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REA617

Real Estate & Urban Economics

Lecture 8



Transportation Economics and Urban Mobility

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lecture

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Abstract



Transportation is the circulatory system of the urban economy. It connects people, goods, and ideas, enabling productivity and shaping land use. In cities, mobility is both **an economic enabler and a real-estate driver** — determining accessibility, land value, and development intensity.

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1. Introduction
 2. Theoretical Foundations of Transportation Economics
 3. Urban Mobility and Accessibility
 4. Economic Principles Governing Transport Systems
 5. Financing Urban Transport: Models and Mechanisms
 6. Transit-Oriented Development (TOD) and Real Estate
 7. Smart Mobility, Technology, and the Future of Transport
 8. Environmental, Social, and Equity Dimensions
 9. Global Case Studies
 10. Analytical Tools and Graphs
 11. Policy Challenges and Directions
 12. Implications for Real Estate Professionals



By the end of the lecture, you will be able to:

- **Explain** the economic foundations of transport systems and their interaction with urban form.
- **Apply** transport economics to real estate valuation and development analysis.
- **Evaluate** transport investment impacts using CBA frameworks.
- **Interpret** and critique global case studies of transport–land use integration.
- **Propose** sustainable mobility and real estate development strategies

1.Introduction

The relationship between transport and urban development is reciprocal:

- **Transport enables urban expansion**, influencing spatial form and real estate markets.
- **Urban growth generates transport demand**, requiring continuous infrastructure investment.



Why?

As cities pursue sustainability and efficiency, the economics of transportation become crucial in understanding how infrastructure influences **property values, urban form, and investment decisions**.

2. Theoretical Foundations of Transportation Economics

Example : Firm Mobility Decision

Context:

A logistics company (FastMove Ltd.) must decide where to locate a new **distribution warehouse**. They have three potential sites on the outskirts of the city, each with different accessibility and transport costs.

Site	Rent (\$/m ² /year)	Distance to Highway	Average Delivery Time to City	Fuel Cost per Delivery	Labor Accessibility
A	90	2 km	25 min	\$12	High
B	70	15 km	40 min	\$20	Medium
C	50	30 km	60 min	\$30	Low

1. Firm's Objective:

Minimize **total logistics cost**, which includes rent + transport + labor accessibility (measured as potential delay cost).

2. Theoretical Foundations of Transportation Economics

2. Economic Analysis:

Let's assume annual operating costs: $\text{Total Cost} = \text{Rent Cost} + (\text{Fuel Cost} \times \text{Number of Deliveries})$

If they make 20,000 deliveries per year:

Site	Rent (for 5,000 m ²)	Fuel Cost	Total Cost	Decision
A	\$450000	\$240000	\$690000	☒ Best Option
B	\$350000	\$400000	\$750000	
C	\$250000	\$600000	\$850000	

3. Decision Outcome:

Site A offers the lowest total cost despite higher rent, thanks to better accessibility.

This shows how **transport accessibility directly affects business location choices**, balancing land cost and logistics efficiency.

3. Urban Mobility and Accessibility

3.1 Defining Urban Mobility

Urban mobility encompasses all modes of movement — walking, cycling, public transport, and private vehicles — that enable access to urban resources.



