smaller locations, containing only a few cars each would be dispersed throughout the rest of the city, anywhere a personal trip might begin or end. Places like shops, grocery stores, office buildings, and residential developments would become part of this system, serving their immediate populations, as well as providing easy drop-off locations for travellers (Fig. 8.10).

The aim is to create a network of car-sharing and energy trade within the city, which is also vibrant and exciting. The Mobility Hubs will act as nodes, or anchors to this network. Synthesizing the ideas of Mobility, Sustainability, and Livability discussed throughout the thesis, the hub at Queens Plaza will now be explored in more detail, providing an example of such development.



MOBILITY HUB
SUBWAY LINE
HIGHWAY
RAILWAY
Woodlawn
George Washington
Bronx Zoo
Grand Concourse
Astoria
LaGuardia Airport
Bayside
Queens Plaza
Jackson Heights
Hunters Point
Bellerose
Jamaica
Williamsburg
Brooklyn Heights
Broadway Junction
J.F.K. Airport
Prospect Park
Fort Hamilton
Canarsie
Martin Luther King Jr.
Verrazano-Narrows
Rockaway Beach
Coney Island
Richmond

Chapter 09:

Design for the Queens Plaza Mobility Hub

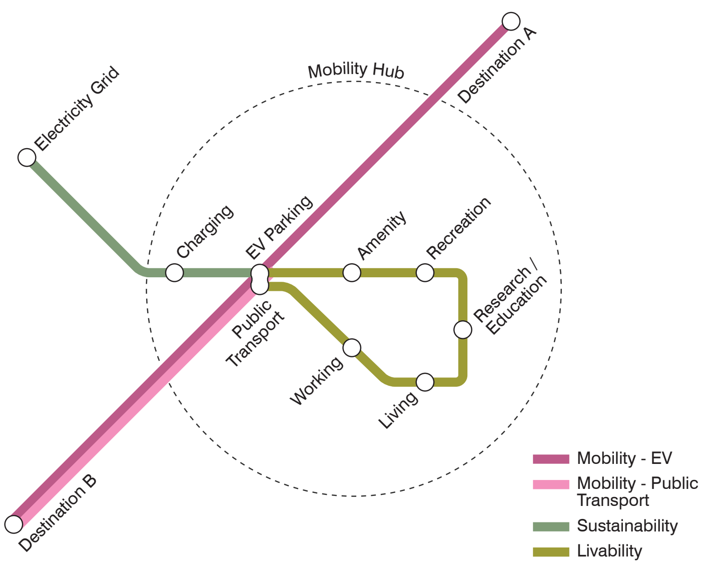


Fig. 9.1. Concept diagram of programme and use of the Mobility Hub.
Fig. 9.2. (Opposite) Summary diagram of design principles.

Queens Plaza is a significant transportation node in New York City, yet it is highly underdeveloped. The design of a Mobility Hub on the site has the potential to invigorate the area, as well as help usher in the new era of auto use and urban mobility.

The Hub can act as a starting point, a destination, or an intermediary stop in any trip (Fig. 9.1). It will provide space for a fleet of Electric Vehicles (EVs) that are all tied in to a city-wide car-sharing network. Users will be able to pick up and drop off their vehicles at the Hub on an as-needed basis. With fun, exciting new vehicles and technology available without the waste and hassle of individual ownership, EV sharing can become an attractive option for many residents and commuters. The Hub will also facilitate seamless connections to mass transit in order to further break down the barriers between public and private transportation.

Localized electricity generation will provide the energy needed to power the vehicles without the inefficiencies and damaging effects of oil use and "dirty" power plant production. Various amenities, recreation, education, living, and working spaces will also be provided. The aim is to achieve a truly integrated and sustainable model of what the future of mobility might look like.

A summary of the specific challenges and design principles discussed throughout this thesis is provided in Fig. 9.2. Subsequently, a list of programme elements is presented, complete with strategies for their implementation and connection.

LIVABILITY

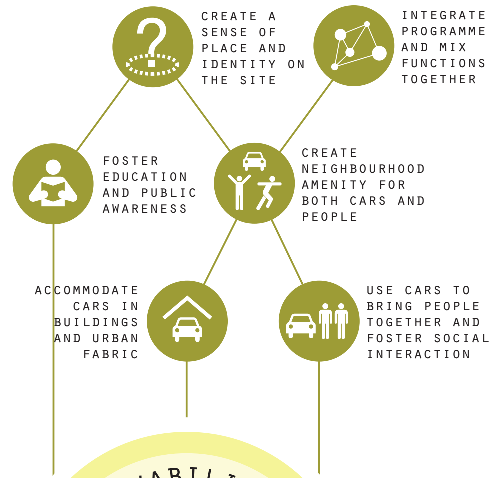
As our cars evolve, so must architecture. Spaces for the automobile need to foster social connections and interaction, and be a pleasant and productive part of daily life. Architecture for the car must also be for people, amenity, neighbourhoods and interaction.[1]

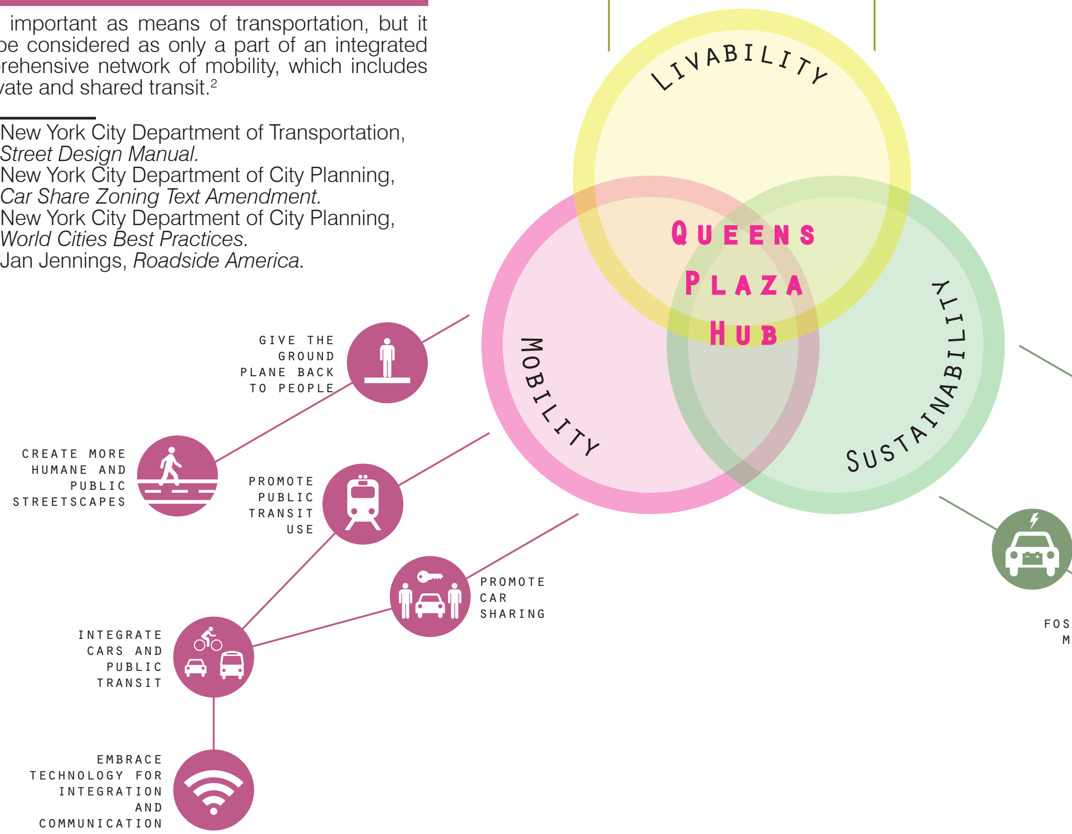
1 Simon Henley, *The Architecture of Parking.* Dietrich Klose, *Metropolitan Parking Structures.* James H. Kunstler, *The Geography of Nowhere.* Dirk Meyhöfer, *Motortecture.*

MOBILITY

The car is important as means of transportation, but it needs to be considered as only a part of an integrated and comprehensive network of mobility, which includes public, private and shared transit.[2]

2 New York City Department of Transportation, *Street Design Manual.* New York City Department of City Planning, *Car Share Zoning Text Amendment.* New York City Department of City Planning, *World Cities Best Practices.* Jan Jennings, *Roadside America.*

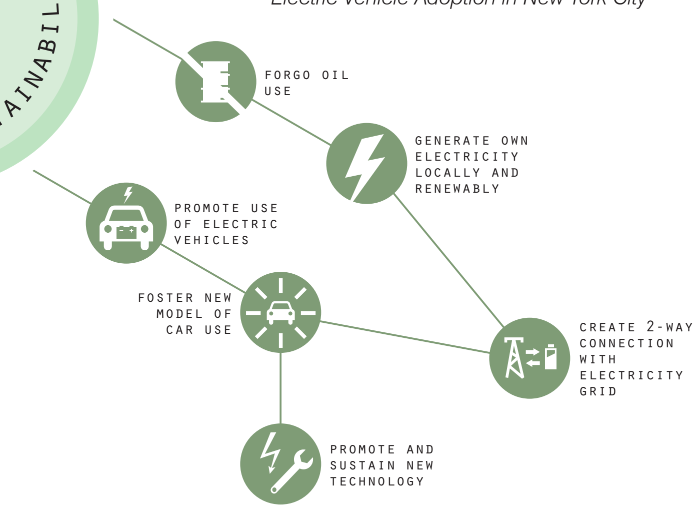


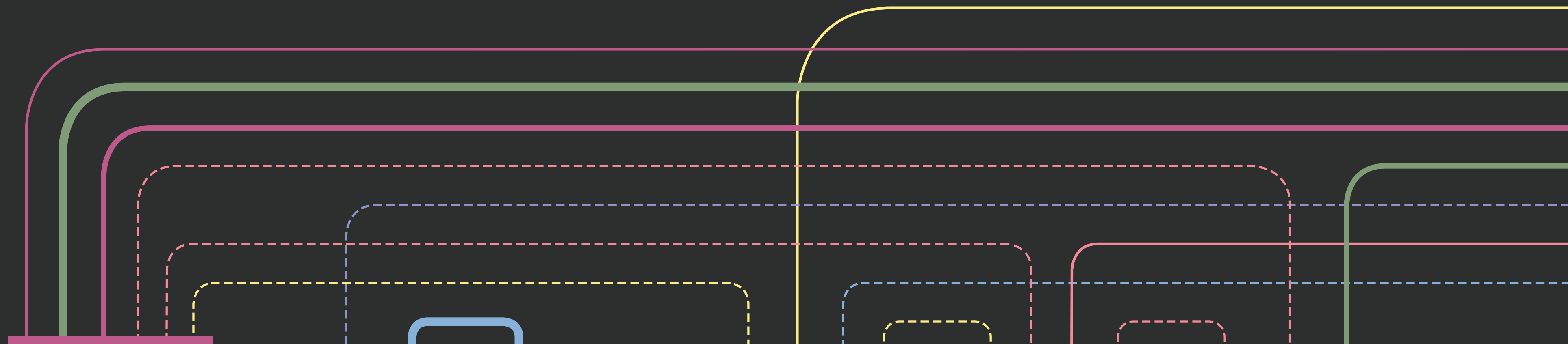


SUSTAINABILITY

To mitigate the environmental issues associated with automobiles, new technologies and strategies for sustainability must be employed in the cars themselves, our means of powering them, using them, and managing our mobility as a whole.[3]

3 William Mitchell, et al., *Reinventing The Automobile* U.S. Dept. of Energy, *Transportation Energy Data Book: Edition 29* National Renewable Energy Laboratory Electrification Coalition, *Electrification Roadmap* The City of New York, PlaNYC: *Exploring Electric Vehicle Adoption in New York City*





Car Storage / Parking

Accommodates cars coming into, or waiting to be picked up from Queens Plaza. Caters specifically to EVs and car-sharing, serving as a hub and promoting a shift in auto use. Utilizes automated parking systems and programme adjacencies in order to mitigate alienating effects, as discussed in Chapter 06.

Fabrication and Exhibition Hall

Provides a space for the repair, customization, and small-scale fabrication of EVs and their components. Fitting in with the area's numerous auto dealerships and repair shops, the hall will be the neighbourhood's destination for all EV needs, promoting an alternative to internal combustion. It will also feature spaces for exhibiting electric cars and technologies.

Educational Facilities

Coupled with the Manufacturing and Exhibition Hall, the Educational Facilities will promote future developments in EV and power grid technologies. A strategy employed by Office dA in their Helios House, these learning spaces will also raise public awareness and foster environmental stewardship.

Residences

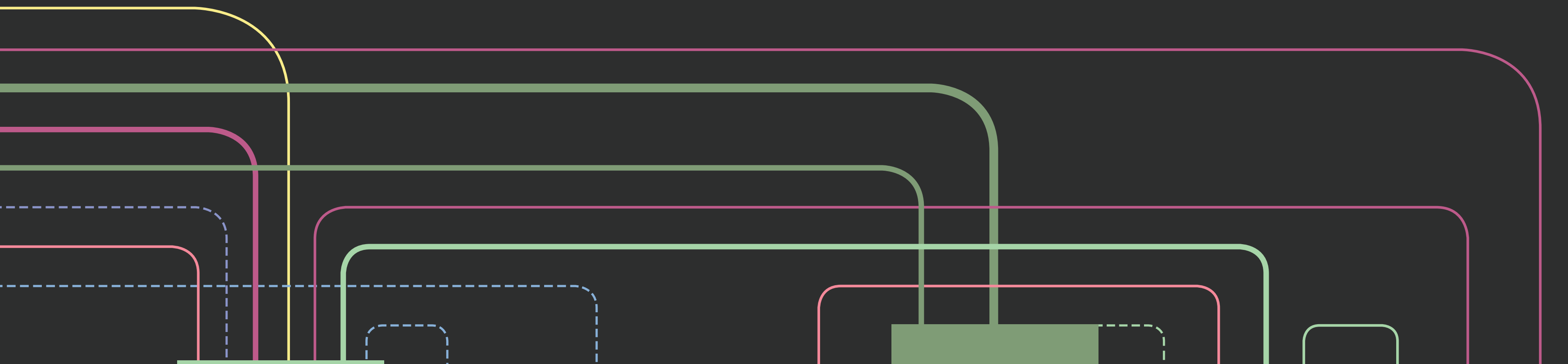
As Long Island City transforms into a vibrant mixed-use neighbourhood, new population will need to be housed. The development should attract people to a dense urban model of living, rather than perpetuate suburban flight. An idea explored by Bertrand Goldberg in Marina City, the aim of integrating residences into the Mobility Hub is to build a community and an identity.

