

RESILIENT TRANSPORTATION

CASE STUDIES REPORT

JUNE 29, 2019

100 RESILIENT CITIES COLUMBIA

Center for
Resilient Cities
and Landscapes

RESILIENT THE HAGUE

CENTER FOR RESILIENT CITIES AND LANDSCAPES

The Center for Resilient Cities and Landscapes (CRCL) uses planning and design to help communities and ecosystems adapt to the pressures of urbanization, inequality, and climate uncertainty. CRCL works with public, nonprofit, and academic partners to deliver practical and forward-thinking technical assistance that advances project implementation through interdisciplinary research, visualization of risk, project design scenarios, and facilitated convenings. CRCL integrates resilience thinking into design education and academic programming, bringing real-world challenges into the classroom to train future design leaders.

Established in 2018 at Columbia University's Graduate School for Architecture, Planning and Preservation (GSAPP) with a grant from The Rockefeller Foundation, CRCL extends Columbia's leadership in climate-related work and supports the interdisciplinary collaborations and external partnerships needed to engage the most serious and challenging issues of our time. CRCL is allied with the Earth Institute's Climate Adaptation Initiative and works across disciplines at Columbia by bridging design with science and policy to improve the adaptive capacity of people and places.

100 RESILIENT CITIES

100 Resilient Cities - Pioneered by The Rockefeller Foundation (100RC) is dedicated to helping cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century.

100RC supports the adoption and incorporation of a view of resilience that includes not just the shocks, such as earthquakes, fires, floods, but also the stresses that weaken the fabric of a city on a day-to-day or cyclical basis.

Cover Image: *Futurama*, by General Motors, from the 1939 World's Fair

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AN INTRODUCTION

How we plan infrastructure today is a matter of life and death for the planet. It can create and strengthen structural inequality in our societies, destroy ecosystems, reinforce fossil-fuel dependent patterns of human settlement, and degrade trust between citizens and the governments that serve them. A better model for planning infrastructure will strengthen trust between citizens and government, protect ecologies and the global climate system, seek to be systematically inclusive, reverse structural inequalities, and work toward a just transition to a post fossil-fuel economy.

A MATTER OF LIFE AND DEATH FOR THE PLANET

In the fall of 2018, the Intergovernmental Panel on Climate Change stated that limiting global warming to 1.5°C above pre-industrial levels “would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems ... These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors.” Meanwhile, as the global population continues to grow, governments around the world are attempting to meet their citizens’ social and economic needs through urban expansion, facilitated by infrastructural development. Left unchecked, the relationship between global urbanization and climate change could be disastrous. Urban areas today account for 80% of GHG emissions, and they will continue to drive of global warming in decades to come. Furthermore, as urban settlements expand, so do urban demands on the agricultural areas and extraction sites that support them, leading to further degradation of critical ecosystems, ecological services, and the world’s remaining carbon stores in oceans, forests and wetlands. To make things worse, poorly planned urban growth can also increase human vulnerability to the cataclysmic events and creeping pressures that often characterize climate change.

CREATES AND STRENGTHENS STRUCTURAL INEQUALITY

Transportation infrastructure has always been a device for the extension of power over territory. Today, governments continue to manage the transformation of once wild areas into urban space through highways, roads, and rails. While infrastructure projects vary in their stated goals, they are generally instrumentalized to expand economic markets, often to the detriment of existing communities. “To build his highways, [Robert] Moses threw out of their homes 250,000 persons,” wrote Robert Caro. “... He tore out the hearts of a score of neighborhoods.” Nevertheless, there are more recent examples of infrastructure projects that are deployed to fill a present or future gap in service for an underserved population. “They didn’t grow up as Medellín citizens,” said Luis Perez, former mayor of Medellín, reflecting on the benefits that the Metrocable brought to marginalized communities. “This little device integrates them ... It brought economic dynamism and people feel proud.” Nevertheless, because infrastructure projects are themselves complicated to plan and expensive to build, they are generally considered first and foremost as agents of economic development. While proponents may tout a project’s environmental or social goals, these are often, at best, secondary to economic drivers. It is never far from the public’s mind that these public investments create windfalls for landowners.

Infrastructure projects are increasingly financed through value capture, thereby tightening the loop between public expenditure and private profit. Absent strong public leadership, this paradigm can limit investment to projects likely to yield a monetary return. A recent extension of the No. 7 train in New York City, for example, which cost an astonishing \$1.5B per mile of construction, was enabled by value capture financing associated with the economic expansion of Hudson Yards. By comparison, a sorely needed rail tunnel under the Hudson River—which would supplement the single, ailing, century-old regional connection between Manhattan and mainland America—was cancelled after two decades of planning when Governor Chris Christie made a unilateral decision that the project “did not make financial sense.”

Nations have always built ports, roads, and rails to expand markets, but no effort so far compares to China’s Belt and Road initiative which will extend to 2/3rd of the world’s population and cost up to \$1.7 trillion by 2027. So far the projects in this initiative have created many burdens for participating countries. In Kenya, for example, as in countries throughout Africa and Asia, a new inter-city rail line is being engineered, built and operated by Chinese companies and banks. The line, which will link Nairobi to Mombasa Port, has severely indebted the Kenyan government and jeopardized its long-term control of the train and port infrastructures alike.

DEGRADES TRUST BETWEEN CITIZENS AND GOVERNMENTS

Public participation in the planning of infrastructure, when it exists at all, is usually limited to narrowly defined environmental impact reviews. When public participation is limited, and public interest unrepresented in the planning process, infrastructure projects risk becoming flashpoints of civil unrest. In Amsterdam, for example, the North-South subway line was initially planned as part of an urban renewal project that was at odds with public values, leading to a decades-long sequence of riots and protests, project hiatuses, and degradation of public trust in the planning process. In Kenya, the Standard Gauge Railway project has been stalled by lawsuits from environmental activists, who fear that the project will irrevocably damage a national park and wildlife refuge that the route bisects. Infrastructure planning is also slow and complex, often incapable of keeping pace with changes in a project's environmental, social and political context. Nevertheless, the political capital gained from implementing a new project can be irresistible to political leaders. Few votes are garnered from diligent system maintenance. In the case of Mexico City, for example, the Metrobus BRT project was expedited by an endorsement from Head of City Andrés Manuel López Obrador, who saw an opportunity to boost his presidential bid. Once built, poor infrastructure maintenance has led to countless avoidable disasters, from the Johnstown Flood to the recent highway collapse in Naples, in which the poor and vulnerable always suffer the most. "When governments address an infrastructure need, their default response tends to be building a new project," states McKinsey Global Institute, "but the cheapest, least intrusive infrastructure is that which does not have to be built."

DESTROYS ECOSYSTEMS

Transportation infrastructure can have severe direct consequences on local and regional ecological systems. Roads and rail line constructions are, in themselves, major ecological disturbances, usually associated with proliferating invasive species, fragmenting habitat, obstructing wildlife migrations, and other consequences. Automotive transport in particular can bring

air and water pollution. Even the light and noise pollution from transportation projects can have an effect on local ecologies. New transportation infrastructure often comes with associated environmental engineering projects that can disturb local hydrological systems, topography and geology. And the extension of roads always precipitates whole-cloth land use change: from forests to farms and farms to suburbs.

REINFORCES FOSSIL-FUEL DEPENDENCIES

At a global scale, the most consequential impact of transportation infrastructure is the enabling of patterns of land use and energy consumption that, once initiated, will last for generations. Transportation infrastructure is also inextricably tied to the exploitation of natural resources. Freight rail in Canada, for example, is increasingly used to transport oil from drilling sites to coastal ports, enabling increased oil production. Transportation infrastructure has, for over a century, opened landscapes to tourism and settlement. At the turn of the 20th century, the Great Northern Railway promoted settlement throughout the USA's northern plains by buying land from the federal government along its corridor and selling it directly to settlers from Europe and the US. It lobbied heavily for the establishment of Glacier National Park along its right of way in Montana, much of which was formerly Blackfoot Indian territory, where it would build easily accessible resort hotels. In Alaska, the Alaska Railroad carries passengers from Anchorage and Fairbanks to Denali National Park; it also carries oil and, since 2016, liquified natural gas to port.

A BETTER MODEL FOR PLANNING INFRASTRUCTURE

New paradigms for urbanization are urgently needed to meet the challenges of climate change. Such paradigms will rely on effective transportation infrastructure, enabled by effective planning processes. Spatial planners and designers must reconsider the relationship between infrastructure, human settlement, ecosystems and climate, and analyze how and why past projects, and the processes that underlie them, have succeeded or failed to address the issues outlined above.

Emissions from the transport sector alone accounted for approximately 14% of total global greenhouse gas emissions in 2010, amounting to about 7B metric tons annually (adjusted for CO₂ equivalences), or roughly triple the amount of carbon offset by the world's forests. Emissions from the transport sector are also rising. The IPCC estimates that "transport emissions could increase at a faster rate than emissions from the other energy end-use sectors and reach around 12 Gt CO₂eq / yr by 2050." But just as transportation infrastructure has been instrumentalized to affect economic development well-beyond the transport sector, so too can it affect cross-sectoral environmental and social change. Transportation drives development, facilitates urban expansion, and opens territory for exploitation. The modes of transportation enabled by an infrastructure project are inextricably related to forms of land development: automobile highways facilitate euclidean zoning and single family homes, subways and mass transit facilitate compact city forms, and trolley cars facilitate medium density suburbs. The impact of transportation infrastructures must be considered broadly, and include infrastructure's influence on people and buildings, communities and neighborhoods, ecosystems and landscapes.

The need for investment in transportation infrastructure is universal, and well-documented. According to McKinsey, the world should spend about \$1.3T annually on transportation infrastructure to meet economic demand, mostly in middle-income countries, in the coming decade. While many have noted a sizable investment gap in several countries, the speed and scale at which new transportation projects are being planned and developed is nevertheless astounding. Projects associated with China's Belt and Road Initiative, for example, are planned in at least 70 countries, and will include countless miles of rail, road and port infrastructure, countless pounds of concrete and steel, and trillions of dollars in financing. Most of the infrastructure that will exist by the middle of the century—the point at which, according to the IPCC, global emissions must be reduced to net-0—is not yet built. How it will be planned, designed and implemented, however,

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remains to be seen. They will enable or hinder climate change mitigation, and affect neighborhood affordability as well as access to markets, jobs and education for billions of people. They will determine emergent dependencies on automotive or other modes of transit, and tacitly determine where and how cities, suburbs, extraction sites and farms proliferate and function. They will, in their way, implicate the fate of humanity and the world in the next century and beyond.

