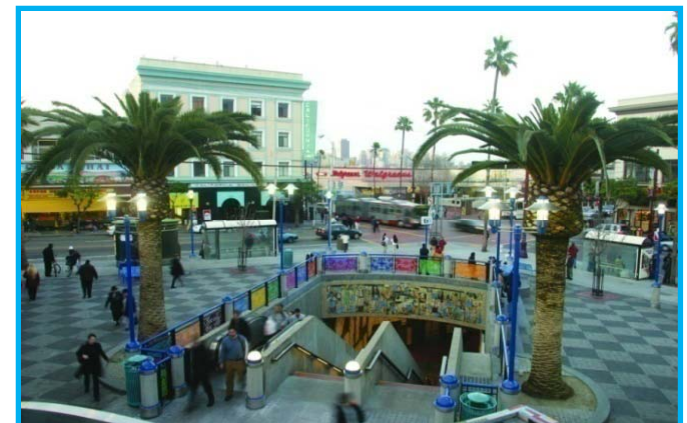
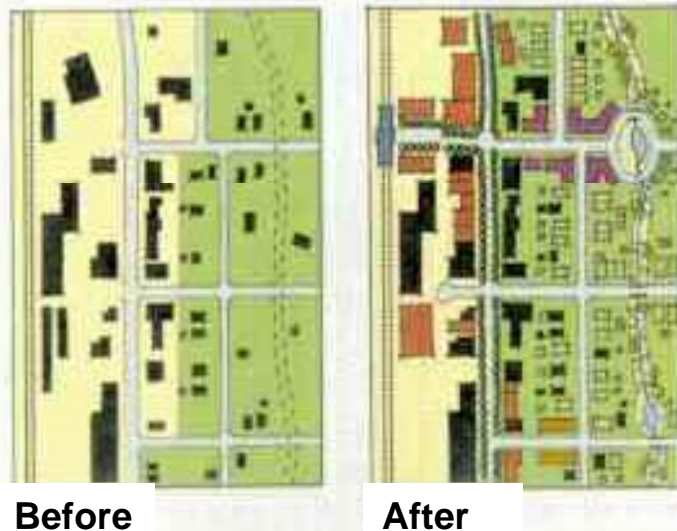
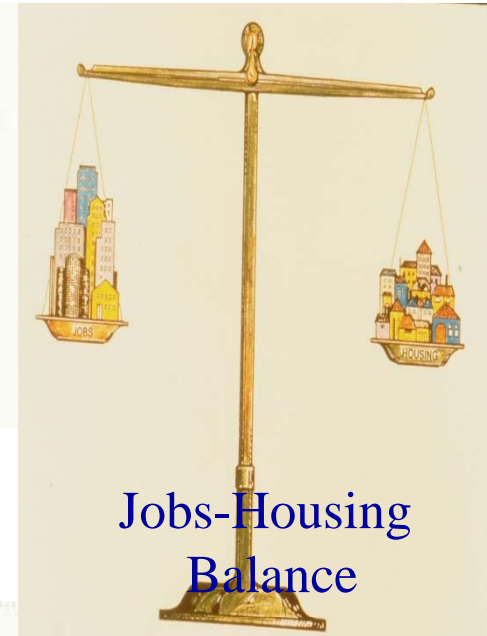


# Urban Planning & Active Living Research

- Urban planning: long rooted in health concerns...
  - Density & crowding
  - Incompatible uses & exclusionary zoning
  - Sanitation
  - Building codes & public safety
  - Clean air mandates
  
- Increasingly inclusionary & trans-disciplinary
  - Bringing key stakeholders together – developers, citizens, employers, environmental advocates, public health officials