Commercial Development

Promotes a mix of commercial development in order to activate the public realm. By locating shops, cafés, restaurants, and other amenity on the ground level, the streetscape can once again become vibrant and human-oriented.

Offices

Geared mostly toward the operation of the Mobility Hub. The offices will manage electricity trade between the Energy Grid and the Hub. They will also manage the EV sharing fleet, its distribution, condition, and battery usage.



Public Square / Plaza

Serves as the main public and event space in the Mobility Hub, revitalizing Queens Plaza. By using strategies similar to Jurgen Mayer's Metropol Parasol, the plaza hosts human activity and links surrounding programme. Events are allowed and encouraged to spill out into the plaza. The aim is to create shelter, amenity, and a sense of place.

Recreational Facilities / Gym

Affords spaces for physical activity and recreation to the visitors commuting to/from the Hub, as well as local residents. An idea introduced by Henley Halebrown Rorrison architects in their "Park+Jog" proposal, the aim is to create a healthier and more active place, regardless of the user's mode of travel.

Nightlife / Bar / Club

Helps create a mixed-use neighbourhood, which is vibrant throughout the day and night. As shops and offices begin to close, the Hub can continue to be activated by public events and/or nightlife. Having a unique local venue can bring people to the Hub and attract activity.

Photovoltaic Skin

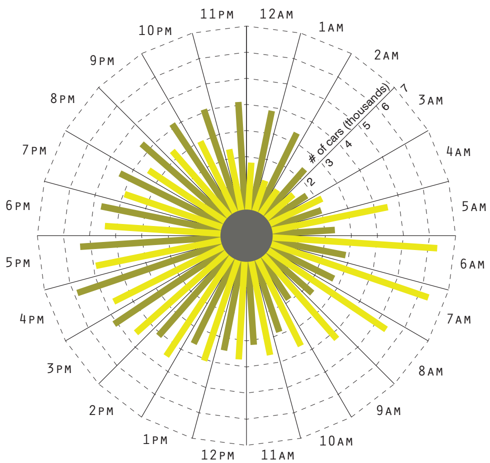
Generates the electricity needed to recharge the EVs coming to the Mobility Hub. By using a sustainable local resource - the sun - the Hub powers cars without any damaging environmental effects. This also eliminates any strain that charging EVs might put on the electricity grid. Using the batteries in vehicles to store energy generated in excess, the Hub can actually aid the grid.

Recreational Path

Linking various programme, as well as providing recreational amenity to the public. A strategy similar to Birds Portchmouth Russum architects' vision for future Croydon, UK, the path will connect and be an easy way to access all of the Mobility Hub's amenity.

Public Transit Stations

Provides links and entrances into the elevated and underground subway stations, as well as the numerous bus lines on ground level. By connecting these with the car-sharing network, a new integrated system of mobility can be achieved. Information displays and wireless communications keep users aware and efficient with their time.



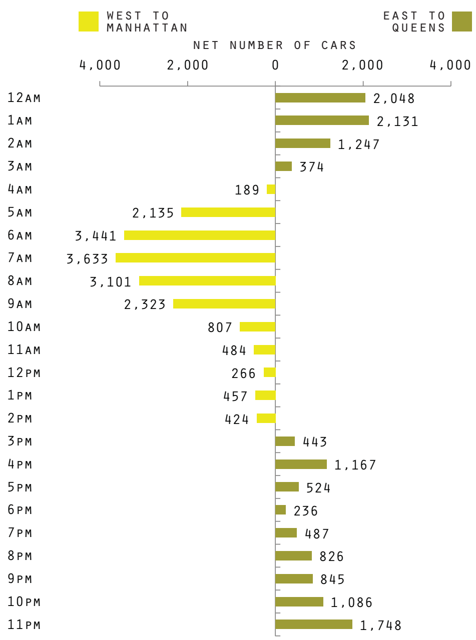
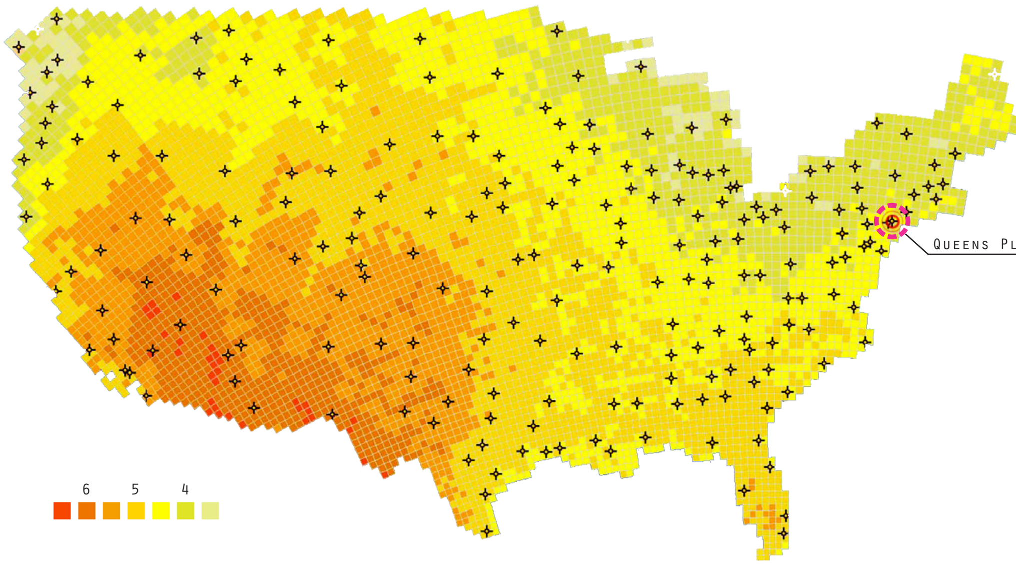


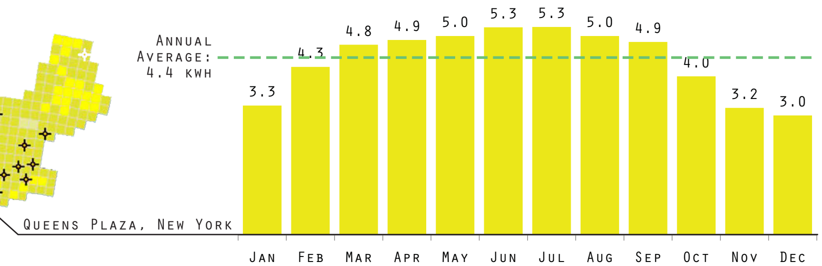
Fig. 9.3. Queensboro Bridge total hourly traffic.
Fig. 9.4. Queensboro Bridge net hourly traffic (Eastbound minus Westbound).

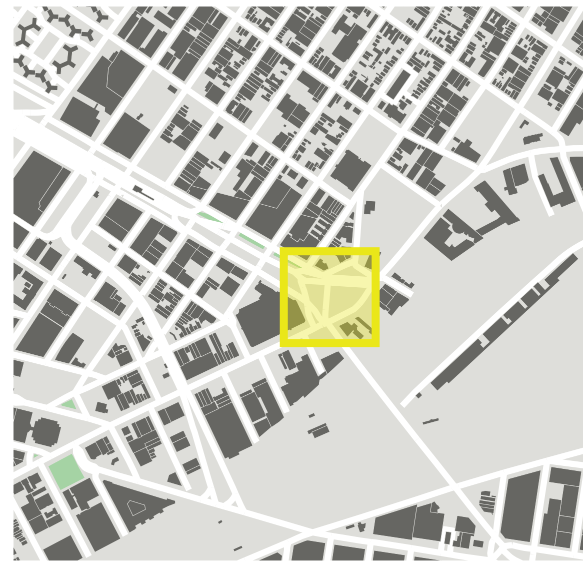
To put this programme together, an understanding of scale and magnitude must first be reached. The amount of automobile traffic going through Queens Plaza can be estimated using data collected from the Queensboro Bridge (Fig. 9.3). If the Mobility Hub at this location is to make a significant impact to the travel patterns and habits in the area, it must be able to handle the majority of this traffic.

One useful way of looking at this data is in terms of net traffic, or the difference between the number of eastbound and westbound vehicles (Fig. 9.4). In an ideal scenario, every car coming to the Hub from Manhattan will be picked up by someone going into Manhattan and vice versa. However, since there is a clear fluctuation in the demand for vehicles throughout the day, a certain amount of overflow, or "stock", must be maintained in the Hub. From the data, a reasonable number to assume is around 2,500 cars. Depending on the car type and dimensions, this would require between 4 and 14 m^2 per vehicle. Therefore, for an average 9 m^2 per car x 2,500 cars, an area of 22,500 m^2 is required. Adding on 30% for lifts and circulation results in a total of 29,250 m^2 needed.

The next challenge is the area required to power 2,500 cars sustainably. While other parts in the U.S.A. have greater solar resources available, photovoltaics are still a simple and viable solution (Fig. 9.5). Because of the large rail yards on the south and east side, as well as the low to mid-rise, industrial-density buildings surrounding it, Queens Plaza remains largely unshaded.







Data from the National Renewable Energy Laboratory shows the solar resource available in Queens Plaza to be an average of 4.4 kWh per day (Fig. 9.6). Using today's technology, photovoltaics can convert around 20% of this energy directly into electricity. This means that a PV array in Queens could produce 0.9 kWh / m^2 / day.

To recharge, EVs today require anywhere from 125 - 225 Wh for every kilometer driven. Since people in the U.S. drive 64 km per day on average, an EV would use about 8-14 kWh per day.[4] To put this into perspective, the average household in the U.S. consumes around three times as much - between 17-42 kWh per day.[5] Therefore, to recharge 2,500 cars, an average of 27,500 kWh per day is needed. At 0.9 kWh / m^2 / day, a PV area of about 31,000 m^2 is required to produce this amount (Fig. 9.7). In comparison, the PV roof of the BMW Welt discussed ealier in Chaper 7 is 16,000 m^2, or about half the size.

4 U.S. Dept. of Energy, *Transportation Energy Data Book: Edition 29.*
5 U.S. Energy Information Administration, *Electricity Explained,* <http://www.eia.doe.gov/energyexplained/index.cfm?page=electricity_home#tab2>

Fig. 9.5. (Top Left) Daily Solar Resource available in the USA (annual average, in kWh).
Fig. 9.6. (Top Right) Daily Solar Resource available in Queens Plaza (by month, in kWh).
Fig. 9.7. (Bottom Right) 31,000 m^2 overlaid on Queens Plaza.

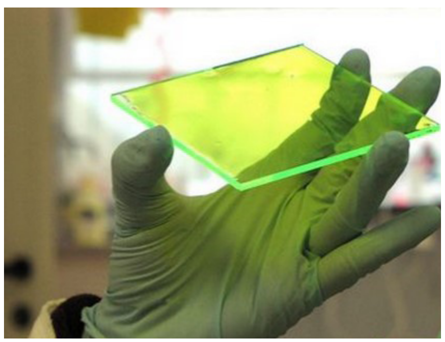


Fig. 9.8. (Top) The Dell Headquarters parking lot in Round Rock, TX.
Fig. 9.9. (Bottom Left) GreenSun's transparent photovoltaic panels.
Fig. 9.10. (Bottom Right) A traditional PV cell next to GreenSun's cell.
Fig. 9.11. (Opposite) Site context at Queens Plaza.

With these areas in mind, the basic design strategy for the Mobility Hub is to arrange and stack programme on the ground, then cover it with an array of photovoltaics. Having a PV-covered car park that can use the collected energy to recharge its electric vehicles is not a new idea. Similar concepts are becoming increasingly popular in small-scale commercial applications (Fig. 9.8), as well as personal residences. As a truly sustainable way of powering mobility, this strategy can also provide basic shelter and be easily integrated into a building envelope.

However, covering a large area, such as the 31,000 m^2 needed at Queens Plaza can be a challenge. Efforts must be placed to avoid creating a vast, dark, and monotonous space, which is often the downfall of parking structures. One such strategy is employing transparent PV panels - a technology currently being developed into a market reality. These panels consist of glass sheets, which are impregnated or coated with special dyes and materials (Fig. 9.9). They capture different parts of the sun's light spectrum and diffuse it to the panels' edges, where photovoltaic receivers are placed. Unlike conventional PVs, they do not need direct sunlight to function efficiently, allowing them to be placed at various angles and locations. They also allow visible light to pass through them, in addition to providing higher conversion efficiency, costing less, and using 80% less silicon (Fig. 9.10)[6].

The next challenge at Queens Plaza is allocating room for the programme. Fig. 9.11 highlights the existing conditions at the site, as well as potential areas to be built on. Afterwards, strategies for organizing the various programme is presented, followed by the final design.