RESILIENT TRANSPORTATION

Much has been written recently about trends and needs in infrastructure planning, from a variety of perspectives: sustainability, environmentalism, economic development, engineering and vehicle technology, and beyond. What can a resilience perspective add to the conversation?

Our operating definition of resilience prioritizes learning lessons from the past, assessing actions across multiple scales and sectors, and anticipating future risks. It embraces complexity and adopts an ecological perspective on the socio-economic activities of human settlement, manifest in physical places.

If, as we believe, transportation is a catalyst for growth, resilience thinking anticipates ways in which such growth, in concert with increased connectivity, can enable social inclusion and support ecological consciousness. It is a Big Picture approach that brings the indirect consequences of transportation planning and infrastructure to the fore.

Resilience has been criticized as a Western and particularly American concept, derived from and for societies, economies and geographies shaped by particular industrial histories. There is also no rational denial that Western governments and companies have disproportionately contributed to the climate crisis. Nevertheless, patterns of urbanization that originated and reached market portability in the USA and Europe are being replicated throughout the world,

and transportation projects are increasingly developed by a web of international interests. As practitioners, students and educators of urban planning and design, we are obliged to examine the mechanisms that underlie past failures and successes, in the places where they originated as well as the places where they have been replicated, in order to propose better models for urbanization around the world.

The following selection of cases have been selected as examples that can begin to illustrate the relative ways that transportation projects affect the global climate system, the communities that they serve, and the institutions that deliver them. Each case presents a range of reasons why a project came to be, how it evolved during project planning and implementation, and a critical assessment of its beneficial or deleterious consequences. Based on our research, we do not believe that there is a single or universal recipe for a resilient transportation project. There is, however, an urgent need for dialogue and knowledge sharing between nations and cities,

governments and communities, agencies and sectors, if we are to build projects that meet global imperatives of climate adaptation and social inclusivity.

EVALUATION TOOLKIT

Recognizing that every project, context, and stakeholder group is different, a universal checklist for resilient infrastructure is not only unrealistic, but could further enable “box-checking” mentalities in planning. Considering the dire state of our global climate system and widening global inequality, all parties involved in planning infrastructure today have an ethical imperative to question the status quo in how we build cities. This evaluation system was developed for this report to help to frame a set of questions around the design and delivery of recent transportation projects. It is not intended to be comprehensive or conclusive, but to aid in the introspection of planning decisions. To use this evaluation tool, one should start by asking, what scale is the project (system, local, regional, global); what phases is it in (design, implementation); and who am I and what do I care about (economy, ecology, society, all of the above). Once you answer the questions closest to where you think you are, move outwards. For instance, how does the local delivery of social infrastructure have other impacts on ecology and economy at a regional scale? Or how does this global economic development project affect local ecologies? In short, resilience thinking compels us to think across scales, sectors, and timeframes. It also discourages us from thinking about city building as a process with a fixed outcome, but a continuously evolving process, a long arc that we must continuously bend toward economic, social and environmental justice.

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EVALUTATION TOOLKIT

LOCAL

Does the Design Improve...

- **Economic Sustainability** with reliable access to jobs and markets?
- **Social Services** by providing integrated social infrastructure in all stations?
- **Environmental Services** with integrated landscape and nature-based infrastructure in station sites and route corridors?

Does Implementation Improve...

- **Economic Growth** by creating jobs and economic opportunity for at-risk populations?
- **Social Inclusivity** with a holistic community planning process?
- **Environmental Quality** by reducing air, water and land pollution?

REGIONAL

Does the Design Facilitate...

- **Economic Opportunity** by creating new jobs and access to regional markets, services and resources?
- **Social Access** through equitable distribution of routes and station infrastructure?
- **Environmental Protection** by minimizing impact to sensitive ecosystems and watershed functions?

Does Implementation Facilitate...

- **Economic Cooperation** on planning and operations between jurisdictions or agencies?
- **Social Coordination** with a long-term regional land-use and infrastructure vision?
- **Environmental Awareness** through monitoring of ecosystem health and function?

SYSTEMIC

Does the Design Achieve...

- **Economic Value** that could not be achieved by improving existing facilities or services?
- **Social Benefit**, proportionate to economic and environmental value?
- **Environmental Endurability**, by adopting the highest reasonable flood, seismic, and heat standards?

Does Implementation Achieve...

- **Economic Efficiency**, on time and on budget, with minimal waste and disruption?
- **Social Responsiveness**, to user and community input?
- **Environmental Robustness**, to withstand failure or disruption without catastrophic consequences?

GLOBAL

Does the Design Achieve...

- **Economic Equality**, by mitigating disparity via access to jobs, markets, services and resources?
- **Social Harmony**, by improving cross-cultural connectivity?
- **Environmental Sustainability**, by reducing transport-sector contributions to global greenhouse gas emissions?

Does Implementation Achieve...

- **Economic Precedent** by establishing a funding mechanism that can be adopted by similar projects in the future?
- **Social Precedent** by promoting social justice in transportation planning and delivery?
- **Environmental Responsibility**, by minimizing embodied energy in construction and operation?



Residential street in The Hague Southwest

‘People come to Escamp and don’t see the problems. they are hidden. So what is it that needs solving? Is it people’s perception? Is it that people feel ignored? That they are afraid? ... Can we solve social problems with infrastructural solutions? Can they change perceptions?’

- Rene baron, director, Escamp district



Social housing in The Hague Southwest



Leyweg Shopping Center, a pedestrian commercial area, rebuilt in 1997

LEYENBURG CORRIDOR

THE HAGUE, THE NETHERLANDS

GROWTH AND SEGREGATION IN THE HAGUE

In the coming years, The Hague—the third largest city in the Netherlands—is expected to grow by 7.6% annually. The population in 2015 was about 515,000, 90,000 lower than its historic high in 1959. It is expected to reach as high as 627,000 in 2040, mostly due to immigration. Already, The Hague has the most diverse—and segregated—population of any city in the Netherlands, with 53% of the population in 2017 foreign-born. The foreign population includes employees of international institutions as well immigrants, migrant workers and refugees from former Dutch colonies in South America and Southeast Asia, North Africa, and, more recently, Eastern Europe and the Middle East. Throughout the city, there are notable discrepancies between neighborhoods (which often align with national/ethnic backgrounds) in average income, health status of inhabitants, access to health and safety services, and employment. As the population grows, the City hopes that public transportation projects will not only mitigate traffic congestion and vehicle emissions, but also address existing stresses in the city’s most vulnerable neighborhoods and further integrate marginalized, isolated communities.

VULNERABILITY IN THE HAGUE SOUTHWEST

Some of The Hague’s most vulnerable communities are in The Hague Southwest, a cluster of three neighborhoods in Escamp, the city’s most populous and poorest district. These neighborhoods were built according to Willem Dudok’s 1948 masterplan, which reorganized and expanded the city in the wake of World War II. They were designed as residential neighborhoods, characterized by three- or four-story apartment complexes that would house young, middle-class Dutch families leaving the city center. At its peak in the 1960s, the Southwest population was about 100,000. The housing, then and now, is heavily subsidized, a provision consistent with the right to housing outlined in Article 22§2 of the Dutch constitution. Today, about 80% of the housing in Southwest is rented, and 70% is subsidized.

POLICY AND IMMIGRATION IN SOUTHWEST

As a result of a planning initiatives in the last 40 years that encouraged middle class flight, The Hague Southwest has become an immigrant enclave burdened with interconnected social stresses, including high rates of unemployment and mental illness, exacerbated by associated stigmas and underinvestment in social housing.

In the 1980s, twenty years after the Southwest was built, the Netherlands instituted a regional planning strategy that favored decentralized “growth centres” (that is, new towns) to meet housing needs in metropolitan areas. The most prominent of these new towns was Zoetermeer, a former village not far from Escamp, that grew from about 17,000 people in 1970 to almost 100,000 in 1990. During the same period, The Hague’s population declined by 100K, and Southwest’s population alone fell from 100,000 to 60,000. The demographic composition of Southwest changed as well. As second-generation families left Southwest for Zoetermeer in the 1980s and 90s, immigrants from North Africa and Suriname moved in. While the city periodically attempted to stimulate the Southwest economy (by renovating houses or building a shopping center, for example), investment generally declined, as did local wealth and public safety. In 2005, following the success of urban renewal projects elsewhere in the city (see Tram Tunnel), The Hague issued its Structuurvisie Wêreldstad aan Zee (Vision 2020), outlining a strategy to further increase city-wide density. In Escamp, the City built the district’s first tall building: 18-stories high with apartments, municipal offices, and a public library. By 2011, more than half of the housing in Southwest was slated for redevelopment, but most projects were put on hold during the global financial crisis at the end of the decade. At the same time, a new wave of immigrants began settling in Southwest, this time from Eastern Europe and the Middle East, as did hundreds of “status holders”—refugees from the Middle East and elsewhere, whose ability to stay in The Netherlands in the long term remains uncertain.