3. Urban Mobility and Accessibility

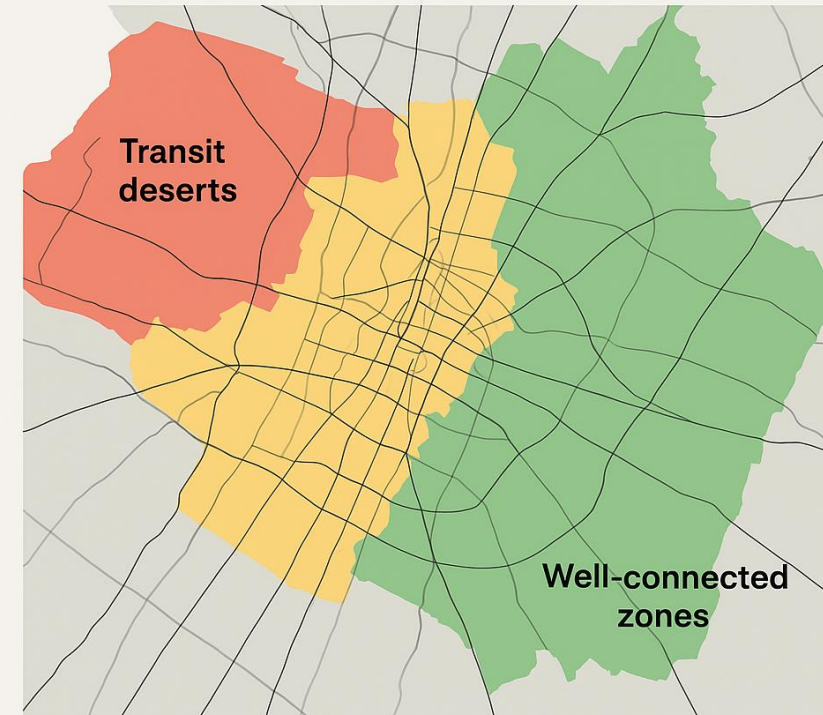
3.2 Accessibility as a Key Indicator

Accessibility measures the ease with which people can reach destinations within a given time and cost. It is more informative than “mobility” because it reflects **economic opportunity**.

Figure :

Accessibility map of a metropolitan area — highlighting “transit deserts” and well-connected zones.

Accessibility map of a metropolitan area



3. Urban Mobility and Accessibility

Example: Accessibility as a Key Indicator – Curitiba, Brazil

Curitiba is known worldwide for its **Bus Rapid Transit (BRT)** system, designed to make the entire city accessible quickly and affordably.

Indicator Used:

Average travel time to key destinations (jobs, schools, hospitals, and commercial centers) by public transport.

Findings: Before the BRT system (in the 1970s), only **45% of residents** could reach downtown Curitiba within **40 minutes** by bus.

After implementing the BRT corridors and integrated feeder routes:

85% of residents could reach the city center or a major employment hub within **40 minutes**.

Property values along transit corridors **increased by 20–30%**, showing how improved accessibility boosted real-estate attractiveness.

Low-income neighborhoods gained better access to education and health services, reducing spatial inequality.

3. Urban Mobility and Accessibility

Accessibility measures : We want to calculate **accessibility** for a residential location i (say, a neighborhood).

Accessibility depends on how many opportunities (jobs, schools, etc.) are reachable and how costly (in time or money) it is to reach them.

The general formula is:

$$A_i = \sum_j \frac{O_j}{c_{ij}}$$

Where:

A_i =accessibility at location i

O_j =number of opportunities (e.g., jobs) at destination j

c_{ij} =travel cost or time between i and j

3. Urban Mobility and Accessibility

Scenario Example

Suppose we have one residential area (i) and **three employment centers (j_1, j_2, j_3)**:

Destination (j)	Opportunities ($O_k = \text{jobs}$)	Travel Time from i (c_{ij} , minutes)
j_1 – Downtown	10,000 jobs	20 min
j_2 – Industrial Zone	8,000 jobs	40 min
j_3 – Suburban Center	6,000 jobs	60 min

Step 1: Apply the formula

$$A_i = \frac{10,000}{20} + \frac{8,000}{40} + \frac{6,000}{60}$$

$$A_i = 500 + 200 + 100 = 800$$

3. Urban Mobility and Accessibility

Interpretation

The **accessibility index ($A_i = 800$)** summarizes how easily residents at location i can reach available jobs.

If travel times decrease (e.g., through better transit), or if new job centers open nearby, A_i **increases**, meaning improved accessibility.