# Diversity & Inclusion

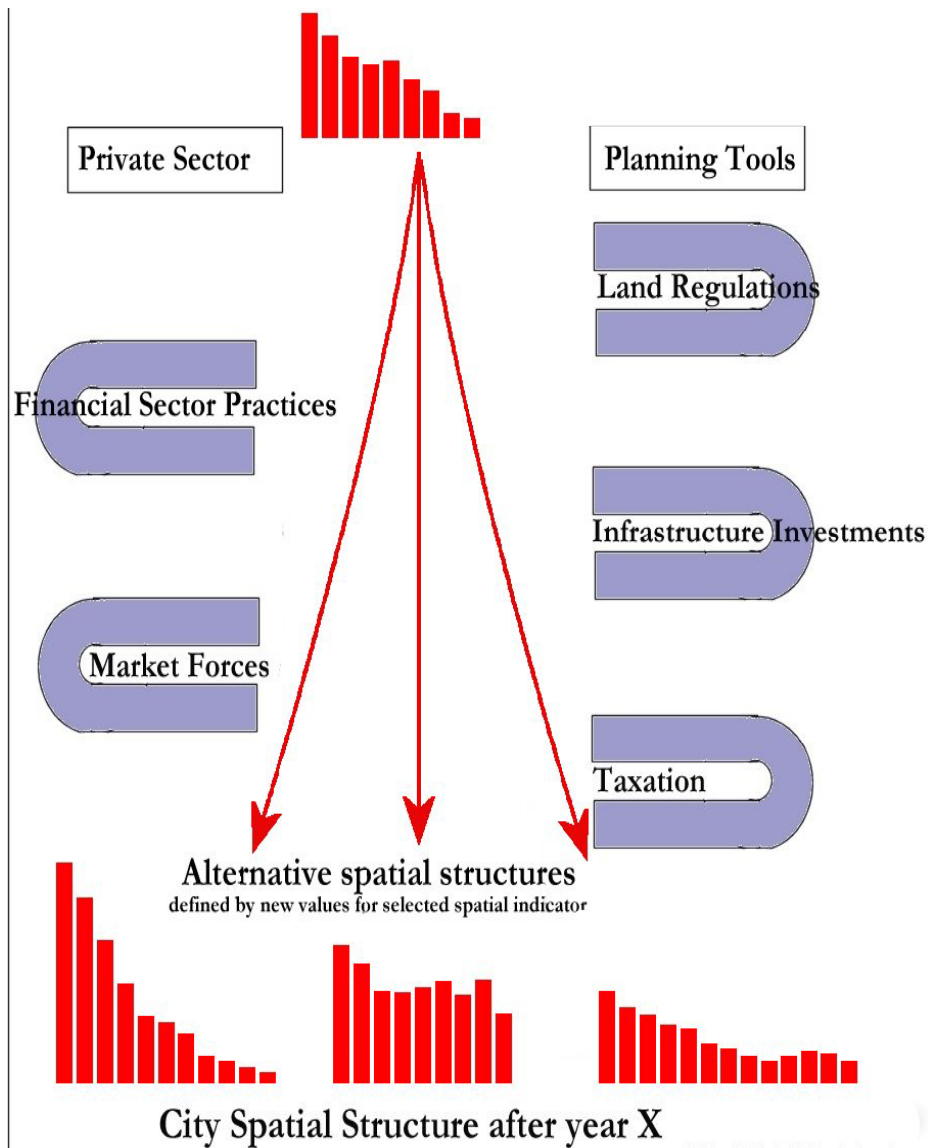


Re-Use & Selective Infill

# Urban Planning: Spheres & Implementation Tools

Private

Public

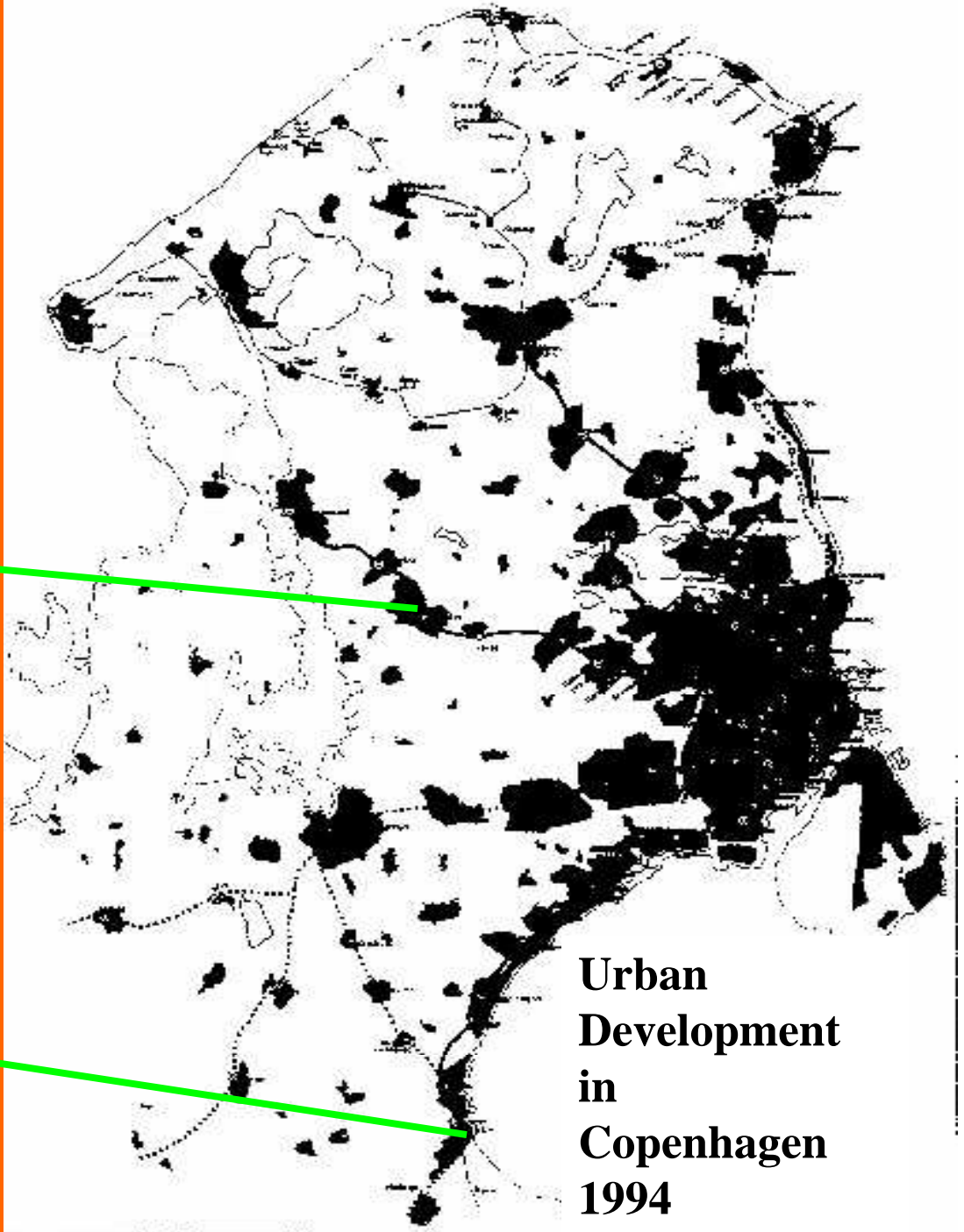


- General Plans/Neighborhood Plans
- Zoning, Subdivision Regulations, Building Codes
- Design Guidelines
- Impact & Environmental Review (NEPA/EIS)
- Land Banking/UGB
- Targeted Infrastructure Investment
- Tax Increment Financing
- Enterprise Zones
- Tax Abatement