WHO *The Hague City Council*

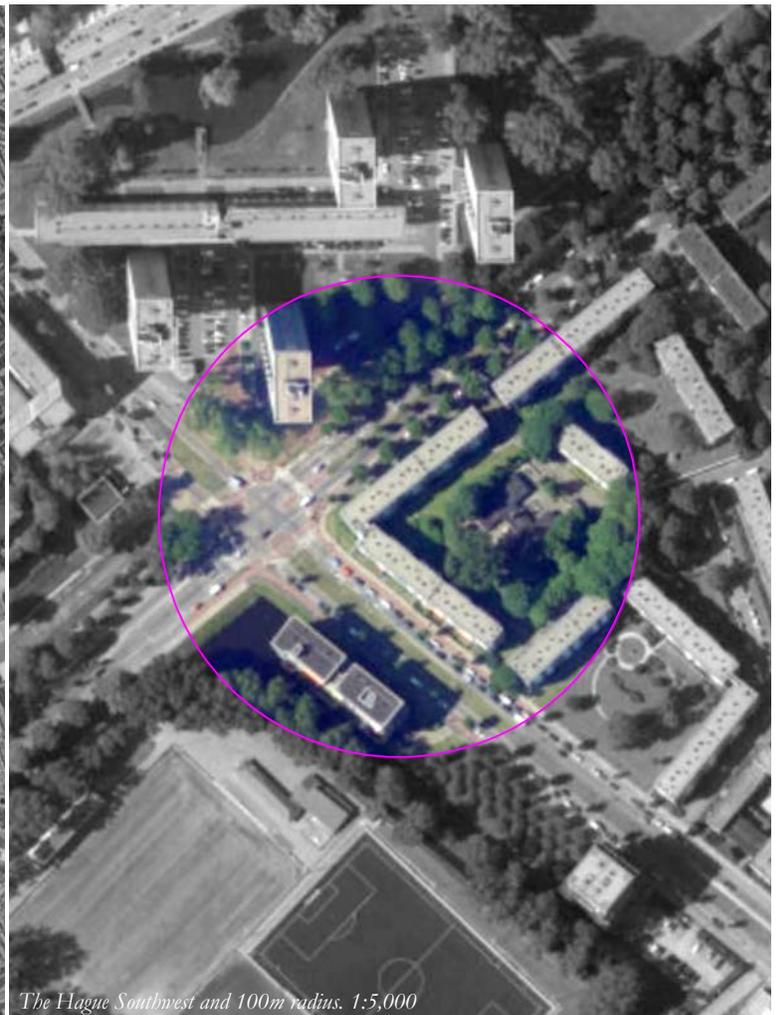
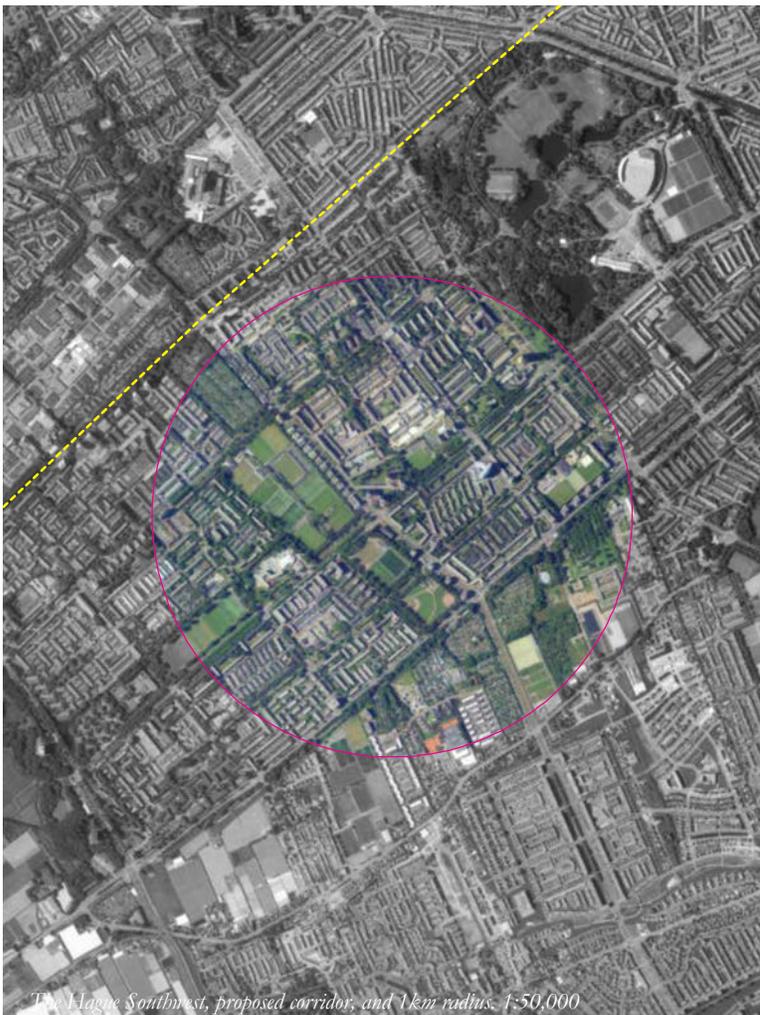
WHAT *Underground rail corridor and associated residential and commercial development*

WHERE *Escamp district, The Hague Southwest neighborhoods*

WHEN *2018–2040*

HOW *\$2B from municipal and national governments*

WHY *Increase density, attract private investment, and integrate isolated communities.*



LEYENBURG CORRIDOR

THE HAGUE, THE NETHERLANDS

AGENDA RUIMTE VOOR DE STAD AND THE LEYENBURG CORRIDOR

More recently, The Hague updated Vision 2020 with a new medley of initiatives called Agenda Room for the City, which, like its predecessor, emphasizes urban densification. The City plans to build as many as 30,000 new housing units by 2040 to meet population growth, including as many as 10,000 in Southwest. To support this goal, the City has allocated \$3 billion to upgrade transportation infrastructure in Escamp, and is considering a new light rail corridor, possibly underground, that will link Southwest neighborhoods to the city's downtown commercial center, central train station, and municipal and regional transportation hubs. This Corridor would shorten travel times, ease access to jobs and markets, and mitigate traffic congestion and vehicle emissions. It would also, hopefully, spur residential and commercial development, increasing the stock of market-rate as well as subsidized housing. However, the project also comes with social risks. As in Amsterdam (see North-South Line), the project could be physically disruptive and socially unpalatable to local communities. As in Boston (see Fairmount Line), there is a risk of unintentionally catalyzing gentrification. And as in the

case of The Hague's own Souterrain Tram Tunnel, economic development could disproportionately serve the needs of corporations to the detriment of local business owners and communities.

OPPORTUNITIES

As it continues planning the Leyenburg Corridor, The Hague has several resources and tools at its disposal that it can use to maximize the benefits of a new tramline. There is a strong network of activists and community leaders in the Southwest, including many who are positioned to facilitate dialogue between stakeholders, negotiate for investments in social infrastructure, or voice opposition to disruptive interventions. Already, there are structures in place in The Hague that enable stakeholder communication, but the City has an opportunity to demonstrate responsiveness through a more participatory planning process (see Medellin Metrocable). Given the long time horizon for the project, community-driven investments can be staged incrementally so that they not only compliment the project spatially, but also temporally. The Hague also has technological resources available that can strengthen both the planning and engineering of the project, including

participatory planning technologies under development at TU Delft, and rapidly advancing tunneling technologies that are being used to build a new car tunnel in The Hague (De Rotterdamsebaan). Finally, the City has an opportunity to serve the ambitions of Agenda Ruimte voor de stad by approaching the Leyenburg Corridor as a cross-disciplinary project by creating a project team to oversee it that draws from multiple city agencies (including housing and environmental as well as transportation authorities), community groups and representatives, and leading researchers from nearby universities.

RECOMMENDATIONS

- *Coordinate Leyenburg Corridor planning with a holistic community plan. Use participatory planning tools to solicit feedback from stakeholders at every stage of planning and development process.*
- *Use data and community based planning to select station locations that maximize access for at-risk communities and preserve existing green space.*
- *Design stations in coordination with other social infrastructure, including healthcare, social services, and recreational facilities.*
- *Strive for maximum inclusion in planning process. Bring people to the table who represent community interests as early and often as possible.*
- *Encourage the creation of jobs for the people of Escamp in the planning and Implementation of the Leyenburg Corridor. Support the products and services of local small businesses.*



Tunnel under the River IJ

“By building 70,000 new dwellings with accompanying amenities within the city’s existing boundaries we can expand the city centre milieu... That is only feasible if we simultaneously invest in the public space, public transport and greenery”

- Amsterdam Structural Vision 2040



North-South Line, Noorderpark station and 1km walking radius. 1:50,000



Noorderpark station and 100m walking radius. 1:5,000

AMSTERDAM NORTH SOUTH LINE

AMSTERDAM, THE NETHERLANDS

BACKGROUND

After decades of planning, the city of Amsterdam began constructing its first city-wide subway system in 1970. Although plans for a subway were proposed to city government as early as the 1920s, it was considered too costly, and tabled until the 1950s, when it resurfaced as a potential component of post-war reconstruction. After another decade and a half of research, analysis and consideration, the municipal council of Amsterdam approved a plan in 1968. It would no longer dovetail with post-war reconstruction planning, but rather with an urban development plan that included inner-city renewal projects and subsidized housing development on the outskirts of town. The system would have 4 routes to start with, built over the course of 30 years.

The North-South line, one of the original 4 routes, was planned to connect neighborhoods north of the River IJ with Amsterdam Centraal, the iconic station on the river's southern bank. Tunneling under the river would require demolishing buildings in Nieuwmarkt, a historic neighborhood near the station. But when construction began, Amsterdam residents rioted, protesting Nieuwmarkt demolition and the urban renewal strategy it represented. Line construction was put

on hold until the late 1980's, when the city reopened research into project feasibility. In the 1990's, planning efforts were revisited following new engineering technologies that would make tunnelling under the river less disruptive. Over the course of the next 25 years, construction would start and stop several times in a cycle of planning, fund-raising, public disapproval, renewed planning and funding efforts, and engineering failures.

PROCESS

The North-South line was revived in 1996 when the city council approved an €800 million budget for project implementation. The River IJ and its surrounding neighborhoods had changed in the previous 30 years: houseboats proliferated in the IJ, indicating a market interest in development, and by the early 2000s, several industrial sites north of the river would become available for commercial and mixed-use development. Project goals changed accordingly: no longer part of a 1960s renewal strategy, the subway was now framed as an asset that could spur economic development. Engineering technologies, too, had advanced since the 1960s. Tunneling technologies developed in the 1990s promised the possibility of constructing tunnels 25m below grade with minimal

disturbance to buildings.