Planners can compare different areas:

A neighborhood with $A_i = 1200$ has higher accessibility than one with $A_i = 500$.

Policy Insight

This measure helps cities:

Identify “**transit deserts**” (areas with low A_i).

Evaluate **impacts of new transport projects** on job accessibility.

Prioritize **infrastructure investments** where accessibility improvements will benefit more residents.

3. Urban Mobility and Accessibility

Case Study: Accessibility Analysis for a New Hospital

Background

A private healthcare company planned to build a new **specialty hospital** in Dubai. The goal was to choose a site that maximizes access to residential areas while ensuring short travel times for emergency access.

Approach

Data used: Road network, population density, and travel-time data from Google Maps API.

Method: GIS-based **accessibility index** using travel-time zones (0–15, 15–30, 30–45 min) weighted by population.

Sites evaluated: Three candidate plots.

3. Urban Mobility and Accessibility

Site	Avg. Travel Time	Population	Accessibility Index	Decision
1	22 min	750000	34	☒ Selected
2	28 min	640000	23	—
3	35 min	520000	15	—

Outcome

Site 1 selected for its superior accessibility and proximity to major roads.

Accessibility score supported a **15% higher land valuation** justified by wider catchment reach and strong market demand.

The project achieved high feasibility ratings from investors and planners.

Key Lesson

→ **Accessibility directly influences site desirability, property value, and financial success.**

Integrating GIS-based accessibility analysis ensures smarter investment and sustainable urban growth.

4. Economic Principles Governing Transport Systems

4.1 Supply and Demand in Transport

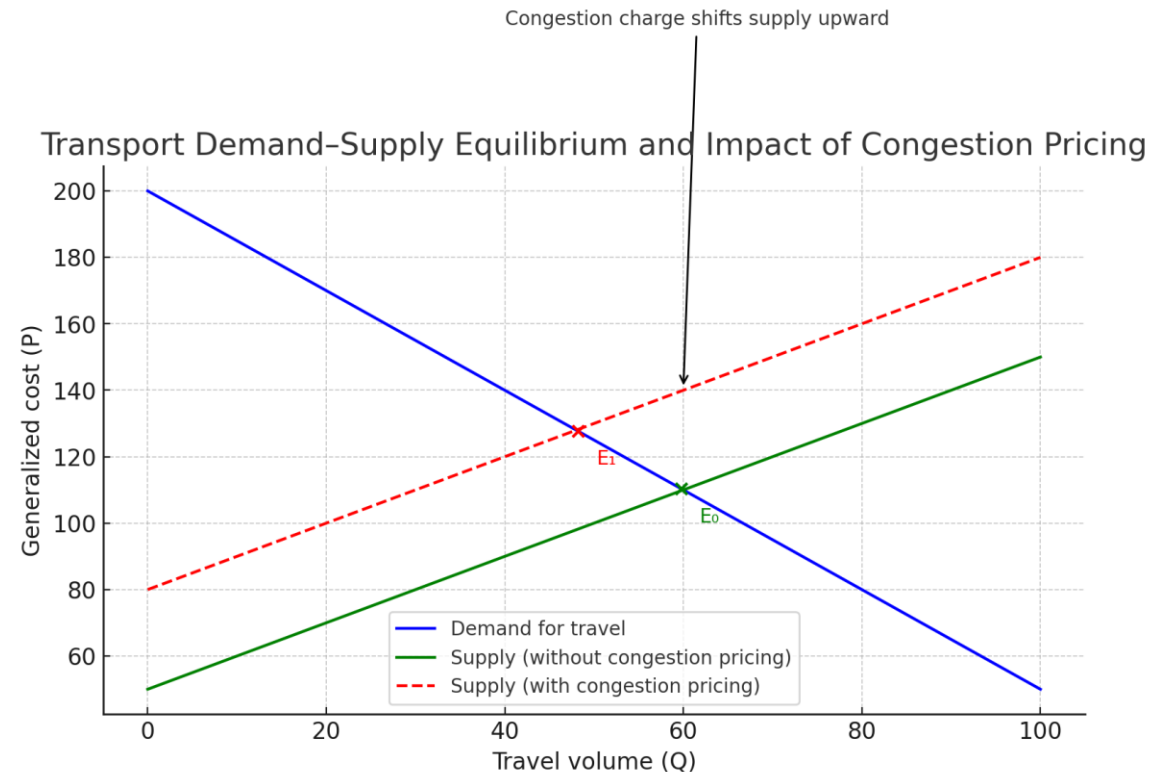
Supply: Infrastructure capacity, road space, or public transit seats.