# COPENHAGEN

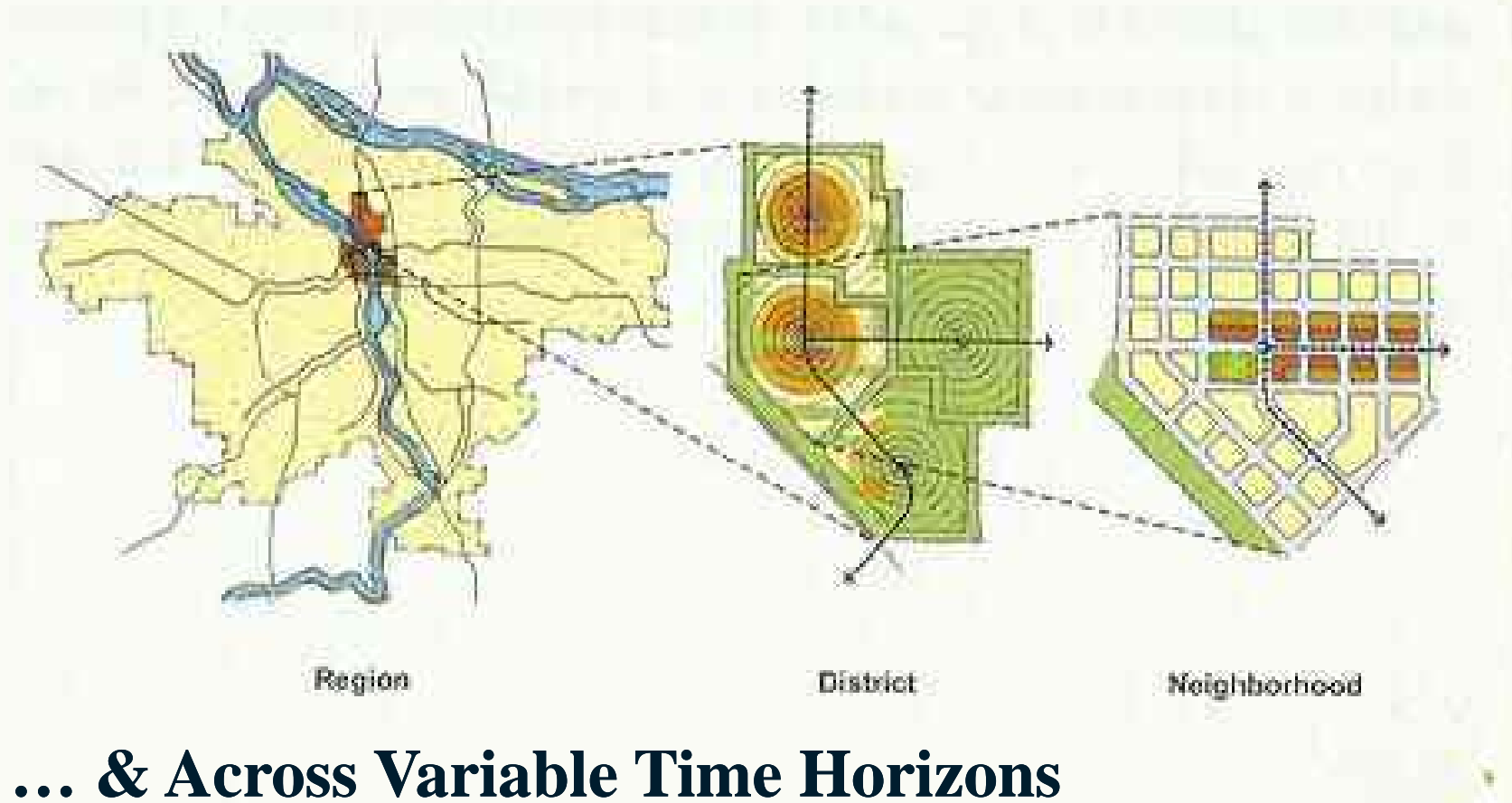
From Vision  
to Plan

... to  
Execution



# Urban Planning: Temporal & Spatial Contexts

## ➤ Planners Work at Multiple Scales



## ➤ ... & Across Variable Time Horizons

- Managing & regulating existing growth
- Forward-looking: anticipating & guiding future growth