Construction began in 2003, with the line scheduled to open in 2011. The project budget had risen to €1.3 billion. However, during the next five years, construction was delayed several times, mostly because of engineering failures, including leaks and subsidence-induced damage to buildings. Construction was finally completed in 2018, with total costs reaching €3.1 billion.

OUTCOMES

The line has reduced travel times between Amsterdam Noord and Amsterdam Zuid, the terminal stations in the northern and southern parts of the city, to just 15 minutes (down from 30), and will serve 120,000 passengers annually. But the unexpectedly long and complicated construction process was extremely disruptive to neighborhoods and communities along the corridor: several residents were forced to evacuate their homes when they were structurally compromised by engineering failures. Lengthy station construction similarly disrupted pedestrian, bike and vehicular traffic.

WHO *Dutch Government, Amsterdam Municipality, MTA (GVB)*

WHAT *9.8km route extension, with 6km underground
Mexico City*

WHERE *Between North and South Amsterdam, under the River IJ*

WHEN *1968–2018*

HOW *€1.7 billion from Municipal Government*

WHY *Enable dense urban development in Amsterdam Noord
by enabling access to major transit hubs in city center*



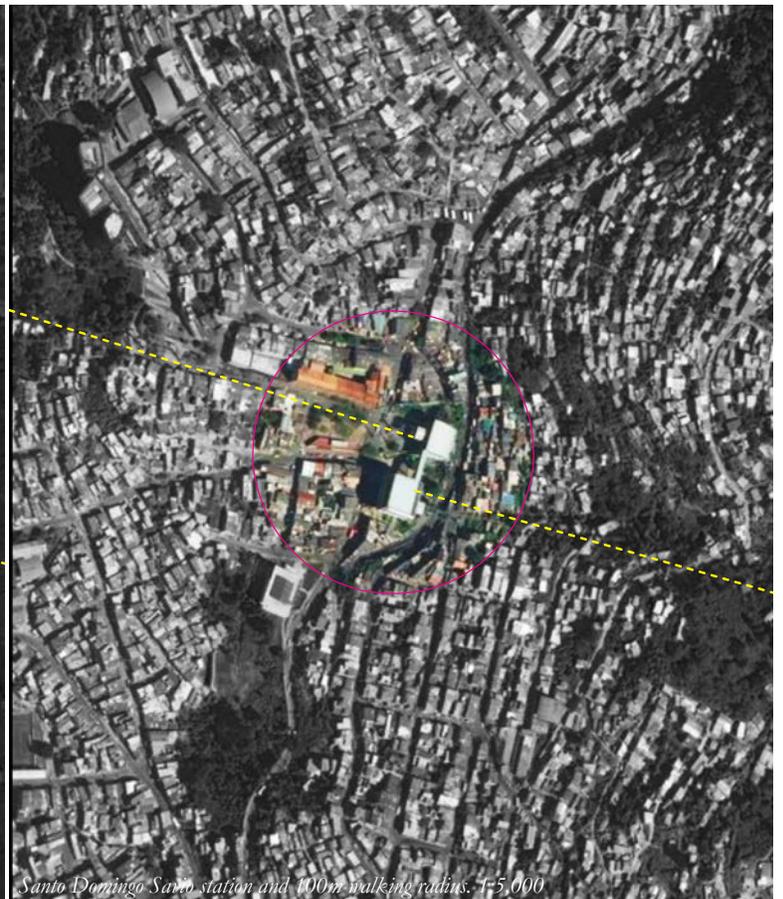
Mitrovic and Espana Library, Source: Wikimedia Commons

“Residents of those neighbourhoods told me ‘I used to say I’m going to Medellín, now I say I’m going to the city centre.’ They didn’t grow up as Medellín citizens. This little device integrates them.”

- Mayor Luis Perez



Santo Domingo Savio station and 1km walking radius. 1:50,000



Santo Domingo Savio station and 100m walking radius. 1:5,000

MEDELLIN METROCABLE

MEDELLIN, COLOMBIA

BACKGROUND

Medellin, the second largest city in Colombia, is the cultural and economic center of the Aburra Valley. The oldest, most affluent and densest districts (comunas) are on the valley floor, straddling the Medellin River, while newer neighborhoods with poorer residents line steep valley walls. Hillside comunas proliferated in mid-20th century, following a period of national political instability that catalyzed urban migration. These neighborhoods increasingly suffered from drug-related gang violence, organized crime, high unemployment, and low literacy. These stresses were directly related to the comunas' challenging physical conditions: with weak soil and steep grades, roads were difficult to build and maintain, leaving many areas inaccessible, disconnected from the city center, and inadequately serviced.

PROCESS

In the 1990s and early 2000s, three successive mayors developed a series of intertwined social, physical, and economic strategies designed to integrate the comunas into civic life. A central feature of these strategies was a proposed gondola-lift system, called the Metrocable. It would transport people from the comunas down to the valley, where it would connect to an existing underground rail system. The

system was endorsed by Mayor Luis Perez (2001–2003), and the first three lines implemented by his successors, Mayors Sergio Fajardo (2004–2007) and Alonso Salazar (2008–2011).

As predicted, the gondolas reduced travel time to and from the comunas. Lines were planned in close coordination with other social infrastructure projects, with strong public input throughout the planning process. The Metrocable is also profitable, a rare achievement for a public transit system.

SOCIAL URBANISM

The Metrocable project was conceived of as a cornerstone of “social urbanism”—that is, transportation infrastructure coordinated with other types of development and social programs to the benefit of marginalized communities. Public participation was integrated into the planning process, and as a result, the areas surrounding Metrocable stations were planned to support the creation of other spaces and buildings that would provide public services, such as parks, houses, libraries and schools. In the four years following the opening of the first Metrocable line, the city invested seven-times the cost of line itself into its complementary projects. The land needed for these projects was purchased through voluntary agreements, without any forced

evictions, and many of the new buildings were designed by well-known Colombian and international architects, by competition. The second two lines, and their associated projects, were partly financed with a participatory budgeting process, in which communities were able to suggest how 5–10% of the project budget would be invested.

FINANCIAL SUSTAINABILITY

The Metrocable is financially self-sustaining. Project implementation and operation involved two major publicly owned companies: a metro company (Empresa de Transporte Masivo del Valle de Aburrá – Metro de Medellín Ltda.) that is owned equally by the City and the Antioquia province, and a city-owned utilities company (Empresas Públicas de Medellín S.A. - EPM), which provides water, sewage, communications and energy services. As a publicly owned company, the Empresas Públicas de Medellín is committed to investing part of its annual surplus into social infrastructure projects, such as the Metrocable and associated development (in 2010–2011, the utilities company invested almost \$900 million into Metrocable projects).

OUTCOMES

The metrocable lines that were planned with the most public participation are also the most successfully integrated with complementary projects. The future of the transportation system itself is uncertain: it has a relatively low capacity compared to BRT systems, and the comunas it serves may become increasingly vulnerable to gentrification or burdensome development pressures as the city and system grow. Nevertheless, the models that the city has developed for public participation and sustainable financing are strong, versatile, and may be the Metrocable project's most valuable achievement.

WHO *Empresas Públicas de Medellín, City of Medellín, World Bank*

WHAT *16 bus, metro, and metro-cable lines by 2020*

WHERE *Medellin, Colombia*

WHEN *2006 - 2020*

HOW *\$4 billion (from PPP, Municipal and National Government*

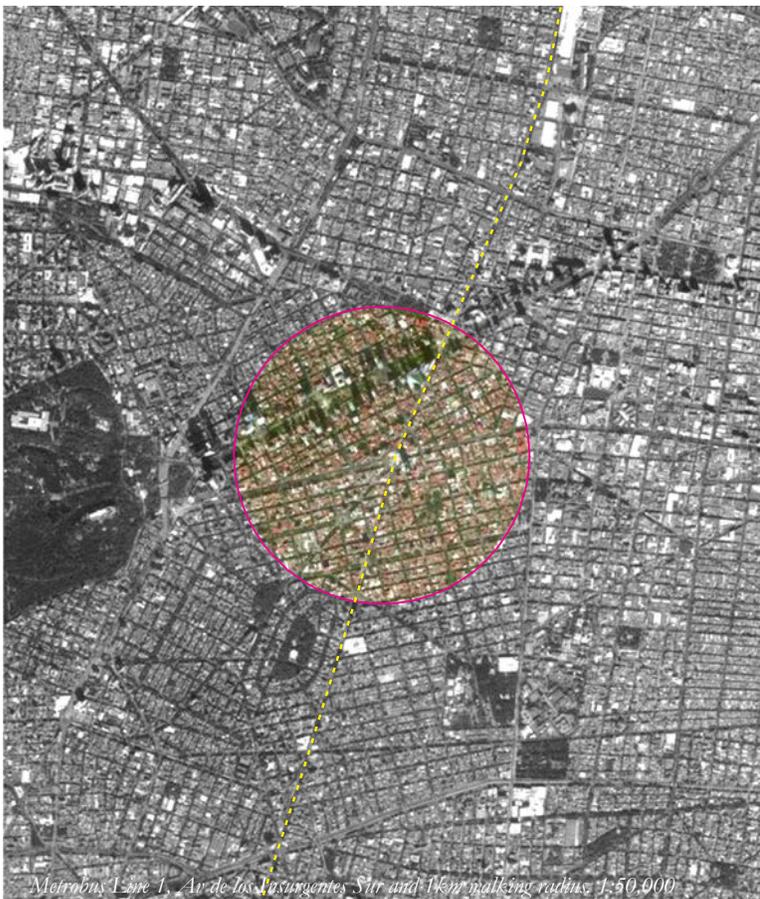
WHY *Integrate isolated neighborhoods by increasing access to jobs, education, and social services. Attract investment in marginalized neighborhoods and increase tourism.*



Mexico City Metrobús on Av de los Insurgentes, Line 1. Source: Wikimedia Commons

“While Metrobus was conceived as a measure to improve the city’s air quality, the various co-benefits it could offer were key in gaining the support of the various actors needed for the project to pass from concept to reality.”