Demand: Trips made per person per mode.

Equilibrium occurs where generalized cost equals perceived benefit of travel.

Figure:

Transport demand–supply equilibrium curve showing the impact of congestion pricing. The **red dashed line** shows the supply curve **with congestion pricing**, which shifts upward as travelers face an additional charge, leading to a new equilibrium E_1 with **lower traffic volume** and **higher generalized cost**.



4. Economic Principles Governing Transport Systems

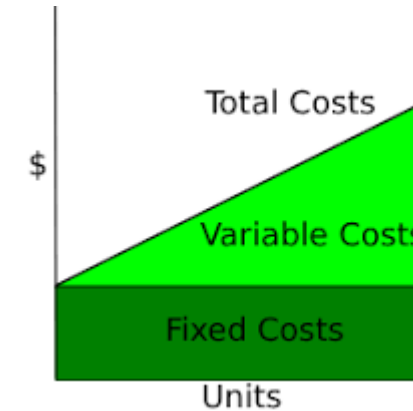
4.2 Cost Structures

1.Fixed Costs:

These are costs that do **not change with the number of passengers or trips** in the short term.

Examples:

- Construction of bus terminals and depots
- Purchase of buses and ticketing systems
- Maintenance of roads and dedicated bus lanes
- Salaries of administrative staff



→ *Even if only a few passengers use the service, these costs remain constant.*

4. Economic Principles Governing Transport Systems

4.2 Cost Structures

2. Variable Costs

These costs **increase with usage**—the more buses operate, or the longer the routes, the higher the costs.

Examples:

Fuel: More kilometers → higher diesel consumption

Driver wages: More trips → more paid hours

Vehicle wear and tear: Tires, brakes, and engine parts degrade with distance

Emissions: More fuel burned → higher pollution cost

→ *If demand doubles, variable costs roughly double too.*

4. Economic Principles Governing Transport Systems

4.2 Cost Structures

3. **Average Cost (AC)** Critical for pricing and subsidy policies.

$$AC = \frac{\text{Total Cost}}{\text{Number of Passenger-Kilometers}}$$

Measures the **cost per unit of service** (e.g., per passenger per kilometer).

Example: If total daily cost = \$10,000 and total passenger-kilometers = 50,000,

$$\rightarrow AC = \frac{10,000}{50,000} = 0.20 \text{ USD per passenger-k}$$

4. Economic Principles Governing Transport Systems

4.3 Externalities

1. Congestion (Time Cost to Others)

Description: Each additional vehicle slows down others, increasing travel time for everyone.

Example:

During morning peak hours in London, average speed may fall from **40 km/h to 15 km/h**.

A single extra car entering a congested route can impose **delay costs** on hundreds of others.

Estimated external cost: ~£0.15–£0.30 per vehicle-km (UK Department for Transport, 2023).

4. Economic Principles Governing Transport Systems

4.3 Externalities

2. Emissions and Noise

Description: Cars emit CO₂, NO_x, and particulates, contributing to air pollution and climate change. Noise also reduces residents' quality of life.

Example:

A petrol car emits ~180 g CO₂ per km → adds to greenhouse gas accumulation.