6 GreenSun Energy, *Technology*, <http://www.greensun.biz/Technology/>


The landmark "Clock Tower" building, completed in 1925. Formerly housing the Bank of Manhattan branch, it is currently rented out as office space.
Vacant lot flanked by small, empty commercial buildings.
Tunneling and construction of the East Side Access project - connecting L.I.R.R. trains from Sunnyside yards to Grand Central Terminal in Manhattan.
New 21-storey office tower currently in construction as Phase I of the Gotham Center office/retail/residential development.
1-2-Storey retail space, mostly vacant.
Abandoned BP gas station and parking lot.
Surface parking lot on the corner of Queens Boulevard and Jackson Ave.
Development to remain
Development to be demolished

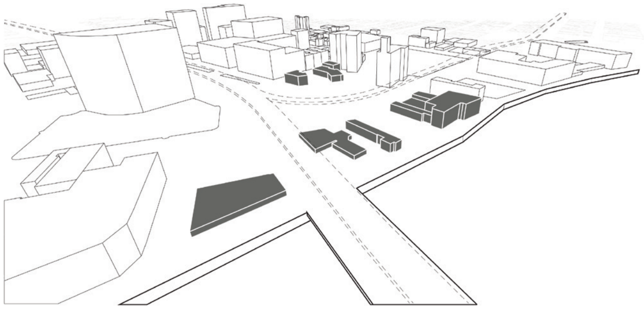


Fig. 9.12. Vacant or redundant buildings are removed as outlined.

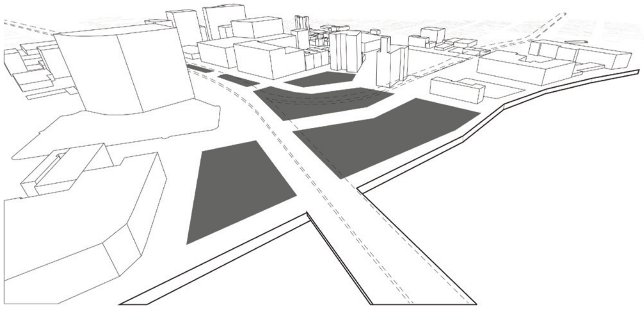


Fig. 9.13. The blocks left to be developed are consolidated.

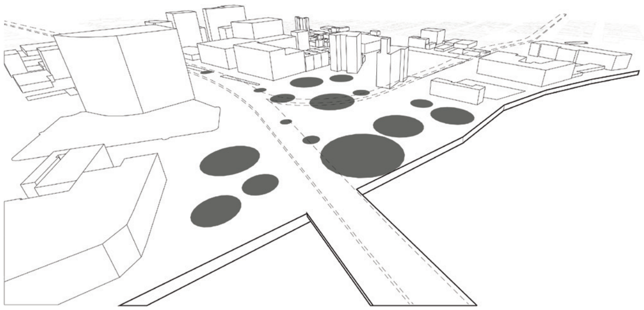


Fig. 9.14. The blocks are broken down into smaller pieces in order to allow access and connections between them, as well as create a more human-scaled environment.

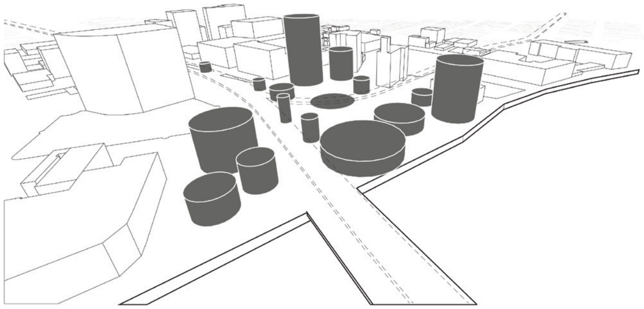


Fig. 9.15. Blocks are extruded and programme stacked in order to acquire necessary area.

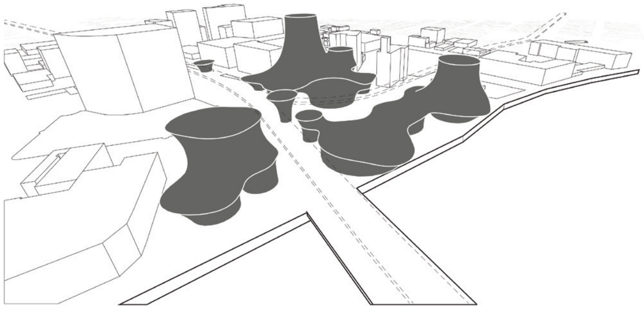


Fig. 9.16. The volumes are blended together and joined at the higher levels in order to connect programme and create a coherent, accessible development.

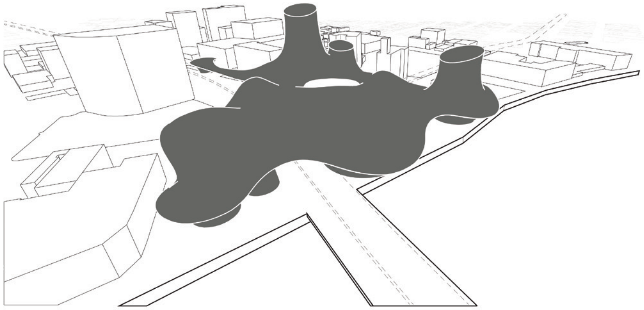


Fig. 9.17. The programme is covered with a photovoltaic skin, as previously discussed.

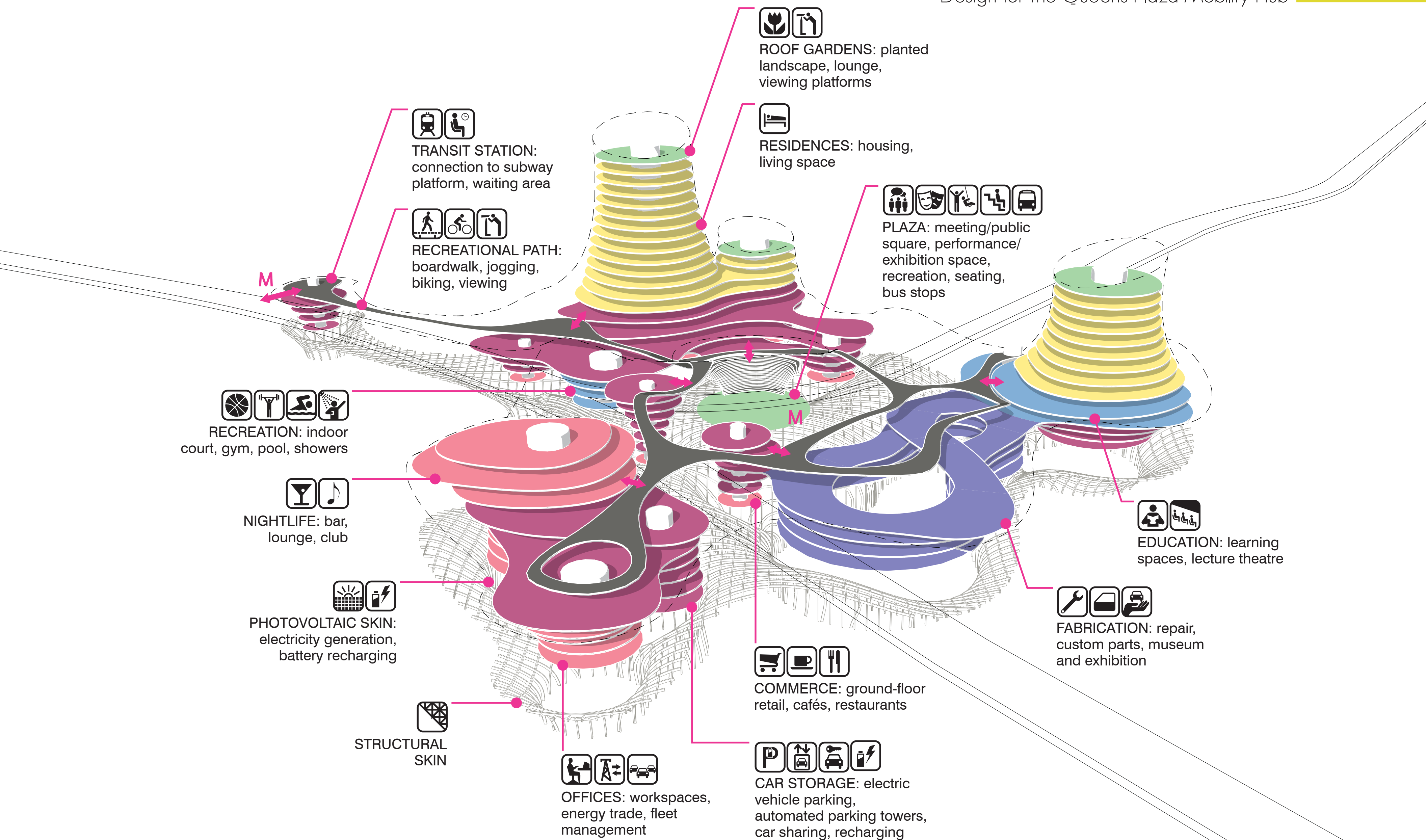


Fig. 9.18. Programmatic relationship diagram.

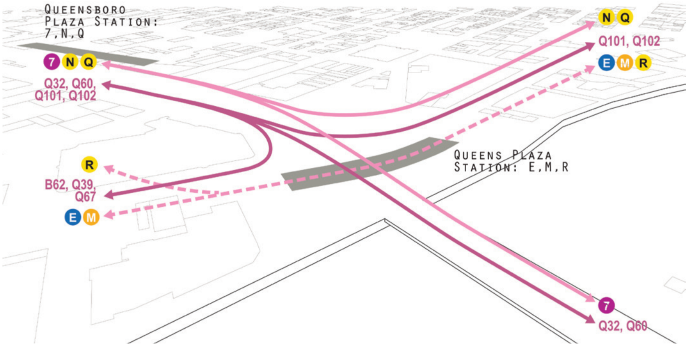


Fig. 9.19. Public transportation flows through the site.
elevated subway — ground bus lines — underground subway

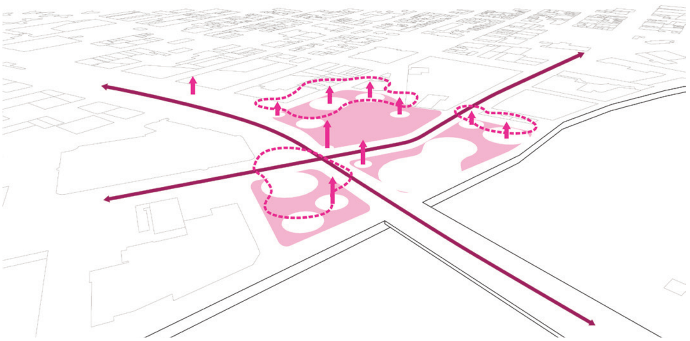


Fig. 9.20. Vehicular flows and areas.
main thru-ways — elevated parking — car-pedestrian shared zone