- CTS EMBARQ Mexico



Metrobus Line 1, Av de los Insurgentes Stn and 1km walking radius. 1:50,000



Metrobus Line 1 crossing Insurgentes subway station and 100m walking radius. 1:5,000

MEXICO CITY METROBUS

MEXICO CITY, MEXICO

BACKGROUND

In the 1990s, greater Mexico City (population 20 million) suffered from severe traffic congestion and poor air quality. The Mexico City Metrobus, now a seven-line BRT system that serves over 187 million passengers annually, was first conceived as part of a strategy to mitigate these local stresses in the Programme to Improve Air Quality in the MCMA 2002–2010 (PROAIRE). The project was soon recognized to have several significant co-benefits, however, which allowed the project to appeal to a broader base of political and financial support.

Planning for the first line (Line 1) began in 2000, and its first 20 km route opened in 2005. It was later expanded to 30 km in 2008, with 43 stations and three terminals. Line 1 serves 420,000 passengers per year and runs 161 busses. The project was enabled by a unique public-private partnership model for planning, construction and bus operations. In total, Line 1 cost \$88 million, with \$10 million from private sources.

PROCESS

Line 1 project planning and phase 1 implementation were overseen by Claudia Sheinbaum, the Secretary of the Environment in Mexico City. Sheinbaum

successfully secured funding from several international sources, including the World Bank (which provided \$4.8 million for project planning), the Japan Human Resources Development Program, the World Resources Institute/Shell Foundation, and the Hewlett Foundation. She also rallied support and input from local environmental organizations, and negotiated terms with private bus operators. With funding and technical assistance in hand, Sheinbaum was able to secure a crucial endorsement from Mexico City's Head of Government, Andrés Manuel López Obrador, in 2004. By then, Obrador not only faced pressure from environmental advocates to support the project, but also recognized that the project could boost his profile during his soon-to-be-announced presidential run. In order to maximize its political benefits, however, Obrador insisted that the project be accelerated, so that the first line would be operational in time for his 2006 campaign.

METROBUS PPP

The initial success of Metrobus hinged on its unique model for project funding, planning and management. While the primary intention of the project was to reduce air pollution, the City was able to appeal to a broad base of financial support (local, national and international, public

and private) by emphasizing its co-benefits, including reduced travel times, decreases in private automobile usage, improvements in public health, decreases in automobile accidents, and opportunities for denser development along Insurgentes Avenue.

To manage the project, the City created a new agency called Metrobus Decentralized Public Organism (DPO), which would report directly to the mayor. DPO would manage project planning and implementation in coordinated partnership with nonprofits and NGOs, including the World Resource Institute of Mexico's sub-organization, CTS EMBARQ. DPO would also administer project funds, which would be held in a trust at a private bank, INBURSA.

As part of the planning process, DPO negotiated with hundreds of private bus operator, resulting in their consolidation into a single private company, called CISA. CISA would operate some of the busses on Line 1, while others would be operated by a publicly owned company, Red de Transportes Públicos (RTP). Fares, however, would be regulated by DPO and collected by INBURSA.

OUTCOMES

The Metrobus system has contributed to significant emission reductions. In its first six years of operation, Line 1 alone reduced GHG emissions by an estimated 300,000 metric tons. It has contributed to 28 million fewer car trips per year, an 84% reduction in traffic accidents on Insurgentes (2005–2010), 40% travel time savings for its users, and has eased movement for emergency vehicles. Line 1 has also contributed to increased development and density along Insurgentes. Nevertheless, Metrobus continues to be more expensive for passengers than peseros, and has not replaced them completely.

WHO *Mexico City Government, the Global Environmental Fund, the Shell Foundation, and the World Bank*

WHAT *First of 7 BRT lines, integrated with other mass transit*

WHERE *Paseo de la Reforma, Mexico City*

WHEN *2002–2005*

HOW *\$83 million*

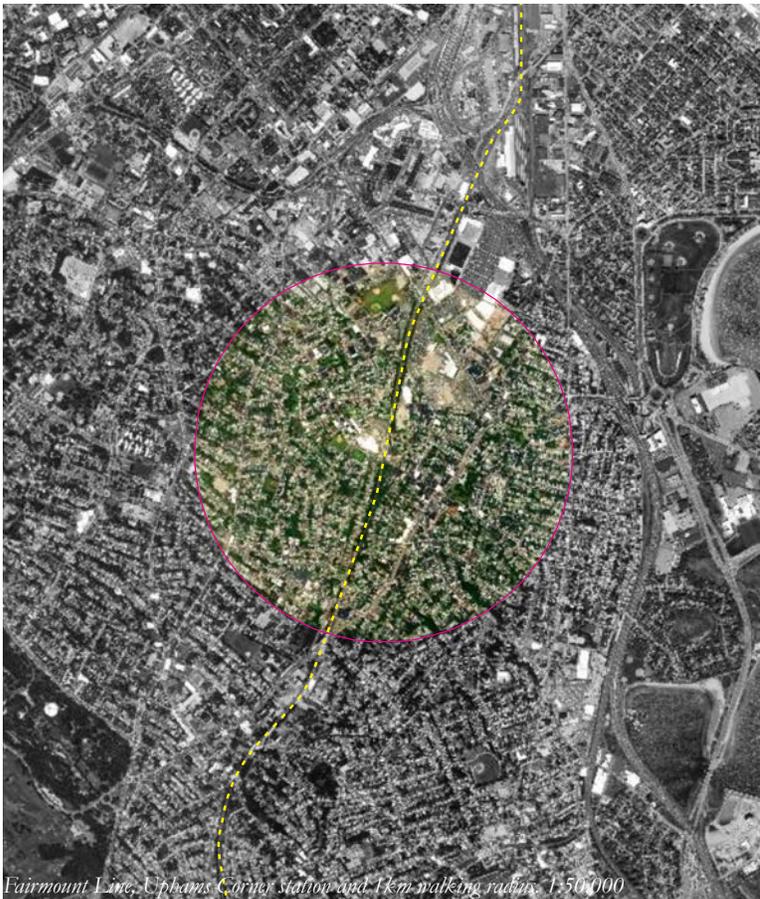
WHY *Reduce vehicular emissions and congestion*



Fairmount line infrastructure in Dorchester. Source: Commons

“As we improve transportation, as we improve the commercial areas, how do we make sure the people who made it great aren’t pushed out?”

- Sheila Dillon, Boston Chief of Housing



Fairmount Line, Uphams Corner station and 1km walking radius. 1:50,000



Fairmount Line, Uphams Corner station and 100m walking radius. 1:5,000

BOSTON FAIRMOUNT LINE

BOSTON, USA

BACKGROUND: SERVICE GAP

The greater Boston area is served by a multimodal transportation system that includes heavy rail, light rail and Bus Rapid Transit lines. The 78-mile long system serves about 350 million riders annually in the greater Boston area, and is owned and operated by The Massachusetts Bay Transportation Authority (MBTA), a state-wide agency in the Massachusetts Department of Transportation. Within the MBTA system, over half of daily ridership is on the rapid transit system, which includes three heavy rail lines, two light rail lines, and a new underground bus line, cumulatively known as the T.

Neighborhoods in southern Boston, including Dorchester, Roxbury, and Mattapan, are not served by the T. They instead rely on the Fairmount (Indigo) Line, a privately-operated commuter rail that runs less frequently. Communities in these neighborhoods are on average poorer, less educated and more ethnically diverse than the city as a whole. The per capita income in these neighborhoods is \$17,000–24,000, while the city-wide average (for Boston) is greater than 35. Access to jobs and education is limited, and the housing prices are high, and rising. Communities

in these neighborhoods often rely on public transportation more than wealthier Bostonians, despite its relative inaccessibility.

PROCESS

Recent upgrades, beginning in the early 2000's, have improved service and introduced new line and station infrastructure along the existing right of way, as part of an initiative to address growing inequality and improve social infrastructure in underserved neighborhoods. These upgrades, which were managed by MBTA, began as part of a remediation program following the Central Artery/Tunnel Project (the Big Dig), a \$14 billion highway megaproject in the 1990s and early 2000s. They include new stations, rail bridges, infill stations, and bicycle and pedestrian paths, as well as more frequent service along the Fairmount line. These improvements are ongoing, and include planned investments in affordable housing and cultural institutions in neighborhoods along the corridor. Nevertheless, the line has continued to suffer in recent years from regular delays, largely due to mismanagement by the operator (Keolis). Some advocates have proposed integrating the Fairmount Line into the subway network and transferring operational responsibility to MBTA. But in order to do

so, the City and MBTA would need to build a new connection to one of the T's major transfer stations, and the Fairmount line's relatively low ridership has been deemed inadequate to justify it.

OUTCOMES

Improvements to the Fairmount line so far have achieved many of the city's objectives. Ridership tripled between 2012–2018, and travel time to Downtown Crossing—a major hub for transfers—is 20% shorter. Upgrades have proved more cost-efficient, time-efficient, and less disruptive than a new-construction would have been. Nevertheless, proponents and critics alike continue to fear that the project has not gone far enough in addressing the underlying stress of rising unaffordability in catchment area neighborhoods.

In an effort to get ahead of gentrification, the City is attempting to coordinate investments in social infrastructure and affordable housing with the Fairmount Line. It has acquired several parcels at Upham's Corner, a station-area in Dorchester, which it plans to develop in partnership with private and community-based developer, in order to protect long-term affordability, create a neighborhood Arts Innovation District, and establish a precedent for similar projects throughout the city. Boston plans to create an independent entity with community input to facilitate acquisitions, coordinate stakeholders, and manage project delivery.