Health damages from vehicle emissions in urban areas are estimated at **€0.10–€0.25 per km** (European Environment Agency, 2022).

Noise pollution near busy roads reduces property values by up to **10%** in some neighborhoods.

4. Economic Principles Governing Transport Systems

4.3 Externalities

3. Land Consumption

Description: Roads, parking lots, and highways occupy valuable urban land that could be used for housing, green spaces, or businesses.

Example:

In Los Angeles, parking spaces occupy nearly **one-third of urban land**.

The opportunity cost of land used for car infrastructure may exceed **\$5–10 million per hectare** in central areas.

4. Economic Principles Governing Transport Systems

4.3 Externalities

4. Accident Risks

Description: Road crashes impose costs beyond drivers' own risks — on victims, emergency services, and healthcare systems.

Example:

The average *social cost* of road accidents (fatalities, injuries, property damage) in the EU is about **€0.07 per vehicle-km**.

Pedestrians and cyclists often bear the brunt of these externalities.

4. Economic Principles Governing Transport Systems

Summary Table: Typical External Costs of Urban Car Use

Externality Type	Example Cost (per vehicle-km)	Key Impact
Congestion	£0.20	Lost time for others
Emissions & Noise	€0.15	Health & environmental damage
Land Consumption	€0.10	Loss of urban space
Accident Risks	€0.07	Medical and social costs
Total External Cost	≈ €0.50 per km	Significant hidden social burden

policy Implications

Because of these external costs, cities implement:

Congestion pricing (e.g., London, Stockholm)

Low-emission zones or electric vehicle incentives

Public transport investment

Road safety campaigns and design improvements

5. Financing Urban Transport Mechanisms

Cost–Benefit Analysis (CBA)

Evaluates whether the benefits (time savings, safety, value uplift) exceed total costs.

$$B/C \text{ Ratio} = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}}$$



Cost Benefit Analysis: Is This Worth It or a Money Pit?

5. Financing Urban Transport Mechanisms

Example: Building a Small Rural Road

1. Project Description

A government plans to **pave a 10 km gravel road** connecting a rural village to the main highway. The goal is to reduce travel time, vehicle maintenance costs, and improve access to markets and schools.

Type of Cost	Amount (USD)	When	Notes
Construction	200000	Year 1	Building and paving the road
Annual Maintenance	100,000 per year	Years 2–10	Routine repairs and cleaning

5. Financing Urban Transport Mechanisms

2. Project Benefits

Type of Benefit	Annual Value (USD)	Description
Travel Time Savings	150000	Farmers reach markets faster
Vehicle Operating Cost Savings	120000	Less wear on vehicles
Accident Reduction	30000	Smoother and safer road
Increased Economic Activity	100000	Easier transport of goods and people
Total Annual Benefit	400000	

5. Financing Urban Transport Mechanisms

3. Economic Evaluation

Project lifetime: 10 years

Discount rate: 5%

Step 1: Calculate Present Value (PV) of Benefits

$$PV_{Benefits} = 400,000 \times \frac{1 - (1 + 0.05)^{-10}}{0.05} = 400,000 \times 7.722 = 3,089,000$$

Step 2: Calculate PV of Costs

Construction = 2,000,000 (in Year 1)

Maintenance = $100,000 \times 7.722 = 772,000$

$$PV_{Costs} = 2,000,000 + 772,000 = 2,772,000$$

5. Financing Urban Transport Mechanisms

Indicator	Calculation	Result	Interpretation
Net Present Value (NPV)	$PV(\text{Benefits}) - PV(\text{Costs})$	$3089000 - 2772000 =$ +317000	Positive → project is worthwhile
Benefit–Cost Ratio (BCR)	$PV(\text{Benefits}) / PV(\text{Costs})$	$3089000 / 2772000 =$ 1.11	Each \$1 spent gives \$1.11 in benefits
Conclusion	—	Economically viable	Small but positive benefit

Key Takeaways

- ✓ Easy-to-measure costs and benefits
- ✓ Positive NPV → good public investment
- ✓ Simple CBA helps justify funding and prioritization of rural roads

6. Transit-Oriented Development (TOD) and Real Estate

6.1 Concept

TOD promotes compact, mixed-use, pedestrian-friendly communities centered around high-quality transit.