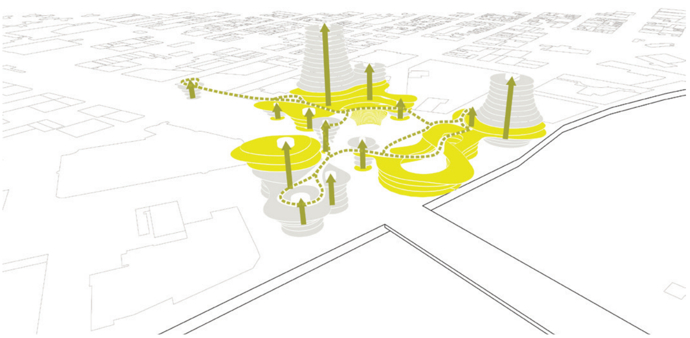
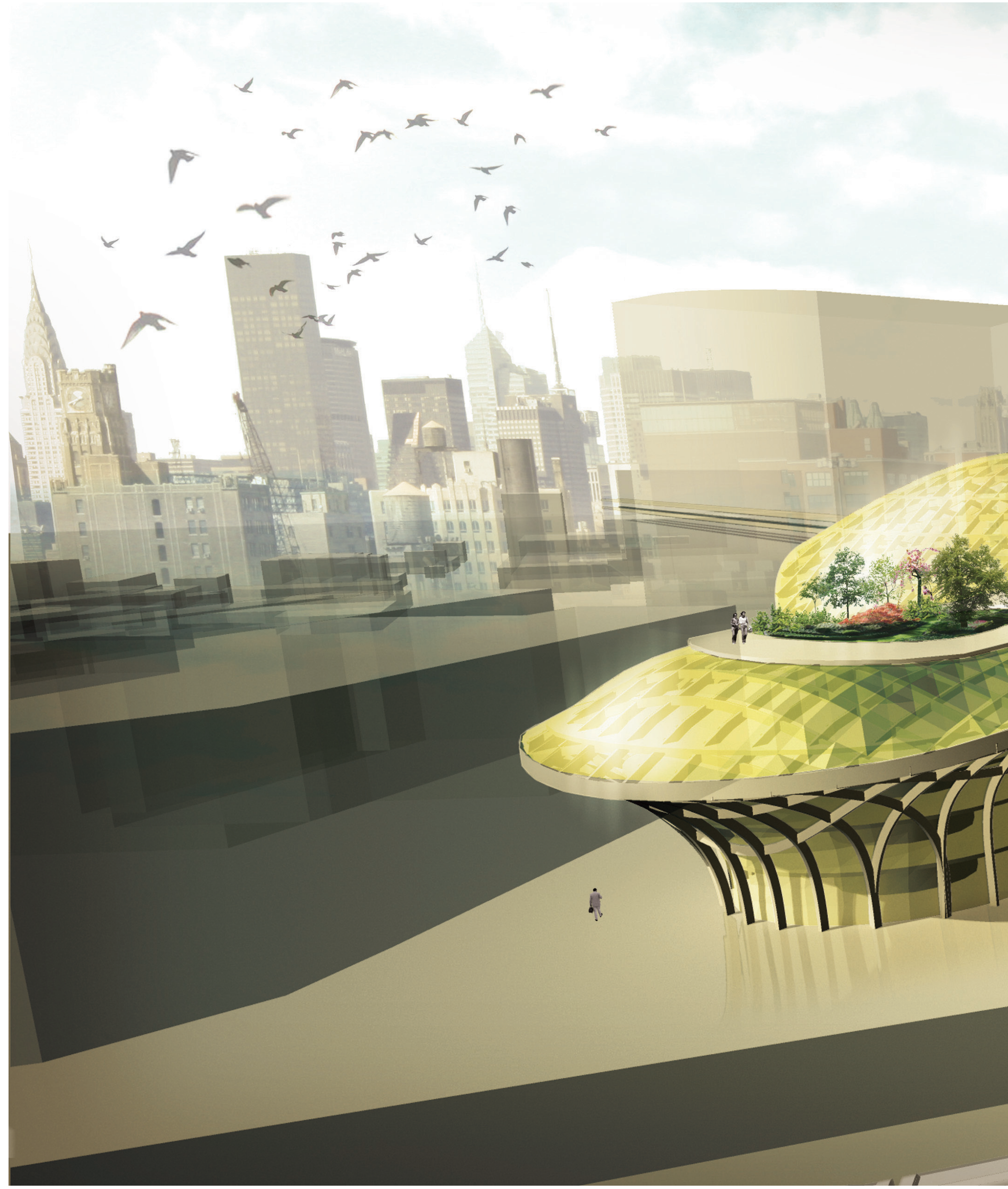
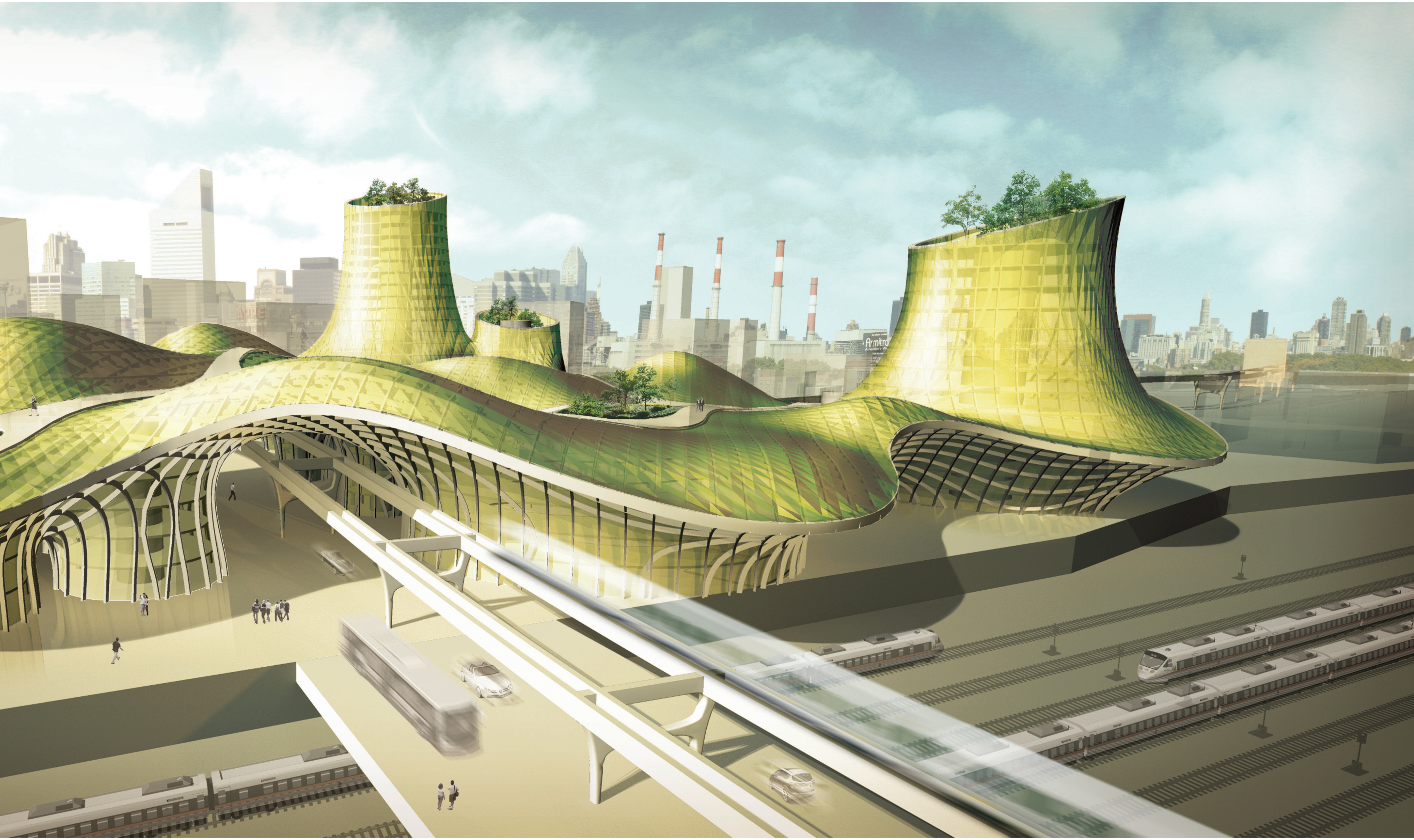
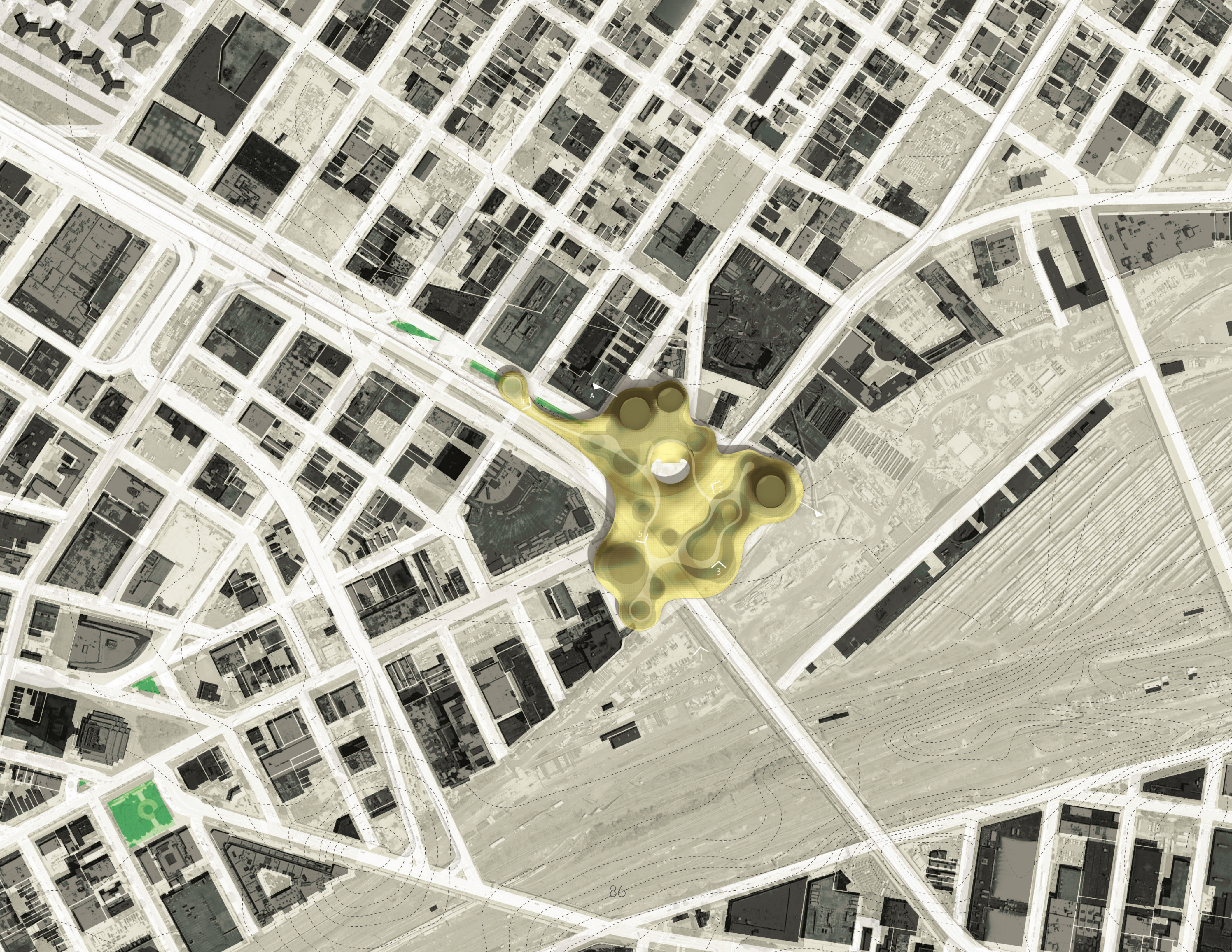


Fig. 9.21. Pedestrian circulation.
pedestrian circulation zone (non-static) — vertical lifts — roof path

Fig. 9.22. (Opposite) View 1: Exterior of the Mobility Hub.






A
5
3
1
86

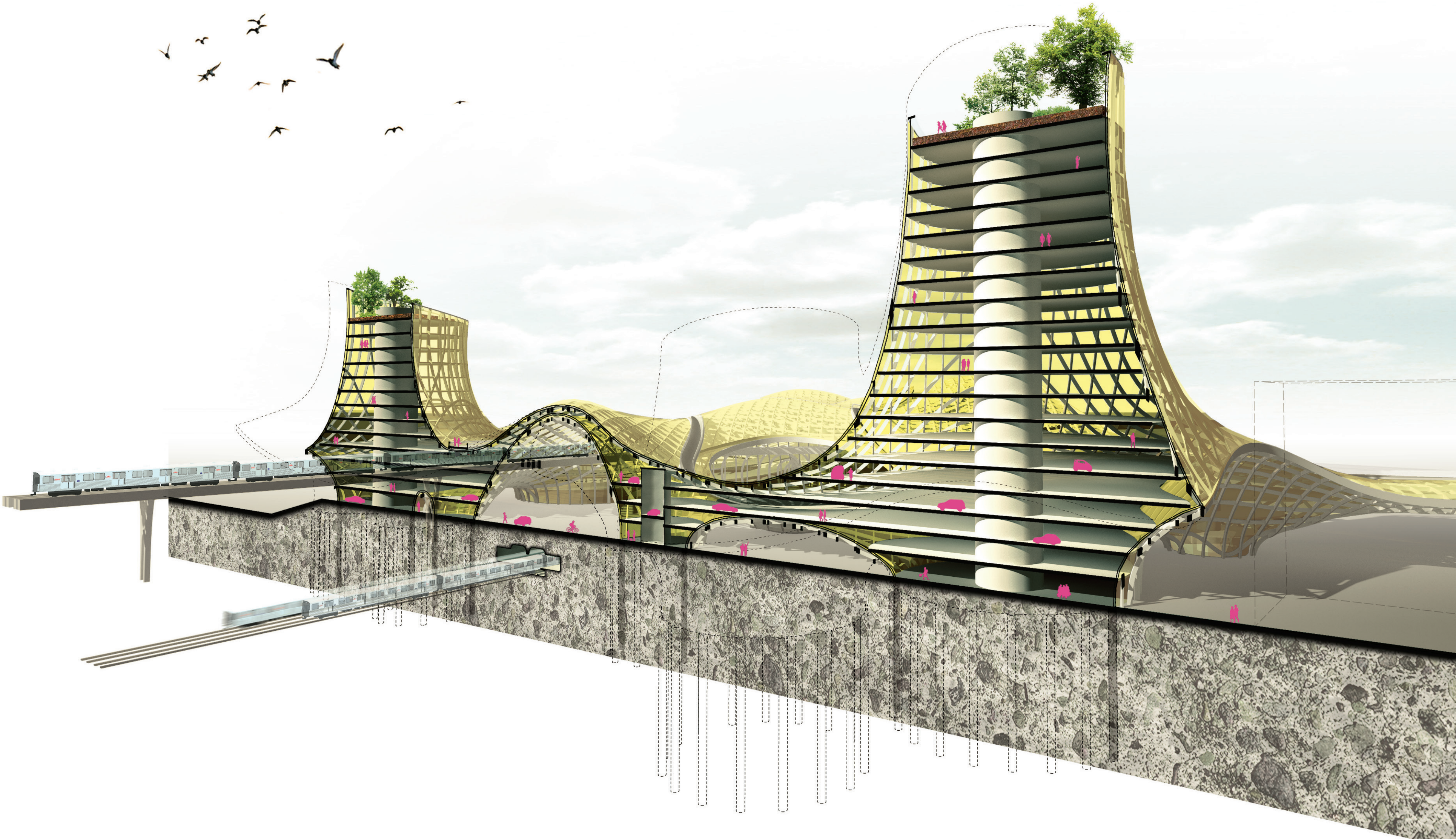


Fig. 9.23. (Opposite) Site Plan.
Fig. 9.24. (Above) Section A-A.