WHO *The Massachusetts Bay Transportation Authority and Keolis*

WHAT *9.2 mi commuter rail line*

WHERE *Boston's southern neighborhoods*

WHEN *2005–present*

HOW *\$200 million from Massachusetts state government*

WHY *Improve commuter access to underserved neighborhoods*



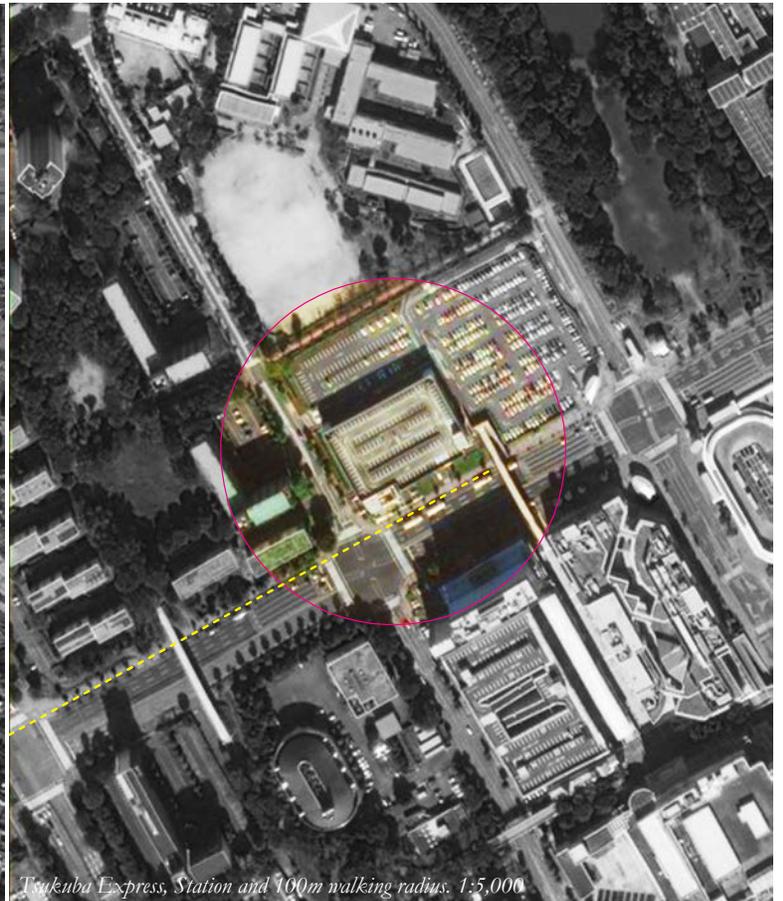
Tsukuba Center and Mount Tsukuba. Source: Wikimedia Commons

“The goal was ... to make the physical place, not the community. I can imagine it was a part of an economic plan to inject money into the economy as much as a real intention to build a creative science center”

- William Galloway, Project Associate Professor, Keio University



Tsukuba Express, Station and 1km walking radius. 1:50,000



Tsukuba Express, Station and 100m walking radius. 1:5,000

TSUKUBA EXPRESS

GREATER TOKYO, JAPAN

A CAR-CENTRIC “SCIENCE CITY”

Tsukuba, Japan is a small city 60 km northeast of Tokyo. It’s land area is about half that of Tokyo, but the population in 2000 was just 165,000 (compared to 12 million in Tokyo). Tsukuba is known for the Tsukuba Science City, a sprawling 70,000 acre research center with dozens of public and private institutions, including labs and universities. Its two universities and most of its national laboratories are located in its central district (the Research and Education District), which is about 7,000 acres. Previously a rural valley, Tsukuba Science City was planned in the 1960s by the federal government, with construction continuing into the 1980s. It is unique in Japan for its automobile-centric urban design: until 2005, it had no train station, and in 2002, 90% of residents owned a car (Dearing 6). Tsukuba is known for having the most highly educated population in Japan as well as the highest density of foreign residents.

CONTROLLING CONGESTION AND ECONOMIC DEVELOPMENT

In 2005, the Metropolitan Intercity Railway Company (MIR) opened the Tsukuba Express (TX), an \$8.7 billion, 58.3 km railway line with 20 stations between Tsukuba and Tokyo. MIR, a

public corporation, was founded in 1991 to plan and oversee the project, which was initially conceived of as a strategy to reduce passenger congestion on other inter-city rail lines. With the decline of the Japanese economy in the 1990s, however, the focus shifted to spurring development along the corridor. In 1989, just before planning commenced, Japan’s federal government passed the Integrated Development Law, requiring new railway construction to be coordinated with regional development plans. Such coordination would include “land readjustment”—that is, the replacement of agricultural plots with new parcel divisions and street grids organized relative to the rail line.

PROCESS

MIR oversaw project implementation, with funding from affected municipalities based on their respective growth expectations. It also received funding and financing from the Japan Corporation for Advanced Transport and Technology (JRIT) and the private sector. Construction was managed by the Japan Railway Construction Public Corporation (which later merged with JRIT into a single public agency). Municipalities along the corridor contributed 40% of overall construction costs with non-interest loans, as did JRIT, which also covered 6%

of construction costs with bonds. Private sector funding covered 14% of construction costs (WCTR 11). MIR continues to oversee operations and management.

OUTCOMES

Today, the TX makes 20 stops between Tokyo and Tsukuba, with express trains running during rush hour. Travel time between the cities is now about 45 minutes, down from 90. In 2013, daily ridership reached 325,000, up from 150,000 in 2005. The TX has, as expected, contributed to growth along the corridor, with 8 new developments built since 2012. In Tsukuba, the population grew from 200,000 to 225,000 from 2005–2015.

Also as expected, the TX and associated land readjustments have led to the destruction of rice paddies in the region, and a subsequent decline in regional water quality. It has also directly disrupted the agrarian Satoyama culture of farmers and foresters who inhabited the area.

WHO *The Metropolitan Intercity Railway Company (federal corporation)*

WHAT *60km high speed rail line*

WHERE *Between Tokyo and Tsukuba Science City*

WHEN *1991-2005*

HOW *\$8.7 billion from federal and municipal governments and private sector*

WHY *Economic development in Tokyo, Tsukuba and along the corridor*



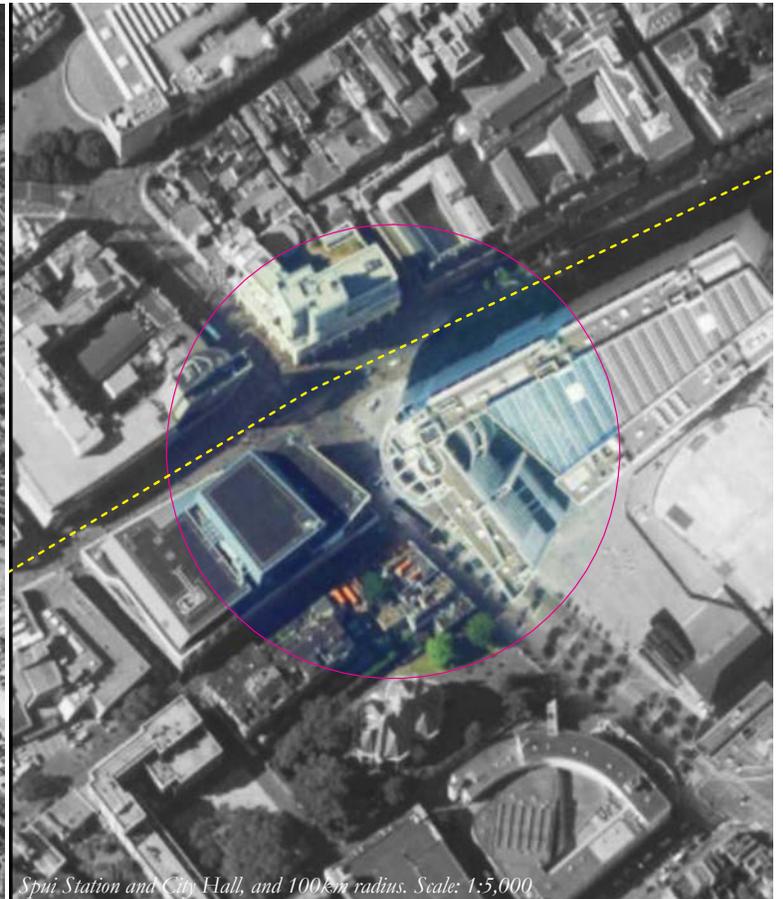
Grote Market Street, above the Tram Tunnel. Source: Wikimedia Commons

“We had to overcome a lot of resistance, with patience, telling people what the positive side effects could be. But people only believe something when they see it, not a piece of paper from a civil servant.”

- Rene Teule, Former Manager, Traffic & Infrastructure, The Hague



Tram Tunnel and The Hague Central Station, and 1km radius. Scale: 1:50,000



Spij Station and City Hall, and 100m radius. Scale: 1:5,000

SOUTERRAIN TRAM TUNNEL

THE HAGUE, THE NETHERLANDS

BACKGROUND

The Souterrain Tram Tunnel is a 1,200 m, three-story tunnel under Grote Marktstraat in The Hague's city center. It was initially proposed to the City Council in 1989 as part of a strategy to reduce traffic congestion, a chronic local stress that contributed to poor air quality and frequent accidents, while increasing business activity in the central district. The strategy included plans to redirect automotive traffic to the district's periphery and to move trams through an underground tunnel. It also dovetailed with a plan to link The Hague's metropolitan tram network to the Rotterdam Metro and regional rail system (Randstadrail). The scope of the project was later expanded to include a two-story parking garage as a result of negotiations with local business interests, which included several large retailers. The addition of the parking garage qualified the project to receive additional federal funding, and allowed the City to offset construction costs by selling concession rights to a private operator.

PROCESS

Because of the project's scale and complexity, the management of the project's planning and design relied on a complex relationship between the municipal Urban Development Department, the City

Management Department, a municipal special project group (Projectgroep Tunnels Centrum), an engineering consultant (SAT Engineering), and the federal Department of Public Works and Water Management. A €127 million budget was approved in 1993, with about 70% of funding from the national government, and construction began in 1996. While under construction, an engineering failure caused the tunnel to flood catastrophically in 1998. Due to the complexity of the project organization, it was difficult to definitively determine who should be held responsible for the flood, which effectively doubled the project cost, and called into question how the project should proceed.

OUTCOMES

During the planning and construction phases of the Tram Tunnel, its surrounding neighborhood was developed with over 500,000 square meters of additional retail, office and residential space, and since its completion in 2004 retail vacancies have declined to zero. Air quality has improved, and traffic accidents have declined. Nevertheless, the tunnel's long construction process caused many small businesses to leave the area, including street kiosks and low-end retail stores. These shops have largely been replaced by higher-end retail and commercial establishments.