6.2 Benefits

Reduces car dependence

Encourages sustainable urban growth

Enhances real estate value

Improves public health and livability

6.3 Design Principles (Calthorpe, 1993)

High density within 400–800 meters of stations

Mixed-use zoning

Pedestrian-friendly design

Integrated public spaces



6. Transit-Oriented Development (TOD) and Real Estate

Case Study: Hong Kong – MTR Transit-Oriented Development (TOD)

Overview

Benefit

Economic

Social

Environmental

Urban Efficiency

Result

Real estate profits financed most of the metro line construction costs

Easy access to housing, work, and shopping within one area

Low car use (under 10% ownership), reduced emissions and congestion

48% of all daily trips made by MTR; compact, walkable urban form

6. Transit-Oriented Development (TOD) and Real Estate

Challenges

High property prices → affordability issues

Need for more mixed-income housing around TOD sites

Lessons Learned

Integrate land-use and transport planning early.

Use **value capture** (development rights, joint ventures) to finance infrastructure.

Prioritize **walkability** and **mixed-use density** near transit hubs.

Maintain **social balance** to avoid exclusive luxury zones.



7. Smart Mobility, Technology, and the Future of Transport

7.1 Intelligent Transport Systems (ITS)

Use of sensors, GPS, and real-time data for traffic optimization.

7.2 Mobility-as-a-Service (MaaS)

Integration of multiple transport modes (bus, metro, car-share, bike) through a unified digital platform.

7.3 Electric and Autonomous Vehicles (EV/AV)

Potential to reshape parking demand, urban form, and environmental performance.



7. Smart Mobility, Technology, and the Future of Transport

Example: Singapore's Intelligent Transport System (ITS)

Overview

Singapore uses an advanced **ITS** combining **sensors, GPS, and real-time data** to manage traffic efficiently and reduce congestion.

Technology

Sensors & Cameras

GPS Tracking

Electronic Road Pricing (ERP)

Adaptive Traffic Signals

Traveler Information Systems

Function

Monitor traffic flow and detect incidents.

Used in buses, taxis, and delivery fleets for route optimization and arrival prediction.

Automatic congestion charge using RFID gantries.

Adjust green light timing based on real-time traffic.

Provide live updates via apps and roadside message boards.

7. Smart Mobility, Technology, and the Future of Transport

Example in Action

- Sensors detect congestion on expressways.
- ERP rates automatically increase to reduce traffic.
- Signals adjust in real time; commuters receive alternative route alerts.

Results

- ✓ 20% reduction in travel time
- ✓ Lower emissions and fuel use
- ✓ Faster accident response