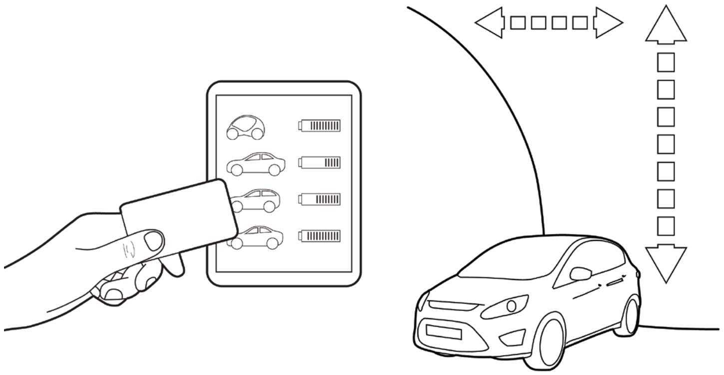
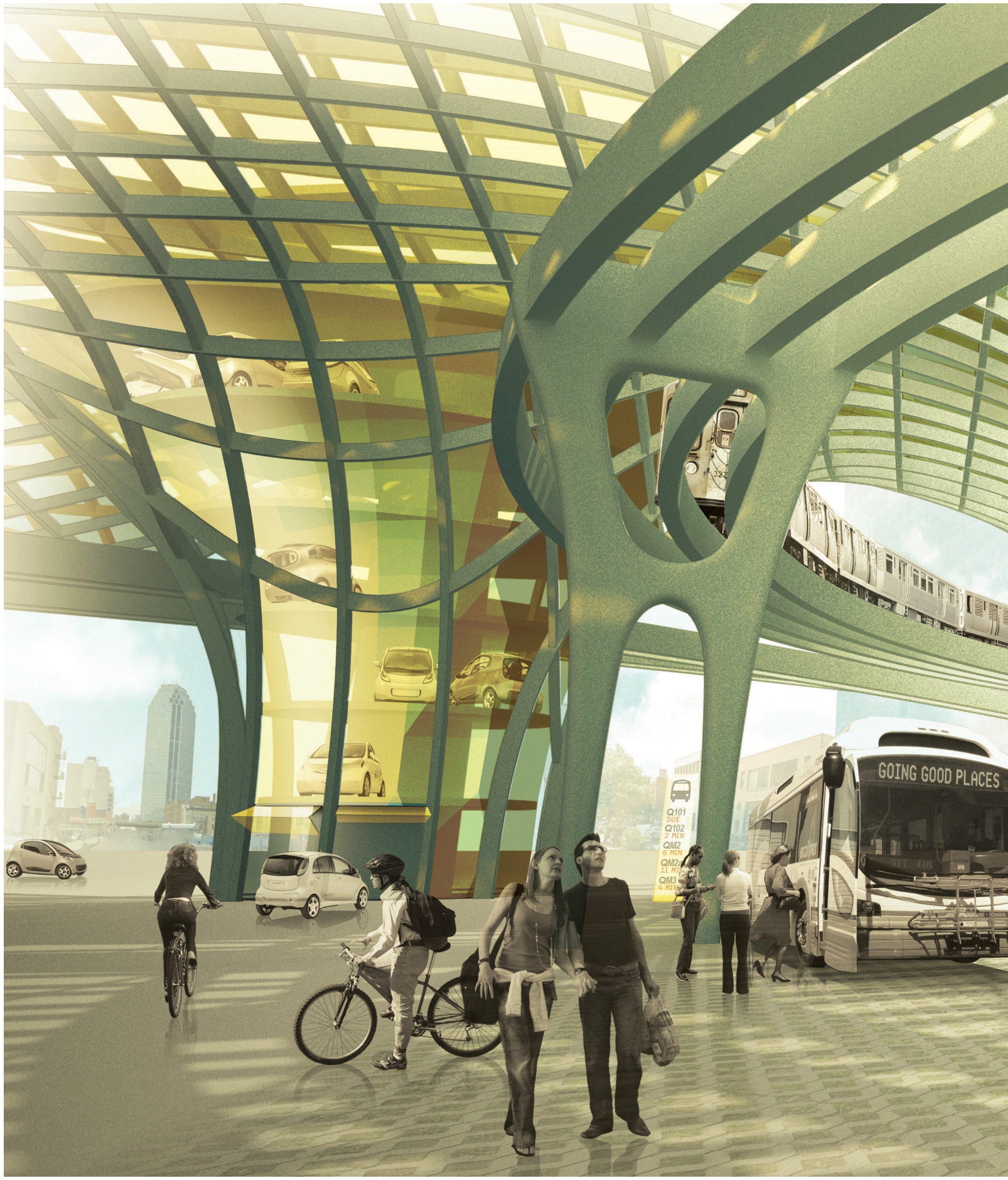


Fig. 9.25. (Opposite) View 2: Main public plaza.
Fig. 9.26. (Above) Car sharing schematic.

The actual site of Queens Plaza becomes the main public space in the project (Fig. 9.25). With thru-traffic simplified, the majority of the ground plane can function as a shared road, where pedestrians are given priority. As discussed earlier on pg. 25, this not only enhances the public experience, but also provides opportunities to use permeable paving, small gardens and vegetation.

The surrounding programme at ground level is occupied by shops, restaurants, and cafés that activate the space. Public events, exhibitions and shows can also be hosted in the plaza. A large staircase sweeps down from the roof and doubles up as seating, while also connects the plaza to the rooftop path and parking floors.

An entrance into the Queens Plaza subway station, bus stops, and access to the car-share vehicles are also featured under the transparent canopy of the PV roof. Plaza patrons can easily switch from one mode of transport to another. Users of the car-sharing system can scan their membership card and choose any of the available vehicles for their trip. They are brought down from the parking towers using automated elevator systems, similar to the ones discussed earlier on pg. 55 (Fig. 9.26).



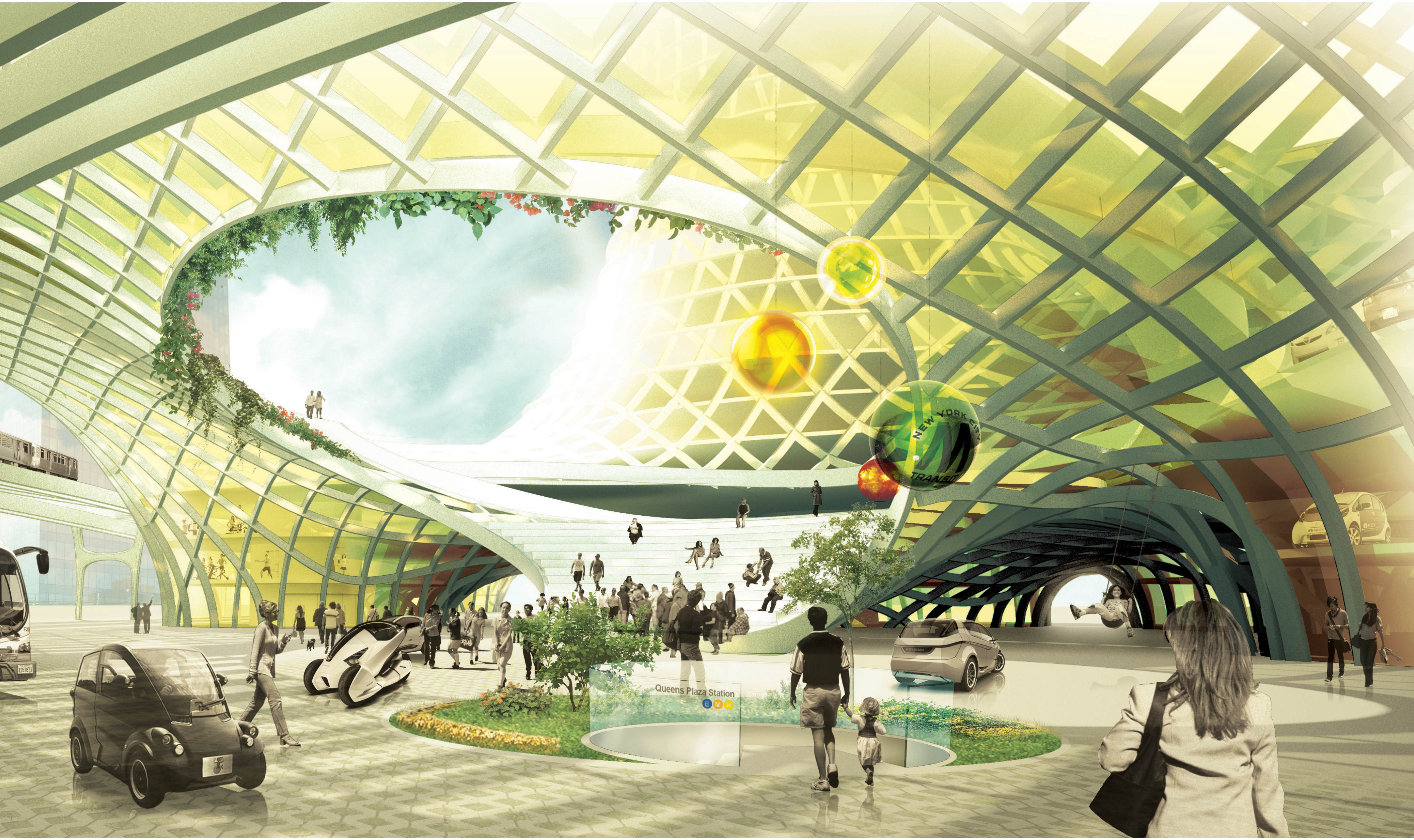
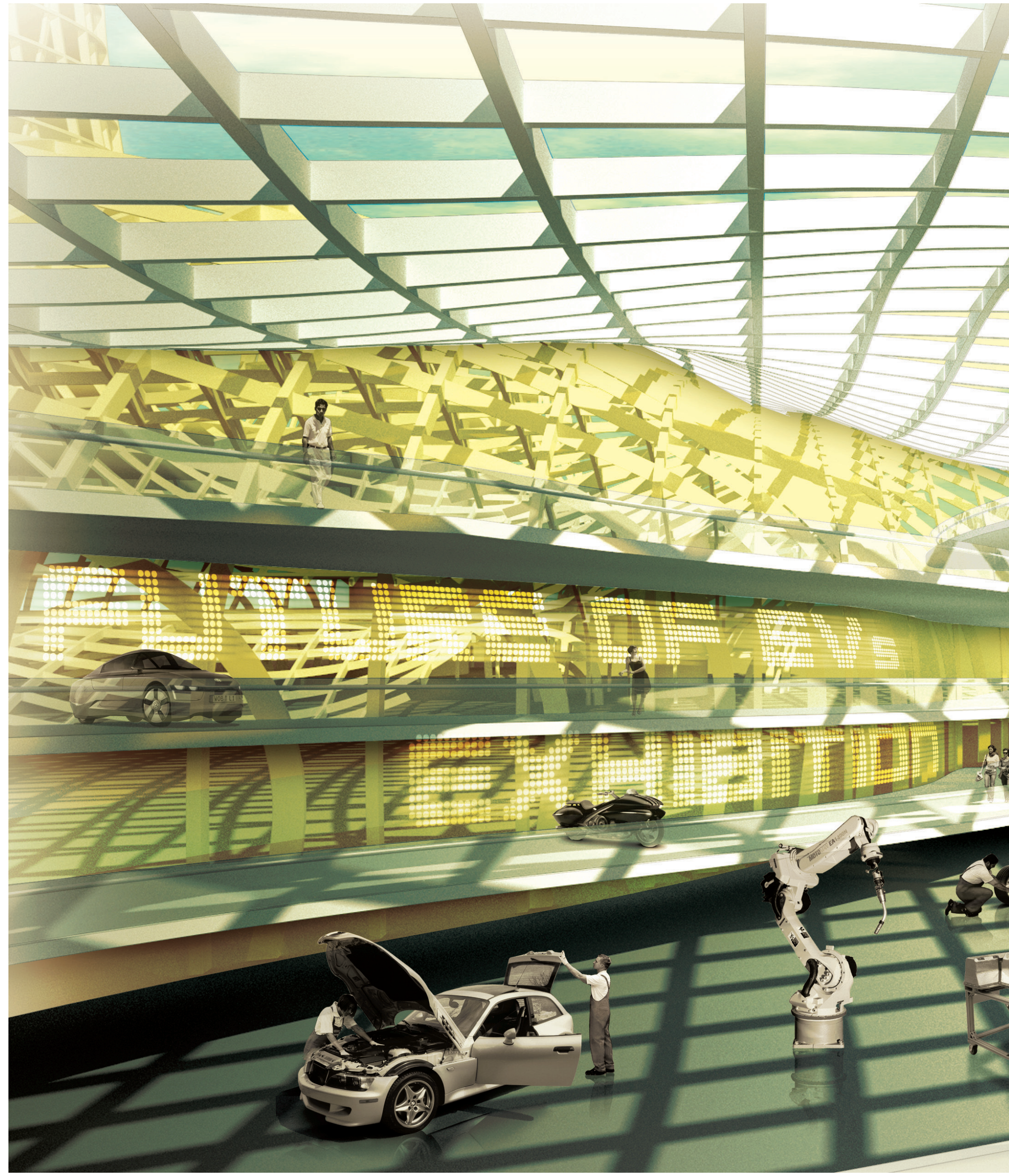

Queens Plaza Station
NEW YORK CITY
TRANSIT

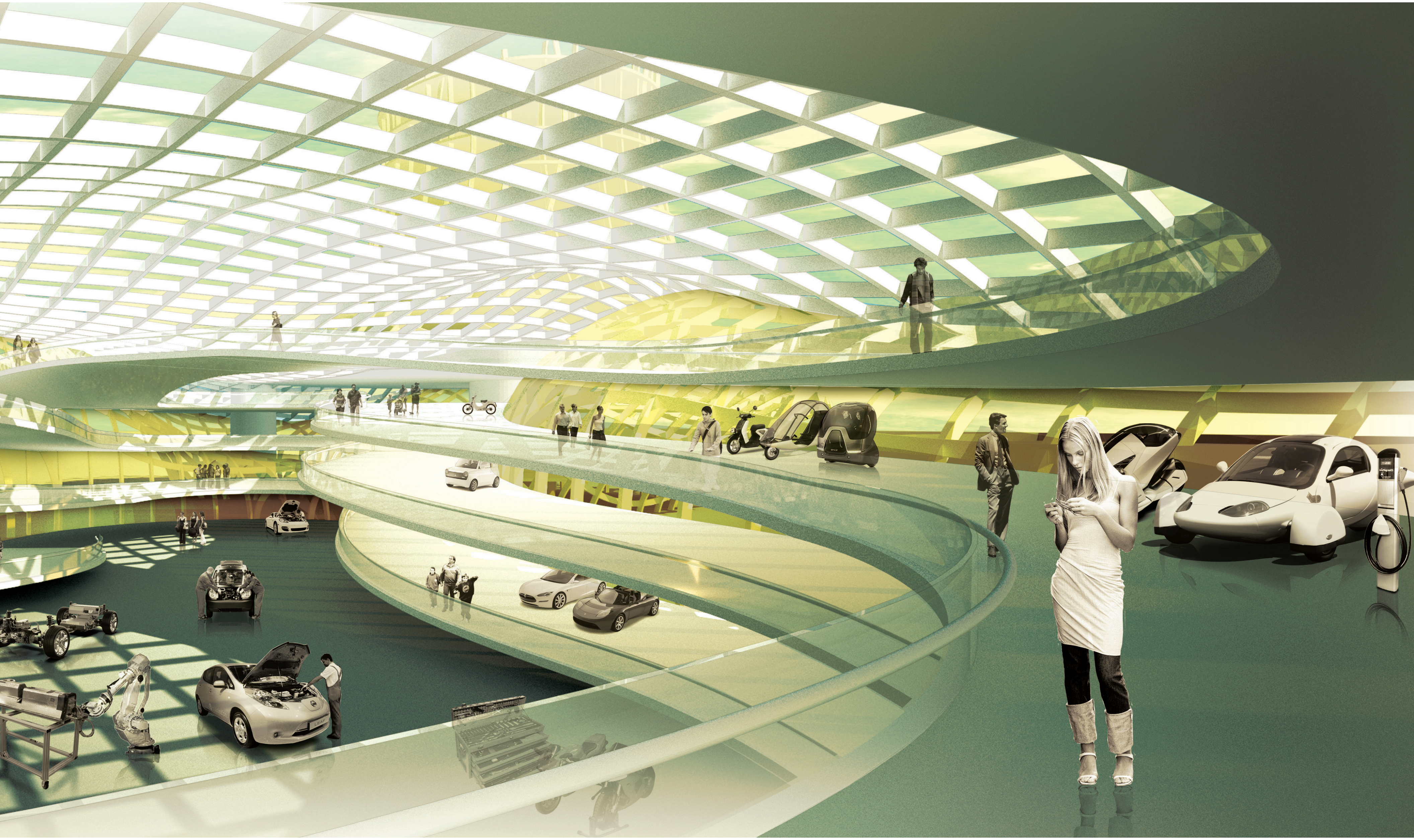
Fig. 9.27. (Opposite) View 3: Interior of the Fabrication/Exhibition Hall.
Fig. 9.28. (Above) Circulation diagram of exhibition platforms.