Moving part of the surface transportation system underground helped enable The Hague to increase urban density, economic activity, and enhance public safety and health. While the project had the effect of bringing more business activity to the area, the gains were mostly enjoyed by higher-end retail and commercial businesses, who were able to influence the project scope, at the expense of smaller businesses. The engineering failure, flood, and subsequent complications to the project were consequences of a complex project delivery structure, which included an unusual reliance on private consultants during project planning and implementation. The project also had to withstand steady opposition from local stakeholders, especially after the 1998 flood. However, the project has been roundly celebrated in The Hague in the years since its implementation, and the pedestrian-friendly Grote Marktstraat has thrived as a lively public space.

WHO *The Metropolitan Intercity Railway Company (federal corporation)*

WHAT *1,250 m rail tunnel with two stations and parking garage*

WHERE *Grotemarkt, in central The Hague*

WHEN *1988–2004*

HOW *234 million from Municipal and National Government*

WHY *Catalyze densification, reduce congestion and encourage commercial activity*



MNSGR crossing the Tsavo National Park. Source: Wikimedia Commons

“Now you have a railway where you can get on a train and you can arrive at the other end in five hours ... That is completely game changing for people movement, but I think perhaps more importantly for goods movement.”

- Irene Sun, McKinsey and Company



SGR station in Nairobi, station and 1km walking radius. 1:50,000



SGR station in Nairobi, station and 100m walking radius. 1:5,000

MOMBASA-NAIROBI STANDARD GAUGE RAILWAY

NAIROBI, KENYA

MNSGR AND THE CHINESE BELT AND ROAD INITIATIVE

As part of its Belt and Road Initiative, an \$8 trillion plan to accelerate economic development in countries throughout Eurasia and Africa, the Chinese government financed and built a \$4.6 billion, 485 km standard-gauge railway in Kenya, from the Mombasa Port to Nairobi. The project, which was completed in 2017, is known as the Mombasa-Nairobi Standard Gauge Rail (MNSGR). It was designed to boost rural and urban industries, including agriculture, manufacturing, tourism and financial services, by easing access to foreign markets. However, because the project is being funded by a Chinese bank, construction overseen by a Chinese company, technical services provided by Chinese institutions, and operations managed by a Chinese operator—and because Kenya is already severely indebted to China—the project has been criticized for contributing to a culture of national dependency and further entrenching Chinese control of the Kenyan economy.

RAIL IN KENYA

The MNSGR runs alongside an existing train line, known as the Uganda Railway or, colloquially, the Lunatic Express. The Uganda Railway was built by a British state-

owned company by the same name in the late 19th century as part of an initiative to secure control of Lake Victoria (the primary source of the Nile River) by connecting it to Mombasa, a British stronghold on the Kenyan coast. It was built with Indian labor and imported British material, and was used by British farm-owners to reach port. Today, the rail line is in a state of severe disrepair. Traveling from Mombasa to Nairobi on the old line can take as long as 24 hours. Rather than repair the existing rail line, the Kenyan government opted in 2011 to build a new, standard-gauge (SGR) line that could connect with other SGRs in East Africa outlined in the East African Railway Master Plan.

PROCESS

In 2011, Kenya entered an agreement with the China Road and Bridge Corporation (CRBC), a state-owned construction company and subsidiary of China Communications Construction Company (CCCC). According to the terms of the agreement, the Kenyan government would pay for just 10% of implementation costs, while 90% would be covered by loans from the Exim Bank of China, a national bank established in the 1990s, primarily to fund overseas projects. CCCC would also manage operations for at least 10 years.

OUTCOMES

To date, the MNSGR has directly created 30,000 construction jobs for Kenyan workers, indirectly contributed to at least 45,000 local jobs, spurred investment in areas surrounding stations, and reduced travel time between Mombasa and Nairobi to just 4.5 hours. It was used by 2,700 passengers per day in 2017. It has, however, also added significantly to Kenya's national debt, which reached US\$50B in 2018 with \$36 billion owed to China—a 1,000% jump since 2013. Because the Kenya Ports Authority's (KPA) revenue was used as collateral for the Exim loan, the Chinese bank could take ownership of the Mombasa Port should Kenya default.

MNSGR project construction has also had severe environmental consequences. The line bisects the Tsavo National Park, and new fencing could fragment wildlife migration corridors as well as lands used for herding and grazing throughout the train corridor. In 2017, the Kenyan National Environment Tribunal ordered a halt to construction in the park pending an environmental impact study, but the order was ignored by Kenya Railways and the China Road and Bridge Corporation.

In 2018, the Kenya Electricity Transmission Company (KETCO), a publicly owned utility company, entered a \$244 million agreement with China Electric Power Equipment and Technology Company Limited (CET) to electrify the SGR. To supply the electricity, KETCO and CET will build at least a dozen new transmission lines and substations, despite ongoing disagreement about whether Kenyan power supply capacity can accommodate the demands of the SGR.

WHO *Kenyan government and the China Road and Bridge Corporation*

WHAT *485 km rail line, part of international rail system in East Africa*

WHERE *Between Mombasa and Nairobi*

WHEN *2011–2017*

HOW *\$3.6 billion from Chinese national bank and Kenyan government*

WHY *Enable international trade*

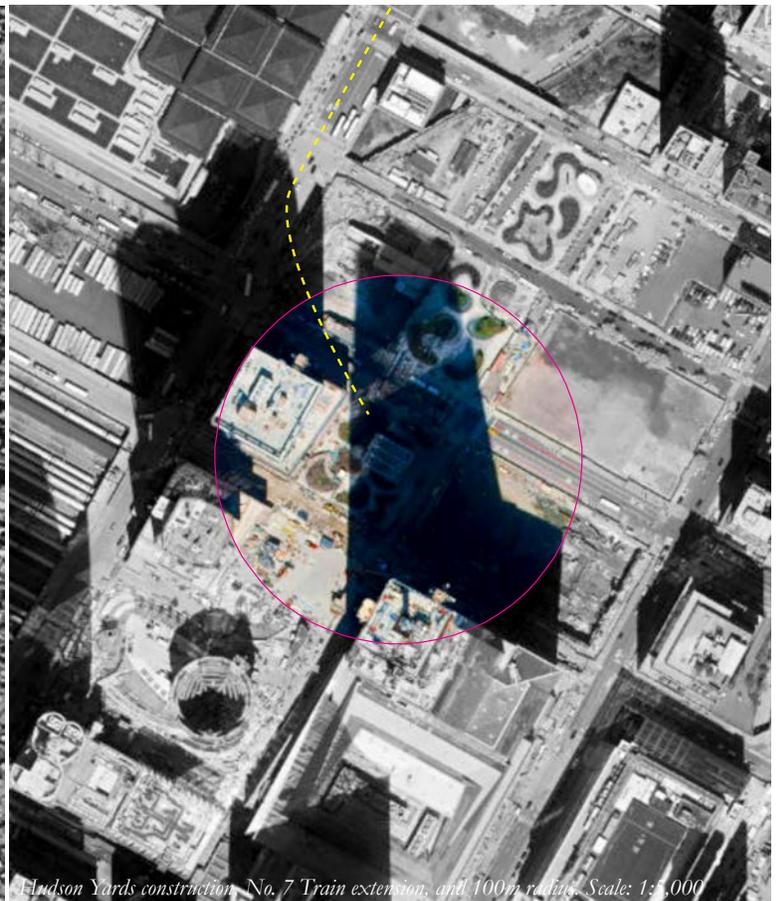


Hudson Yards subway entrance and associated development.

“We created money out of air ... It’s a classic example of what government can do.”
- Dan Doctoroff, Former Deputy Mayor of New York City



Hudson Yards construction, No. 7 Train extension, and 100m radius. Scale: 1:50,000



Hudson Yards construction, No. 7 Train extension, and 100m radius. Scale: 1:5,000

HUDSON YARDS 7-LINE EXTENSION

NEW YORK, USA

BACKGROUND: AN OPPORTUNITY FOR GROWTH IN A DENSELY BUILT CITY

In 2001, the United States experienced its first economic downturn in over a decade, caused, in part, by declines in manufacturing and deflation of what was then known as “the internet bubble.” After the September 11th terrorist attacks, the recession grew more widespread, particularly in New York City. Looking for ways to stimulate the municipal economy, Mayor Michael Bloomberg and Deputy Mayor Dan Doctoroff believed hosting the 2012 Olympics could help to revive the economy and sense of civic pride. The Olympic Bid proposed major constructions in all five of the city’s boroughs, including a new stadium on Manhattan’s Far West Side that would require redevelopment of a 26 acre rail yard. The West Side Yard and its surrounding neighborhood had previously eluded development because it lacked access to the city’s subway system and major regional bus and train stations. As formerly marginal neighborhoods across Manhattan transformed rapidly into wealthy enclaves, the West Side Yard remained a gritty industrial zone that helped to suppress the inflation of surrounding land value.

PROCESS: VALUE TRANSCENDS PURPOSE

In order for an 80,000 seat stadium to be viable, the Olympic Bid proposed extending

New York City’s No. 7 subway line, which would link the stadium to the city’s regional bus terminal, Midtown Manhattan, and points east. The stadium was ultimately canceled: not only did New York lose the Olympics, but the stadium also faced strong opposition from other venue owners who feared competition, other districts in Manhattan who feared competition for redevelopment dollars, and, ultimately, state government. Instead, the Mayor’s office reconceived of the project in 2005 as a dense mixed-use development, enabled by the same transit strategy and designed by competition.

The project would be overseen by the Hudson Yards Development Corporation (HYDC), a new public company that distributed accountability between New York City and New York State. The 7 Line extension, which cost \$2.4 billion for about 1.5 miles (2.5 km) of track, was financed through “synthetic Tax Incremental Financing,” an unprecedented value-capture arrangement that allowed the City to earmark future revenue from taxes on the yet-unbuilt luxury towers and issue Payment in Lieu of Taxes (PILOT) bonds. This arrangement was especially unusual because New York’s subways are managed by the Metropolitan Transit Authority, a public company owned by New York State. The City usually does not fund subway projects.

When the global financial crisis occurred in 2008, the Hudson Yards project was already under-way. As property values around the USA declined sharply, luxury housing in New York tended to maintain value more consistently than other housing assets. As less wealthy New Yorkers struggled with the consequences of market collapse, public concern started to shift. Earlier in the decade, New Yorkers worried more about economic recovery. By the end of the decade, they were becoming more concerned with gentrification and loss of city character.