8. Environmental, Social, and Equity Dimensions

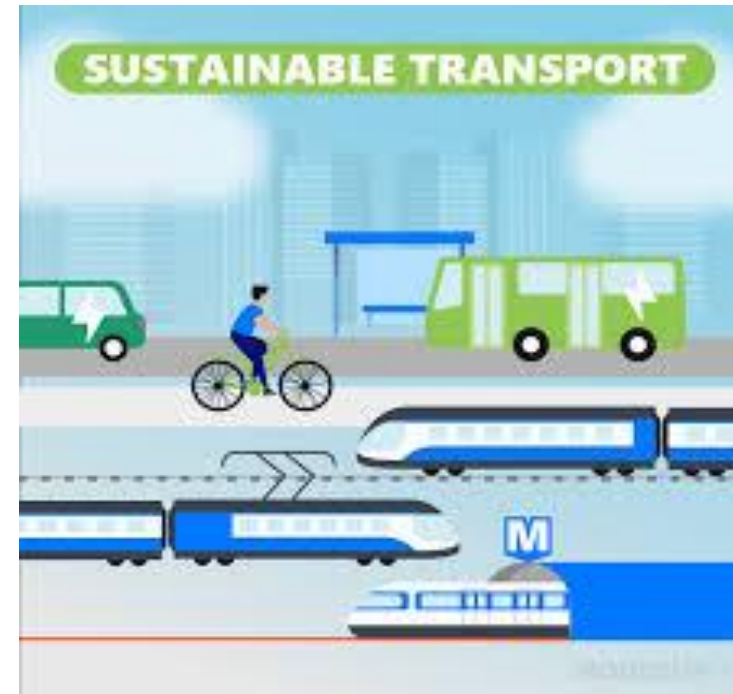
Environmental: Transport is responsible for 25% of CO₂ emissions globally.

Social: Mobility inequities reinforce spatial segregation.

Economic: Lack of transport access limits labor participation and productivity.

Sustainable transport policies focus on:

- Compact urban form
- Non-motorized mobility (walking, cycling)
- Public transport enhancement
- Inclusive access for low-income groups



9. Global Case Studies

Case 1: London Congestion Charge

Introduced in 2003; charge of £15/day for entering central London.

Results: 15% reduction in traffic, 20% rise in bus ridership.

Revenue reinvested in public transport improvements.

Case 2: Hong Kong MTR “Rail + Property” Model

MTR finances rail expansion by developing property above/around stations.

The model generates sustainable revenue and promotes transit-oriented growth.

Example: Tung Chung Line generated HK\$ 20 billion from adjacent property leases

10. Global Case Studies

Case 3: Curitiba BRT, Brazil

Early adopter of integrated bus rapid transit with land-use planning.
High accessibility, low emissions, and equitable transport outcomes.

Case 4: Dubai Metro

Real estate values within 500m of stations increased 15–25%.
Developers capitalize on station proximity for mixed-use projects along Sheikh Zayed Road.

Case 5: Singapore

Integrates transport with land policy through the Urban Redevelopment Authority (URA).
Uses congestion pricing, high parking fees, and transit-oriented zoning.

10. Analytical Tools and Graphs

Tool	Application	Example
Cost–Benefit Analysis	Evaluate project viability	Metro extension
GIS Accessibility Mapping	Identify transport deserts	Real estate site selection
Pricing Model	Estimate impact of transport proximity	Housing price analysis
Elasticity Models	Forecast mode shift	Public transport fare policies

11. Policy Challenges and Directions

Challenge	Impact	Policy Option
Urban congestion	Productivity loss	Congestion pricing, telework incentives
Climate change	Emission targets	Electrification, modal shift
Funding gaps	Infrastructure delays	PPPs, value capture
Inequality	Reduced access	Affordable transit, inclusionary zoning
Coordination failure	Inefficient planning	Integrated land–transport agencies

12. Implications for Real Estate Professionals

- ❑ Transport investments create **location advantages** and **market differentiation**.
- ❑ Developers must anticipate **infrastructure timing** and **policy changes**.
- ❑ Accessibility analysis supports **site selection, valuation,** and **market feasibility**.
- ❑ Collaborations between **real estate developers and transit agencies** can unlock mutual benefits through joint development.



Conclusion

The economic concepts of marginal cost pricing, congestion management, accessibility, and value capture reveal how rational planning and sound policy can reduce inefficiencies and align private behavior with social welfare. Smart transportation systems, digital mobility platforms, and the transition toward low-carbon modes of transport represent not only technological shifts but also economic transformations that redefine urban mobility patterns.

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As urbanization continues to accelerate, policymakers and planners must recognize that every transportation decision is also an economic decision, shaping not only mobility but also social equity, competitiveness, and the long-term livability of our urban environments.



Thank You