The Fabrication and Exhibition Hall is dedicated to promoting and advancing Electric Vehicle technology and its widespread adoption by the public (Fig. 9.27). It also serves to educate and raise awareness to mobility issues and sustainable opportunities.

The large open ground floor is conceived as an EV garage. Since the surrounding area is already home to many conventional auto shops and dealerships, the Hall can become an important destination for EV needs, as well as an alternative to the current paradigm. Electric cars have far fewer moving parts than ones relying on internal combustion and, therefore, require far less repair and servicing. This allows efforts to instead be placed on modifications, customizations, and making cars more fun and enjoyable. Coupled with the adjacent education facilities, the Hall can also serve to test and implement new research and technologies.

The ramps spiraling around the Hall provide a continuous exhibition space for these technologies, as well as new or interesting vehicles being developed (Fig. 9.28). By keeping the public interested and involved in the process, EVs have a much better chance of becoming a widespread reality.



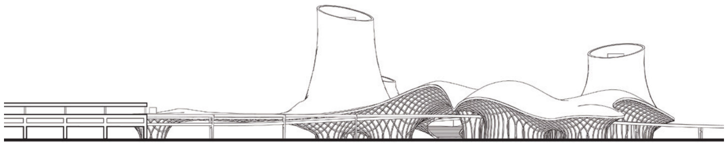
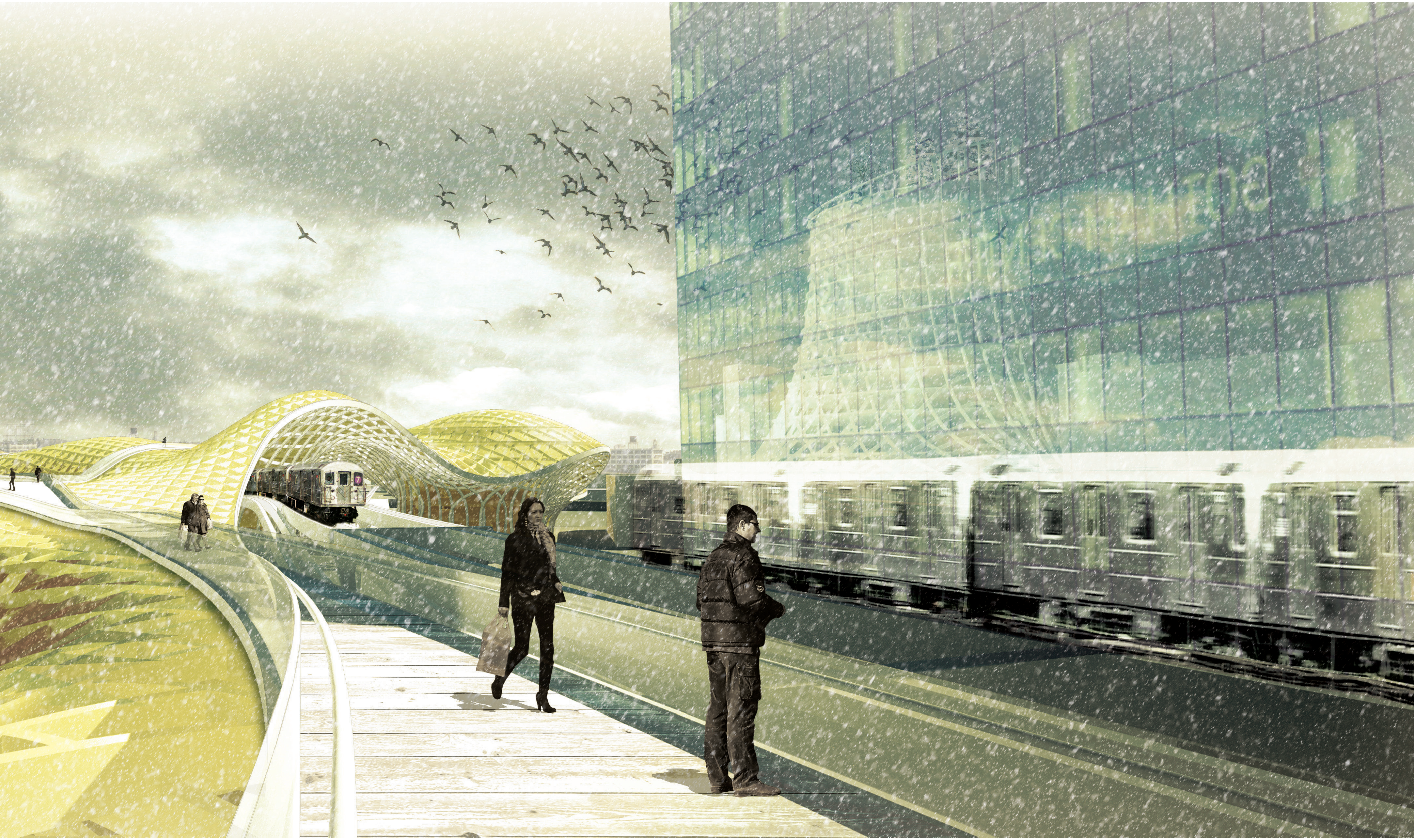


Fig. 9.29. (Opposite) View 4: Subway connection path in winter.
Fig. 9.30. (Above) SW elevation, showing connection to subway platform.

The roof path is integral to connecting all the programme in the Mobility Hub and providing an active recreational space. It also helps link the various modes of transport across the site by providing a clear and seamless connection between them. The path stretches out to Queensboro Plaza elevated subway station, bridging two currently separated stations and consolidating commuter traffic. The access to the subway platform sits on top of a parking tower, which provides visitors with instant access to the Hub's car-sharing inventory (Fig. 9.29 and Fig. 9.30).

The continuous activity of the public transit stations helps bring people to the site all year round. The Hub's canopy is also designed to function year-round. Since the PV panels need only diffused light to function, they can still provide enough electricity in the winter. A small amount of this electricity can also be used to run electric heaters underneath the surface of the panels in order to melt any accumulated snow and minimize performance losses.



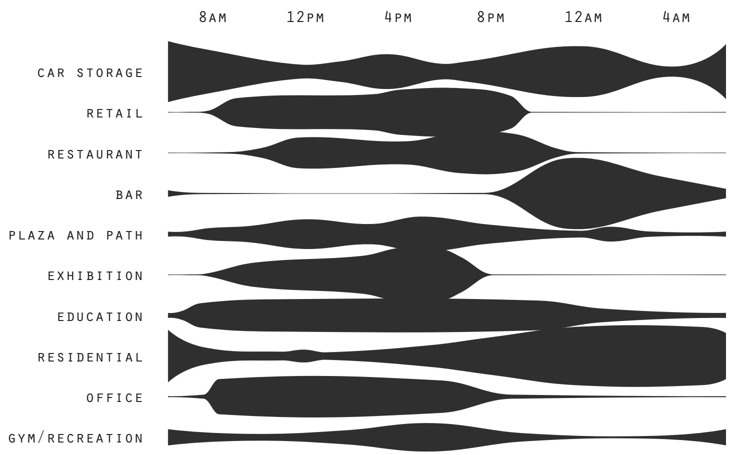


Fig. 9.31. (Opposite) View 5: Recreation path and nightclub.
Fig. 9.32. (Above) 24-hour activity intensity diagram.

Programme elements in the Mobility Hub are organized to run throughout the 24-hour daily cycle and keep the site active (Fig. 9.32). Nightlife is an important part, because it has the potential to attract visitors and residents alike, even after all the shops and cafés close.

The bar is conceived as the prime catalyst to this activity. It is located on top of the offices and away from the residences, so it does not disturb the Hub's inhabitants. However, it is directly connected to the roof gardens and the rest of the development via the path, transforming the roofscape into an active, stimulating place (Fig. 9.31).

The Queens Plaza area is currently known mostly for its lewd establishments, such as the infamous City Scapes strip club. Creating an attractive and exciting new venue could spur a revitalization of the area's nightlife. Taking cues from the success of other similar areas such as Williamsburg, Queens Plaza and its Mobility Hub have the potential to become a true icon in the city, as well as an attractive destination for many individuals.

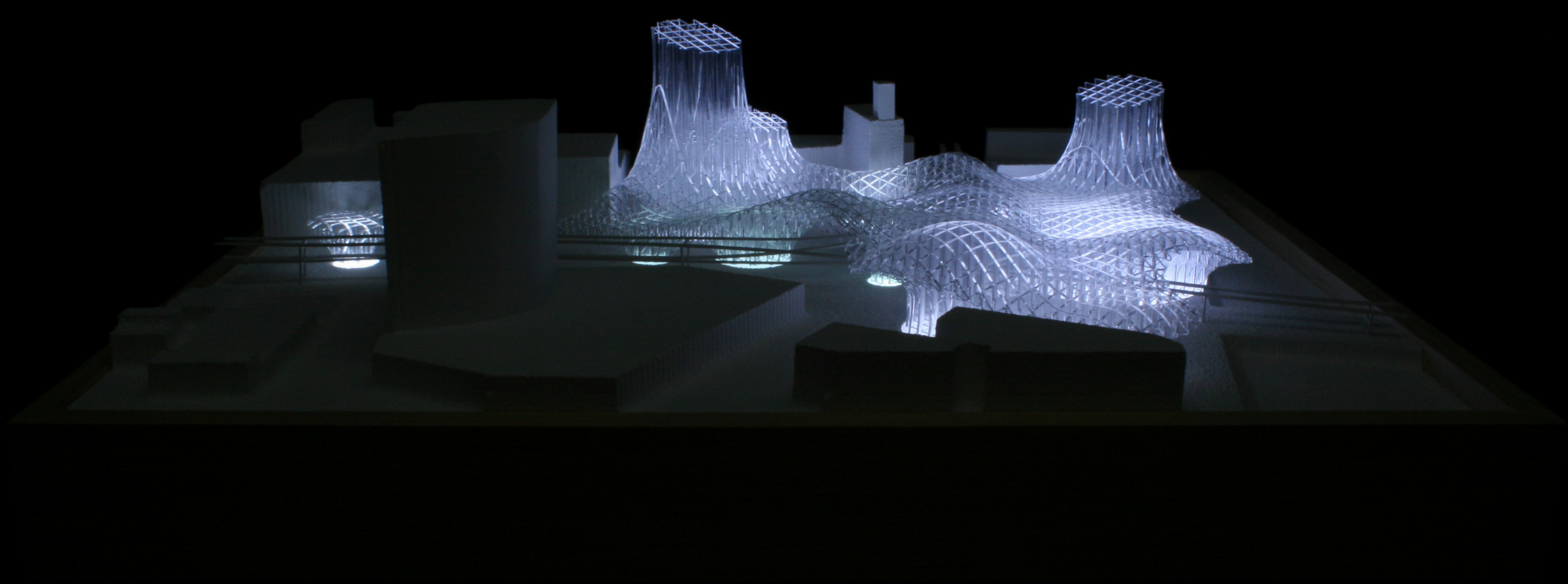


Fig. 9.33. Physical model of the proposal for the Queens Plaza Mobility Hub. Slotted plexiglass sections on painted rigid foam base in wooden frame. LED lighting inside frame. 24" x 30" x 10".