## Neighborhood Grocery Store Access

1/4 Mile Isochrones, Imputed from City Block Data

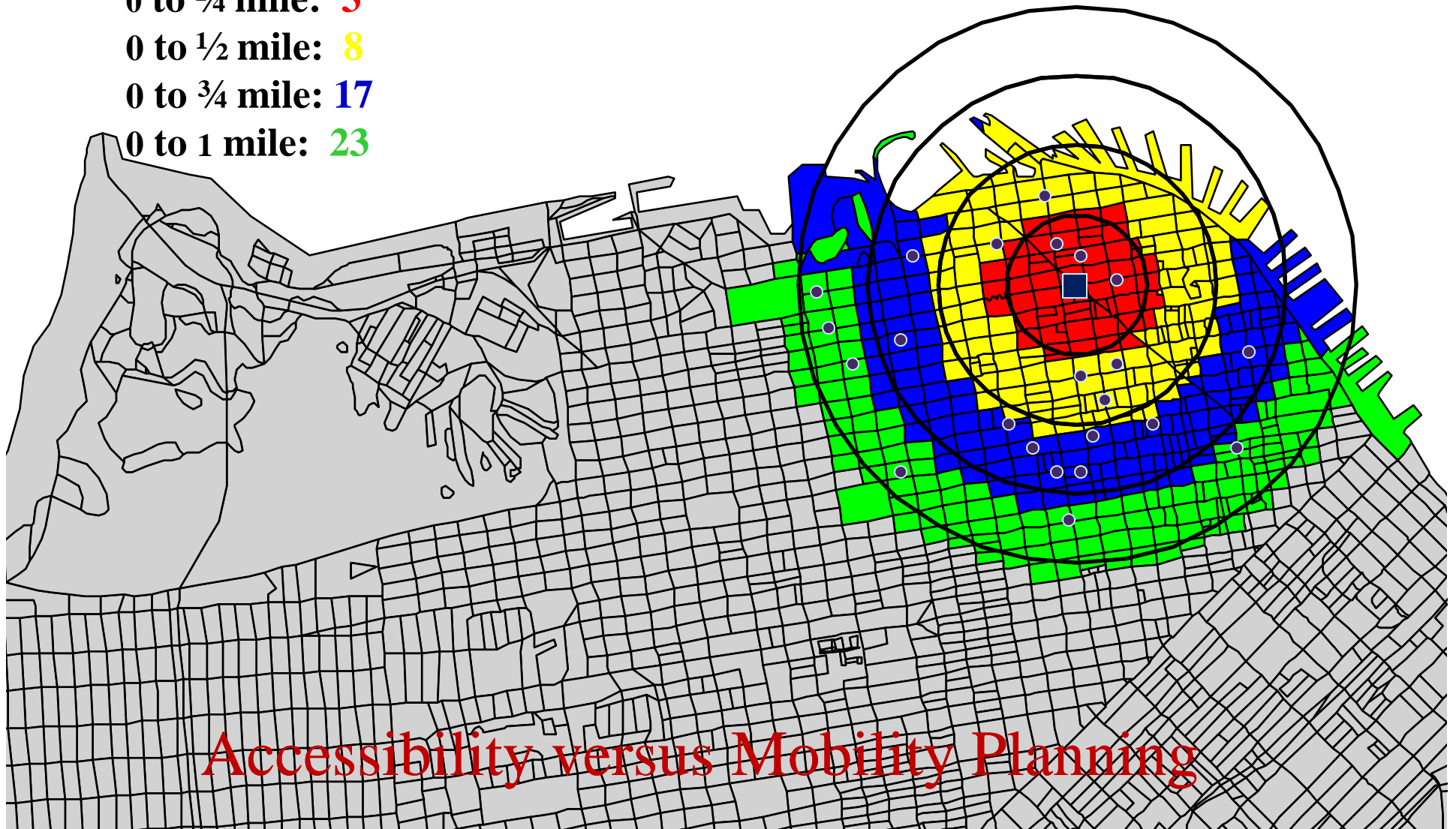
No. of Convenience Retail Stores (< 5000 ft.<sup>2</sup>) within Isochrone