OUTCOMES: THE COSTS OF SUCCESS

As an economic development project, the 7-Line extension successfully enabled massive private investment and high density growth. More than 60 new buildings have been planned in the area since the project was announced, and condos are selling for more than \$4,000 per square foot. Throughout the New York region, and in other formerly industrial cities, there are similar sites that could be decked and developed like the West Side Yard. The strategy has been pursued in other densely built cities, such as Paris, Tokyo, and Stuttgart. From a conventional regional planning perspective, dense transit-oriented-development near a central business district has many benefits, even if it is reserved exclusively for the beau monde.

It is unfortunate, though, that given the magnitude of public expenditure on the infrastructure, the 7-Line extension doesn’t serve any public other than Hudson Yards’ own future residents and workers. As an urban brownfield with utilities on site before the project, local impacts were limited to gentrification and indirect displacement in surrounding neighborhoods. And while the new development has yet to mature, but by all indications it will remain an enclave for the rich. In greater New York City, housing and transportation affordability are among the most prominent stresses—stresses that are not alleviated by Hudson Yards or the

WHO *NY City, NY State, MTA, Private Developers*

WHAT *Mixed-Use Development with subway extension*

WHERE *Manhattan’s Far West Side*

WHEN *2005–2025*

HOW *\$2.4B in value-capture from NYC government*

WHY *To encourage high-end development on an under-utilized lot*

HUDSON YARDS 7-LINE EXTENSION

NEW YORK, USA

7-Line Extension. Poor and working class New Yorkers have been pushed ever farther from Manhattan in recent decades, where most good jobs remain. The city's century-old subway system is crumbling. Expansion of the Midtown central business district may have been economically desirable while NYC was vying to maintain its dominance as leading center of global finance, but the current housing crisis begs a regional and polycentric approach to land use planning; where transit improvements should be made strategically to increase access to naturally-occurring affordable housing in former post industrial cities like New Rochelle and Newark.

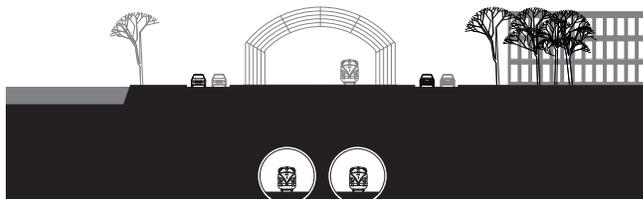
Hudson Yards will include about 400 affordable housing units, but current affordable housing programs cannot keep pace with demand. There will also be some social infrastructure as part of the project: new parks, performance spaces, and at least one school. But could the city have demanded more? More affordable housing? More environmental and social co-benefits? Perhaps the primary challenge that Hudson Yards reveals—common to cities all over the world—is for the City to understand the value of public investment to developers.

Institutionally, the approach to planning across sectors was lauded as a success, boosted the profiles of Mayor Bloomberg and others in his administration, launched many careers, and blazed a trail for several ongoing, large scale TOD projects Brooklyn and Queens. The project, due to its scale and ambition, brought about a confidence in the capabilities of City government more common to the Robert Moses era. Under the Bloomberg Administration, the City rezoned an unprecedented number of neighborhoods (according to the Furman Center for Real Estate and Urban Policy, the Bloomberg Administration rezoned 18% of lots in New York in just 4 years, from 2003–2007). While many new zoning policies were directed at protecting existing neighborhoods from unwanted development, the more visible effects

are in the form of rapidly proliferating luxury towers in post industrial waterfront neighborhoods throughout the city. By the time Bill DeBlasio succeeded Bloomberg as Mayor in 2013, the rezoning process was perceived by many vocal neighborhood activists as a vehicle for real estate development profiteering and gentrification, clouding the City's goals of increasing the supply of affordable housing and employment opportunities.

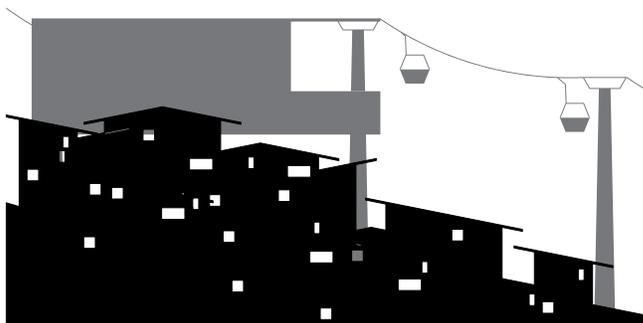
LESSONS LEARNED

AMSTERDAM NORTH-SOUTH LINE



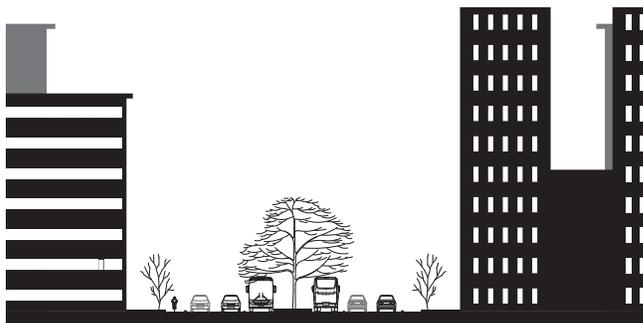
- At a **Systemic** level, project implementation should seek **Economic Efficiency** by anticipating engineering challenges.
- At a **Systemic** level, project implementation should seek **Social Responsiveness** by incorporating community input.

MEDELLIN METROCABLE



- At a **Local** level, project design should improve **Economic Sustainability** and **Social Services** by enabling access to jobs and markets for at-risk populations, and by integrating social infrastructure into station design.
- At a **Systemic** level, project implementation should promote **Social Responsiveness** by incorporating community input and participatory planning.

MEXICO CITY METROBUS



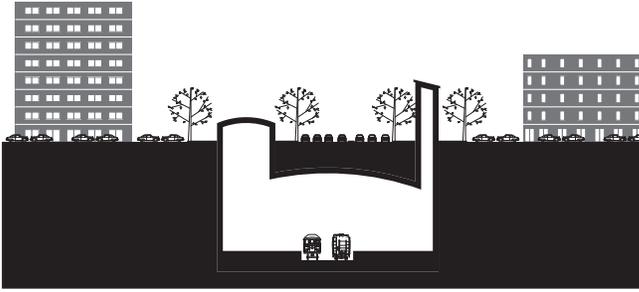
- At a **Local** level, project implementation should improve **Environmental Quality** by reducing air pollution.
- At a **Global** level, project implementation should set an **Economic Precedent** by establishing funding mechanisms that can be adopted by similar projects elsewhere.

BOSTON FAIRMOUNT LINE



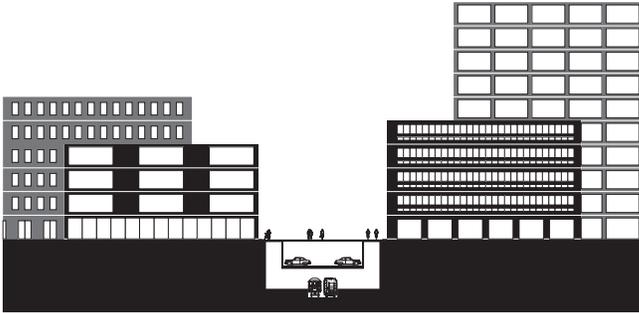
- At a **Regional** level, project implementation should improve **Social Access** through equitable distribution of routes and station infrastructure.
- At a **Local** level, project implementation should seek **Social Inclusivity** with a holistic community planning process that addresses local concerns.

TSUKUBA EXPRESS



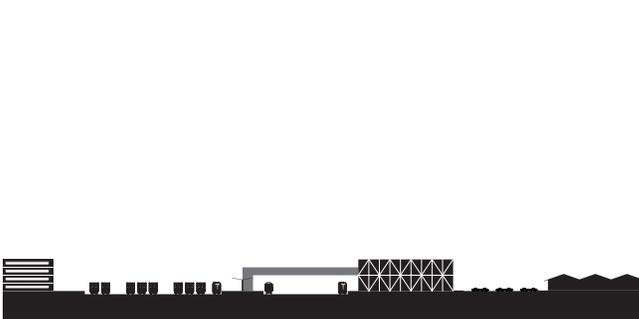
- At a **Regional** level, project design should promote **Environmental Protection** by minimizing impact on sensitive ecosystems and watersheds.
- At a **Regional** level, project implementation should seek **Social Coordination** with a long term land-use and infrastructure vision.

SOUTERRAIN TRAM TUNNEL



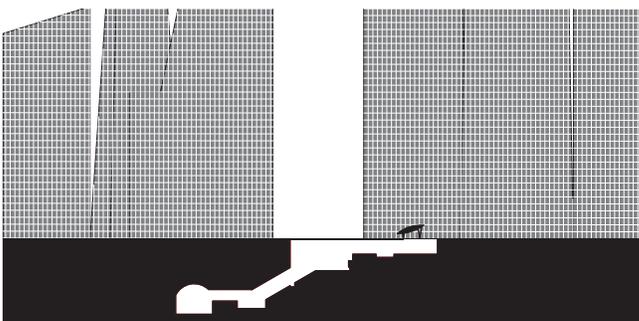
- At a **Systemic** level, project design should seek **Economic Value** that could not be achieved by improving existing facilities or services and **Environmental Endurability** by adopting the highest reasonable flood, seismic, and heat standards

MOMBASA-NAIROBI SGR



- At a **Regional** level, project design should promote **Environmental Protection** by minimizing impact on sensitive ecosystems and watersheds.
- At a **Global** level, project implementation should seek **Economic Equality** by protecting local jobs and authority.

HUDSON YARDS 7-LINE



- At a **Systemic** level, project design should achieve **Economic Value** and **Social Benefit** by improving existing facilities and services whenever possible and prioritizing social values proportionately to economic gain.
- At a **Global** level, project implementation should achieve **Economic Precedent** by exploring innovative funding mechanisms that can be adopted by similar projects in other cities.

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