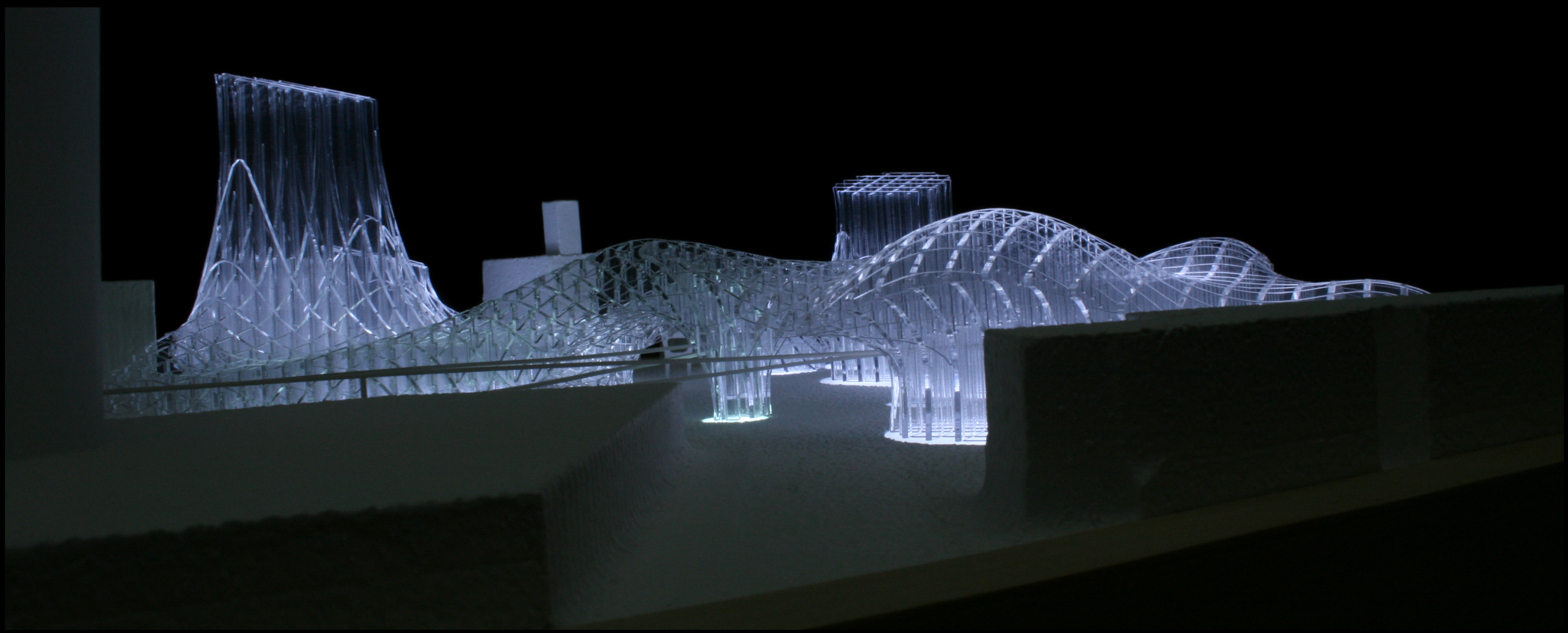


Fig. 9.34. Close-up view facing North-East along Northern Boulevard.

Chapter 10:
Conclusion

This thesis sets out to envision an architectural response to the changing paradigm of urban mobility. Travelling around in North American cities today is drastically different from pre-automobile times. The relatively small, slow-moving, and manageable flow of pedestrian and horse traffic has been replaced by extremely large quantities of fast, dangerous machines, as well as the infrastructure required to keep them moving and organized. This particular development has had a profound effect on cities worldwide, and architecture as whole. The issues of streets, parking lots, garages, and infrastructure have become integral to the development of any city, and thus quite relevant in the professional discourse.

Dealing with cars and finding ways to make cities function with them has been a challenging task for architects for over 100 years. While there have been many different visions and innovations, the developments during the 20th century have been predominantly car-centric. They have profoundly altered the urban, as well as the natural landscape, and their negative effects have become apparent to a point where they can no longer be ignored. Necessitated by urbanization, pollution, unsustainable energy sources, and quality of life issues, an alternative model for dealing with the car in the city is needed today.

As technologies advance and disciplines converge to allow for more sustainable, smart, clean, and integrated cars, the future of mobility seems to be on the verge of another dramatic change. A new paradigm for automobile use and operation holds many opportunities for improving the way we design for cars in the city. The proposal for a Mobility Hub in Long Island City, Queens, New York serves as a case study, responding to this reality and exploring its possible resolution in architecture.

This thesis explored a number of challenges and organized them into the following three parts: mobility, sustainability, and livability. Issues of mobility pertained to the way personal and public transport operate within the city and how they interface with each other and people. Case studies from New York City, continental U.S., and overseas provided a broad understanding about the current attitudes and future plans for urban mobility.

Improving public transit and making it a more viable and attractive option is one of the leading concerns for urban professionals and policy-makers today. The Mobility Hub responded to this concern by integrating two currently separate subway stations, as well as bus stops directly into its architecture. It provided clear, easy connections for

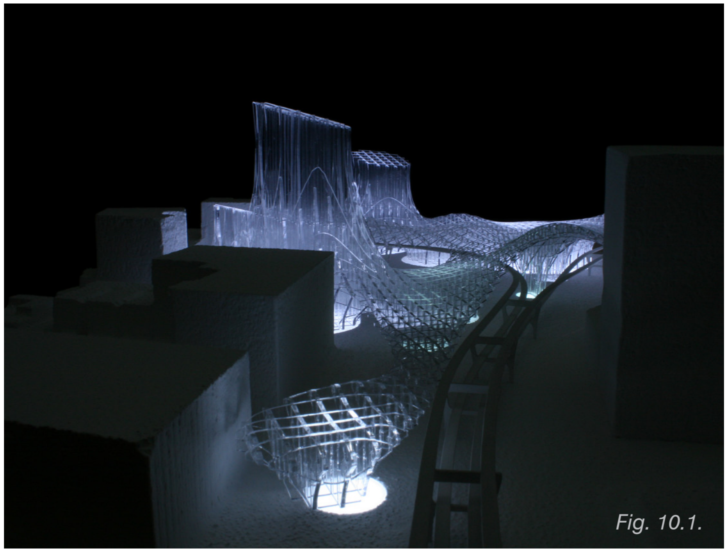


Fig. 10.1.

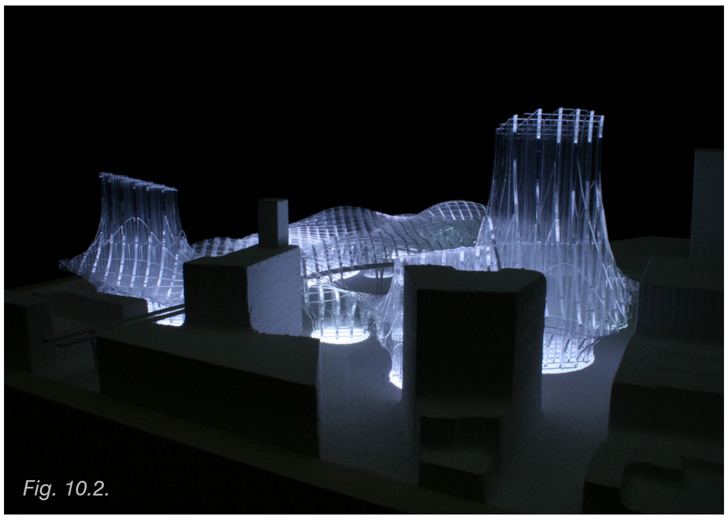


Fig. 10.2.

accessing them. It also included facilities for private transport in the form of car-sharing - an initiative currently receiving a lot of support worldwide, as well as in New York City in particular. By making a car-sharing system possible and easily accessible, the Hub addresses the issue of personal mobility. Most importantly, it illustrates an alternative that does not diminish individual freedom - a fundamental trait of the automobile.

Finally, the Hub deals with issues of the street and streetscapes. It strives to avoid the isolating and impenetrable effect created by wide thoroughfares and messy intersections. The design streamlines traffic flow, utilizes shared streets, prioritizes the pedestrian realm at ground level, and connects programme with various users. These strategies help blur the lines between public and private transport and re-imagine Queens Plaza as a place that is equally inclusive and welcoming to all inhabitants.

Sustainability addressed the issues of powering mobility and establishing a viable model of auto use within the city. As fossil fuel dependence in America is at a level which cannot be supported much longer (due to resource shortages, as well as damaging impacts to the environment), an alternative is needed. The Mobility Hub finds promising opportunities in using electric vehicles (EVs) for its car-sharing system. By being oil-independent, simple, and easily customized, as well as able to use their batteries to introduce a level of energy storage to the electric grid, EVs offer significant advantages over their internal combustion counterparts. EVs themselves can go a long way in improving urban pollution and oil dependence. However, the required electricity must also be generated in a sustainable manner if the issue is to be tackled on a meaningful scale. This component prompted the design for the Mobility Hub to incorporate its own localized electricity generation, using renewable sources and creating a two-way connection with the energy grid. A main feature of the proposal was the photovoltaic roof, which has the capacity to produce all the electricity required to power the cars coming to the Hub. Dedicated offices were another important component to achieving the goal of sustainable mobility. They are meant to manage charging, energy flow, and trade of electricity between the Hub and the grid, as needed.

To further the advancement of energy and EV technology, as well as promote their widespread adoption by the public, education/exhibition facilities are also featured in the design. They are envisioned to transform Queens Plaza into a source/destination for learning, creating, and showcasing new, exciting developments in the world of mobility.

Livability tackled the social challenges inherent in widespread automobile use. With the creation of architecture dedicated to cars, the human experience is often neglected and suffers as a result. The thesis examined various designs and built works from around the world as case studies, to establish primary successful ingredients for an architecture dealing specifically with cars. In addition to strategies responding to the issues of mobility and sustainability already discussed, the human element was strongly considered.

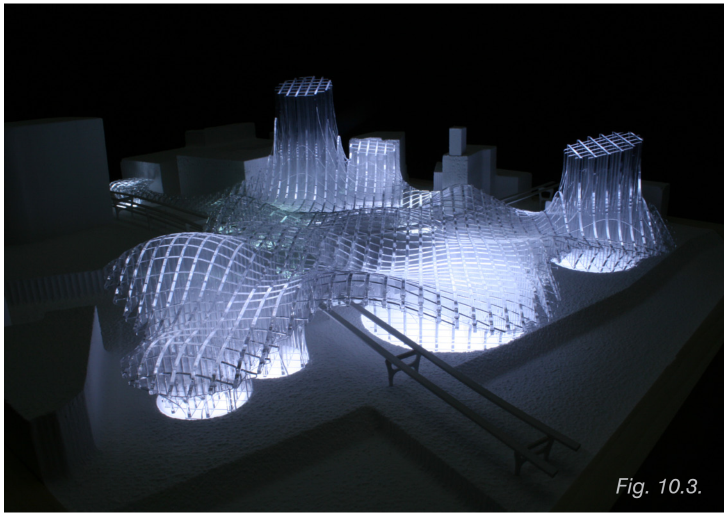


Fig. 10.3.

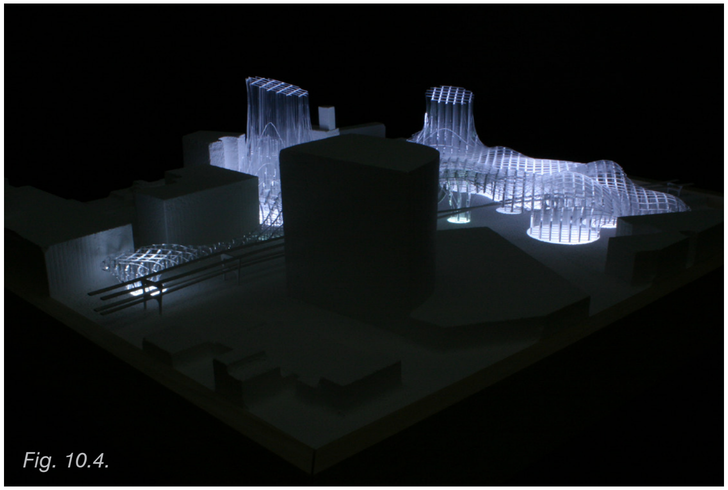


Fig. 10.4.

The Mobility Hub addresses social needs by providing various amenity for residents and visitors alike, and integrating it closely with the car and transit-oriented spaces in the proposal. The design also features a revitalized Queens Plaza, aimed at creating a main public space for the project, as well as the surrounding neighbourhood. Shops, restaurants, entertainment, and connections to transit are all designed to activate the space and create a unique and vibrant new identity for the up-and-coming area.

This site presented the challenge of finding an appropriate architectural language to express the dynamic and vibrant character of the Mobility Hub. To create a pleasant and enjoyable space for the community, the design needed to reflect more than the purely functional elements of a typical parking garage. In so doing, it also strived to avoid unnecessary ornamentation, or mimicry of existing building typologies. The proposal needed to assert itself as a new and forward-looking hybrid development, while embodying the sense of movement, freedom, and possibilities - the primary role of the Mobility Hub. Naturally, a more organic form is developed and adapted to fit within the surrounding context. To avoid a heavy or static aesthetic, an undulating latticework of beams is employed as structure, then covered in tinted glass and transparent photovoltaic panels. The form is manipulated to respond to programmatic and spatial requirements, as well as create a sense of play, intrigue, and dynamism.

Limitations and Future Research

The author would like to acknowledge topics that warrant further investigation, but have been limited due to the scope of this thesis. The first is the development of new technologies. Forecasting the future of automobiles and alternative energy is particularly difficult, because a lot of research worldwide is currently focused on the subject. Consequently, this thesis is based on current technologies and the electric vehicle as the most promising in becoming a widespread market reality. While alternatives do exist, such as hydrogen fuel cells, biofuels, and compressed natural gas, they could not all be explored within this research. However, the need for automobiles and renewable electricity generation is universal, and unlikely to become obsolete anytime soon. Further advancements in battery, photovoltaic, and vehicle technologies are envisioned to only improve and validate the work.

Another challenge that needs to be understood is the gradual nature of transitioning from internal combustion to electric vehicles, as well as from private ownership to car-sharing. A complete shift in the paradigm will take time and different systems will have to co-exist during this period. While the Mobility Hub could still function today, the thesis focuses on its implementation once the transition to EVs and car-sharing is well on its way. It is imagined as a response to, and a way to sustain this emerging reality.

Finally, in order to be fully effective, the Mobility Hub cannot

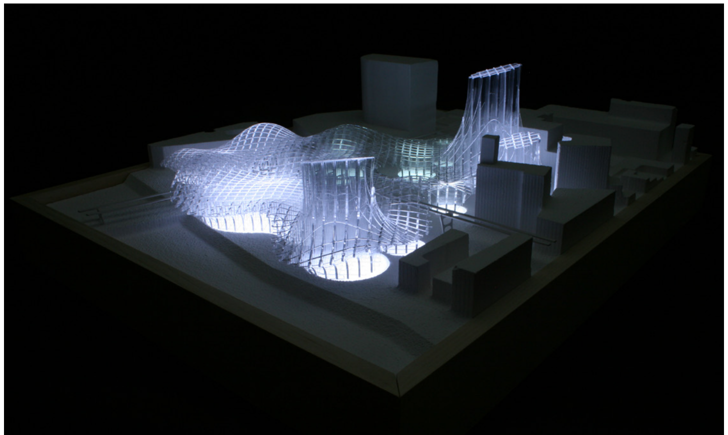


Fig. 10.5.

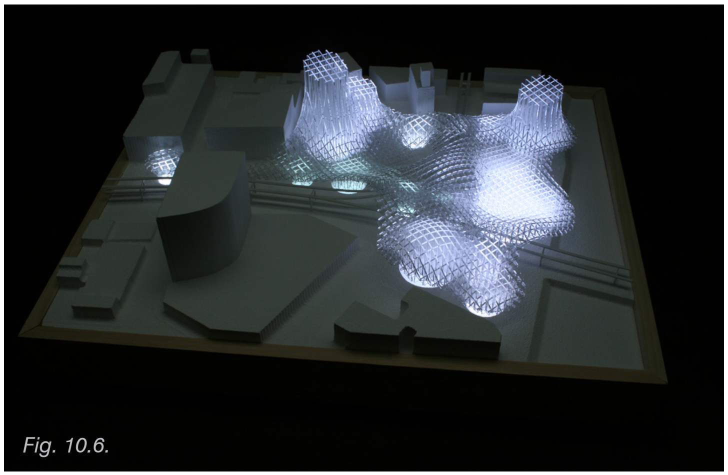


Fig. 10.6.

function on its own. A distributed, networked system of hubs and car-sharing stations is needed for the system to operate. Cars, as well as electricity, must be easily available and shareable in the city if this model of mobility is to become widely adopted as the new paradigm. While the thesis focuses on a single example of a Mobility Hub, the same lessons and strategies can easily be adapted to other sites and cities as well. The project is meant to serve as a case study, rather than a final outcome. As such, it has the potential to become a model for future development and an important step towards reconciling the car and the city.

Transit hubs such as this are a viable solution to the current issues of mobility, despite the challenges outlined above. However, to be successful, they must address the three major elements discussed throughout the thesis: mobility, sustainability, and livability. A strong integrations of public/private transport and pedestrians is essential to creating a vibrant and accessible place, thus diminishing the need for vehicle ownership and extensive driving. Incorporating clean, local, and renewable means of powering transit is another key component, significantly reducing the environmental impact of automobiles and fostering a sustainable approach to mobility as a whole. Lastly, developments such as these must have enough to offer their residents and visitors alike. They must create pleasant, enjoyable, and entertaining places that play an important role in the urban fabric, becoming more than simply a confluence of transport modes and energy.

Combining these ideas can be a challenging task for architects, but one that is increasingly needed in today's growing cities. As an object that has profoundly transformed our built environment in the past, the car holds immense potential for the future of urbanity. With new/converging technologies and disciplines, architects are presented with the unique opportunity to re-imagine the role of the car (and mobility as a whole) in the city. By approaching this challenge responsibly and implementing the concepts outlined above, design professionals can significantly improve the quality of our urban experience. Spaces for cars could also become spaces for people, activities, and entertainment. They could be vibrant, accessible, and truly integrated into the fabric of the city, without contributing to pollution, congestion, or personal injury. By proposing a way to envision such development, this thesis ultimately argues for a productive, yet social architecture for dealing with urban mobility.

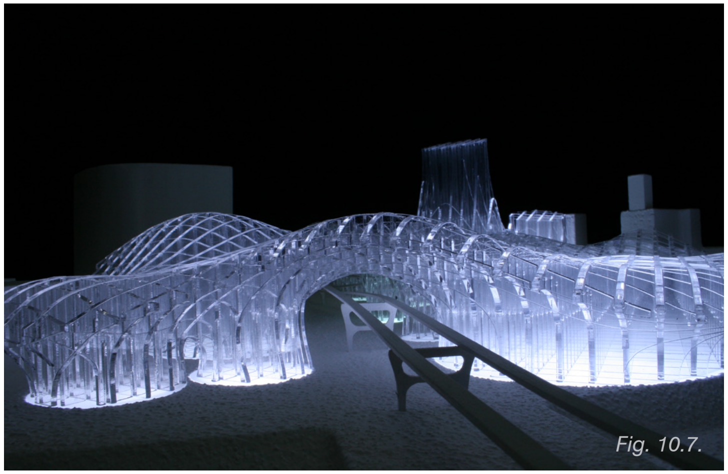
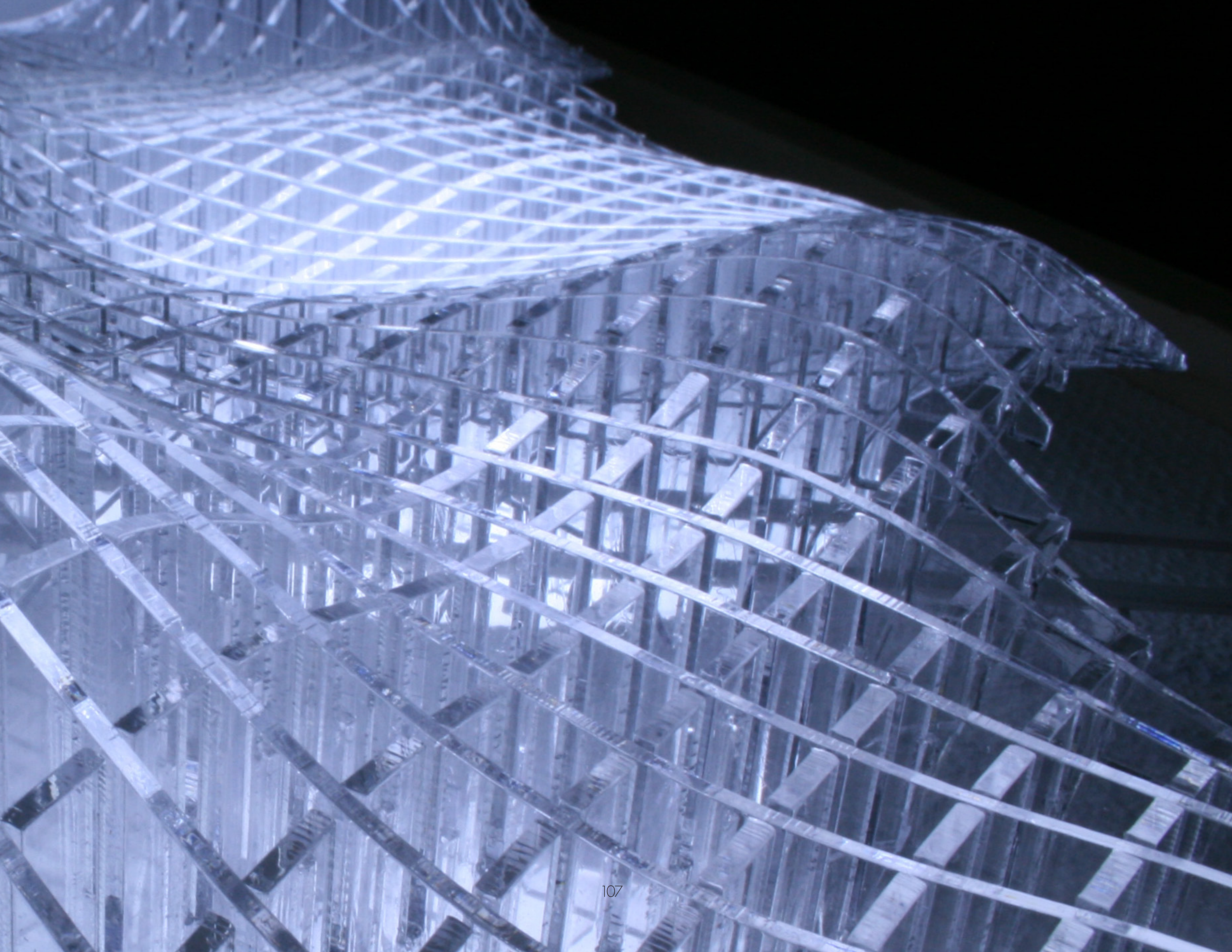


Fig. 10.7.

Fig. 10.8.



Bibliography

Ballon, Hilary. Jackson, Kenneth. *Robert Moses and the Modern City: The Transformation of New York.* New York: W. W. Norton & Company Ltd. (2007).

Bell, Jonathan. *Carchitecture: When the Car and the City Collide.* London: August Media. (2001).

Corbusier. *The Radiant City*. New York: The Orion Press. (1967).

Crawford, J.H. *Carfree Cities.* Utrecht: International Books. (2000).

Daniels, Klaus. Trans. Ralph Hammann. *Energy Design for Tomorrow.* London: Edition Axel Menges. (2009).

Heinberg, Richard. *Powerdown: Options and Actions for a Post-Carbon World*. Canada: Friesens Inc. (2004).

Henley, Simon. *The Architecture of Parking.* New York: Thames & Hudson Inc. (2007).

Jennings, Jan. *Roadside America: The Automobile in Design and Culture*. Iowa: Iowa State University Press. (1990).

Joachim, Mitchell. *Ecotransology: Integrated Design for Urban Mobility.* Massachusetts Institute of Technology. (2006).

Johnson, Elmer. *Avoiding the Collision of Cities and Cars: Urban Transportation Policy for the Twenty-First Century.* Bulletin of the American Academy of Arts and Sciences, 47. 2, 5-11. Cambridge: American Academy of Arts & Sciences. (1993).

Kay, Jane Holtz. *Asphalt Nation: How The Automobile Took Over America, And How We Can Take It Back*. Los Angeles: University of California Press. (1997).

Klose, Dietrich. *Metropolitan Parking Structures: A Survey of Architectural Problems and Solutions*. New York: Frederick A. Praeger, Inc. (1965).

Kunstler, James Howard. *The Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape*. New York: Simon & Schuster. (1993).

Margolius, Ivan. *Automobiles by Architects*. Chichester: John Wiley & Sons Ltd. (2000).

Meyhöfer, Dirk. *Motortecture*. Ludwigsburg: Avedition GmbH. (2003).

McShane, Clay. *Down The Asphalt Path: The Automobile and the American City*. New York: Columbia University Press. (1994).

Mitchell, William. Borroni-Bird, Christopher. Burns, Lawrence. *Reinventing The Automobile: Personal Urban Mobility for the 21st Century.* Cambridge: The MIT Press. (2010).

Parker, Dave. *Microgeneration: Low Energy Strategies for Larger Buildings.* Oxford: The Architectural Press. (2009).

Richards, Brian. *Future Transport in Cities.* New York: Spon Press. (2001).

Safdie, Moshe. Kohn, Wendy. *The City After The Automobile: An Architect's Vision.* Boulder, Colorado: Westview Press. (1997).

Sheller, Mimi. Urry, John. *The City and the Car.* International Journal of Urban and Regional Research, 24.4, 737-757. Malden, MA: Blackwell Publishers. (2000).

Silk, Gerald. *Automobile and Culture*. New York: Harry N. Abrams, Inc. (1984).

Solomon, Jonathan. *13 Projects for the Sheridan Expressway: aka. Jump, Slump, Hump, Bump – Guide Specifications for a Post-Fordist Infrastructure.* New York: Princeton Architectural Press. (2004).

Sorkin, Michael. *Exquisite Corpse, Writing on Buildings*. New York: Verso. (1991).

Sperling, Daniel. Gordon, Deborah. *Two Billion Cars: Driving Toward Sustainability.* New York: Oxford. (2009).

Stubbs, Michael. *Car Parking and Residential Development: Sustainability, Design and Planning Policy, and Public Perceptions of Parking Provision*. Journal of Urban Design, 7.2, 213-237. (2002).

Wollen, Peter. Kerr, Joe. *Autopia: Cars and Culture*. London: Reaktion Books. (2002).

Electronic References:

National Renewable Energy Laboratory. *Power Technologies Energy Data Book.* <http://www.osti.gov/bridge> (2006).

New York City Department of Transportation. *Street Design Manual.* <http://www.nyc.gov/streetdesignmanual> (2009).

New York City Department of Transportation. *Sustainable Streets Index.* <http://www.nyc.gov/html/dot/html/about/ssi.shtml> (2009).

The City Of New York. *PlaNYC: A Greener, Greater New York*. <http://www.nyc.gov/html/planyc2030/html/downloads/download.shtml> (2010).

The City Of New York. *PlaNYC: Exploring Electric Vehicle Adoption In New York City*. <http://www.nyc.gov/html/planyc2030/html/downloads/download.shtml> (2010).

United States Department of Energy. *Transportation Energy Data Book: Edition 29*. <http://cta.ornl.gov/data> (2010).

United States Department of Transportation. *National Transportation Statistics*. <http://www.bts.gov/publications/national_transportation_statistics> (2008).

United States Energy Information Administration. *Annual Energy Outlook 2010, With Projections to 2035*. <http://www.eia.doe.gov/oiaf/aeo> (2010).

Film:

Greene, Gregory. (Director). *The End of Suburbia: Oil Depletion and the Collapse of the American Dream.* [DVD]. Canada: The Electric Wallpaper Company. (2004).

Paine, Chris. (Director). *Who Killed the Electric Car?* [Motion Picture]. USA: Sony Pictures Classics. (2006).

Temple, Julien (Director). *Requiem For Detroit*. [Television Programme]. UK: British Broadcasting Corporation. (2010).

Woolf, Aaron (Director). *Blueprint America: Beyond the Motor City.* [Television Programme]. USA: Public Broadcasting Service. (2010).