0 to 1/4 mile: 3

0 to 1/2 mile: 8

0 to 3/4 mile: 17

0 to 1 mile: 23

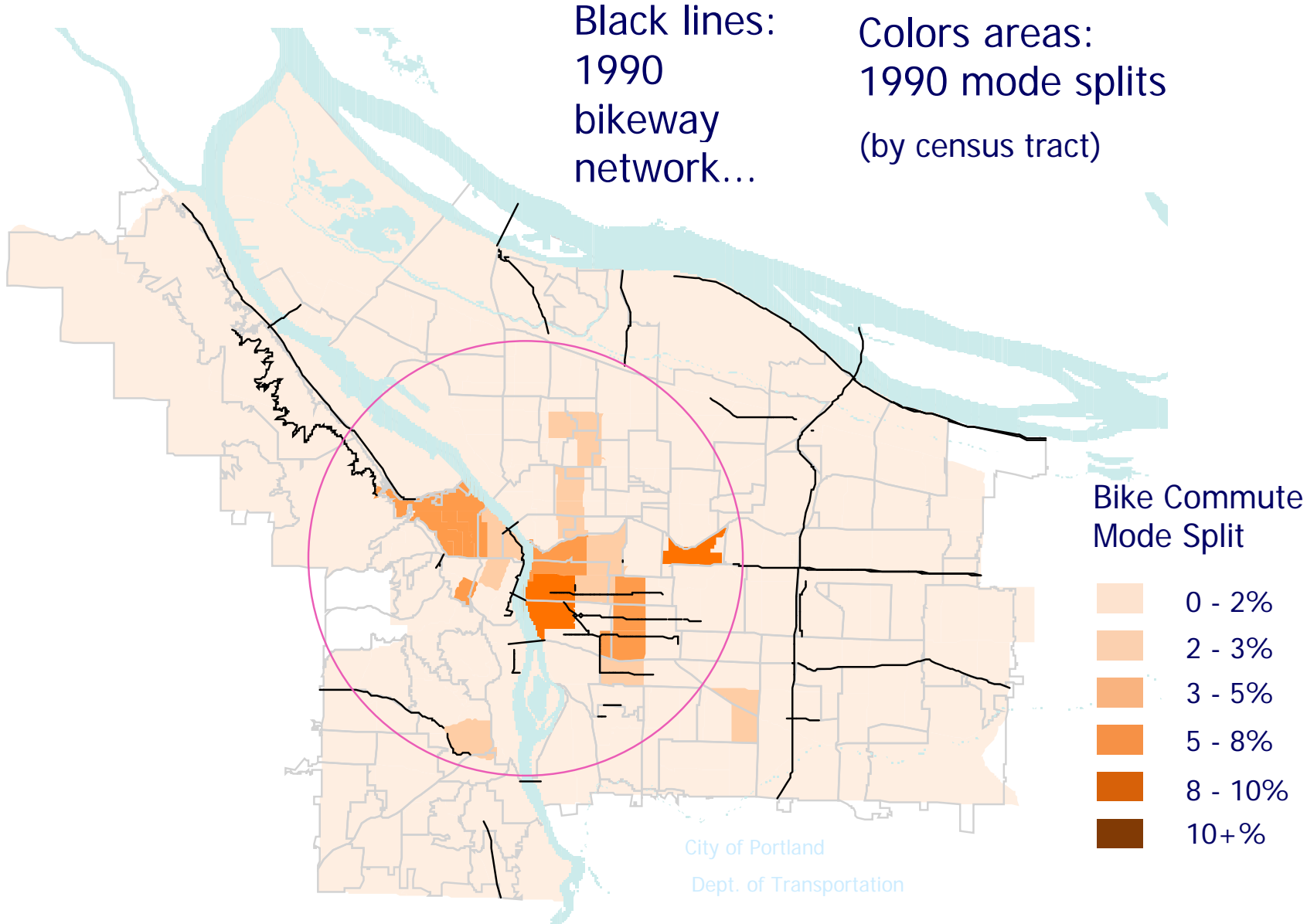


Accessibility versus Mobility Planning

# BUILDING A NETWORK

Bike lanes encourage bike commuting:

## Portland, Oregon 1990

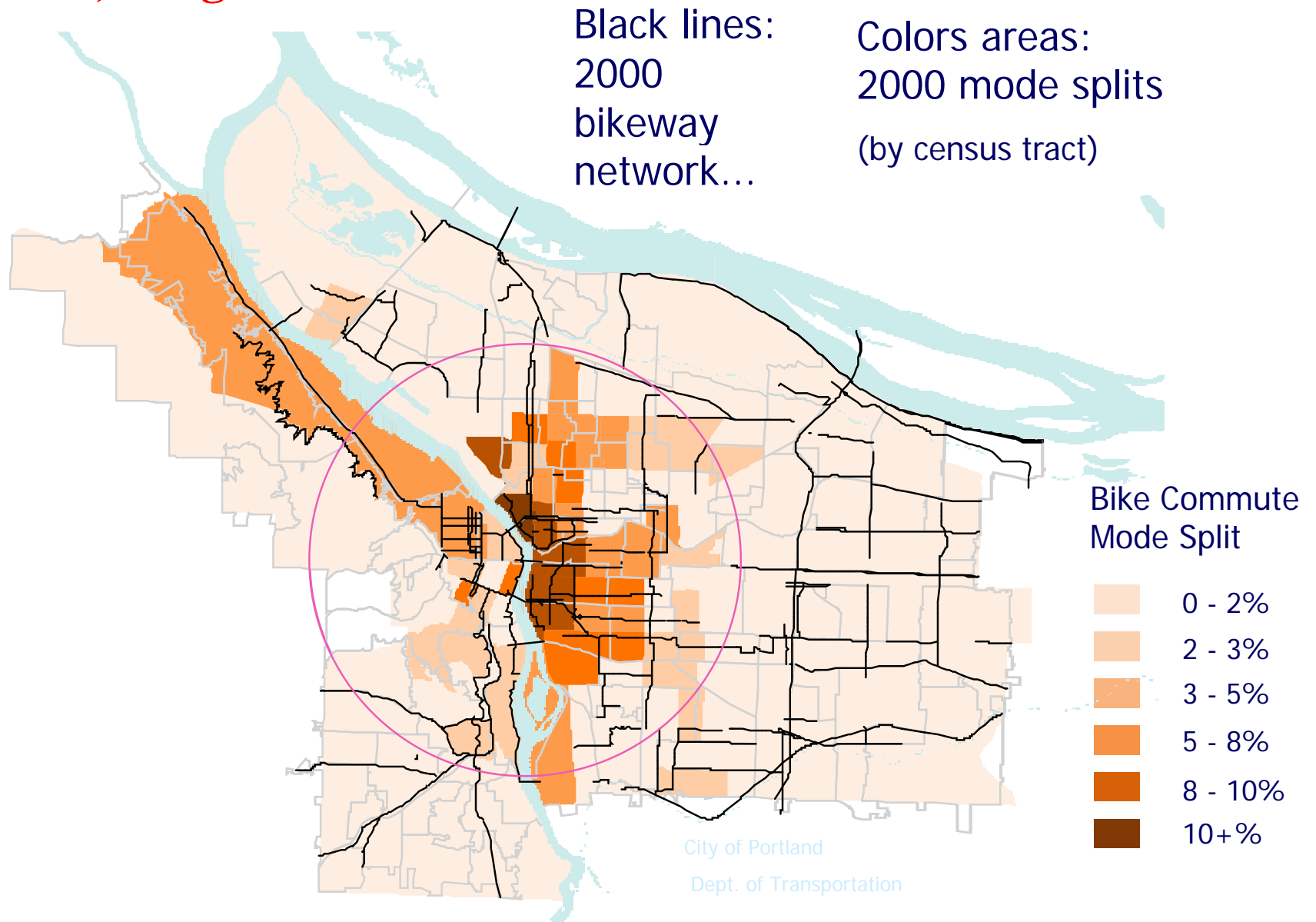


# BUILDING A NETWORK

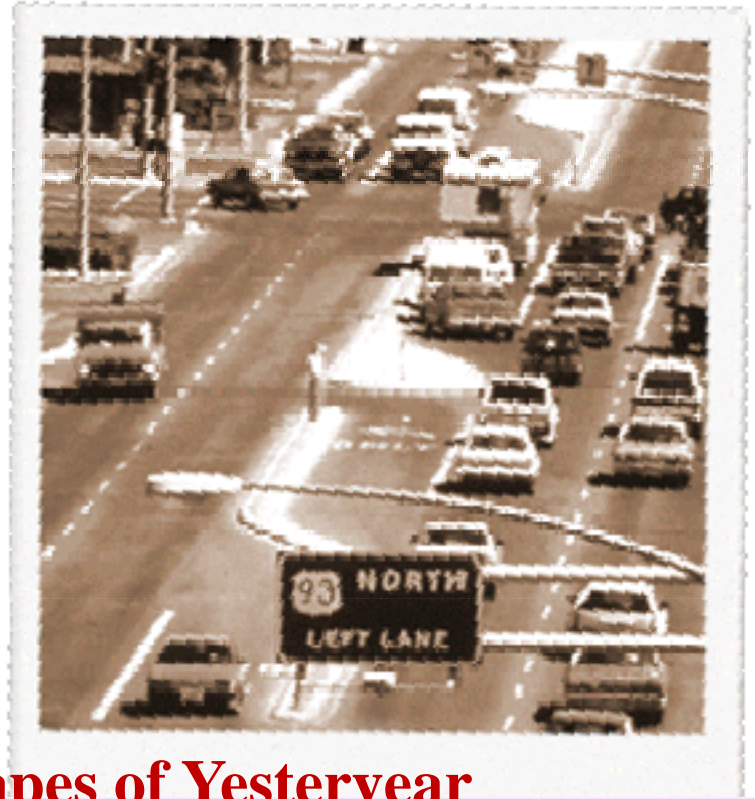
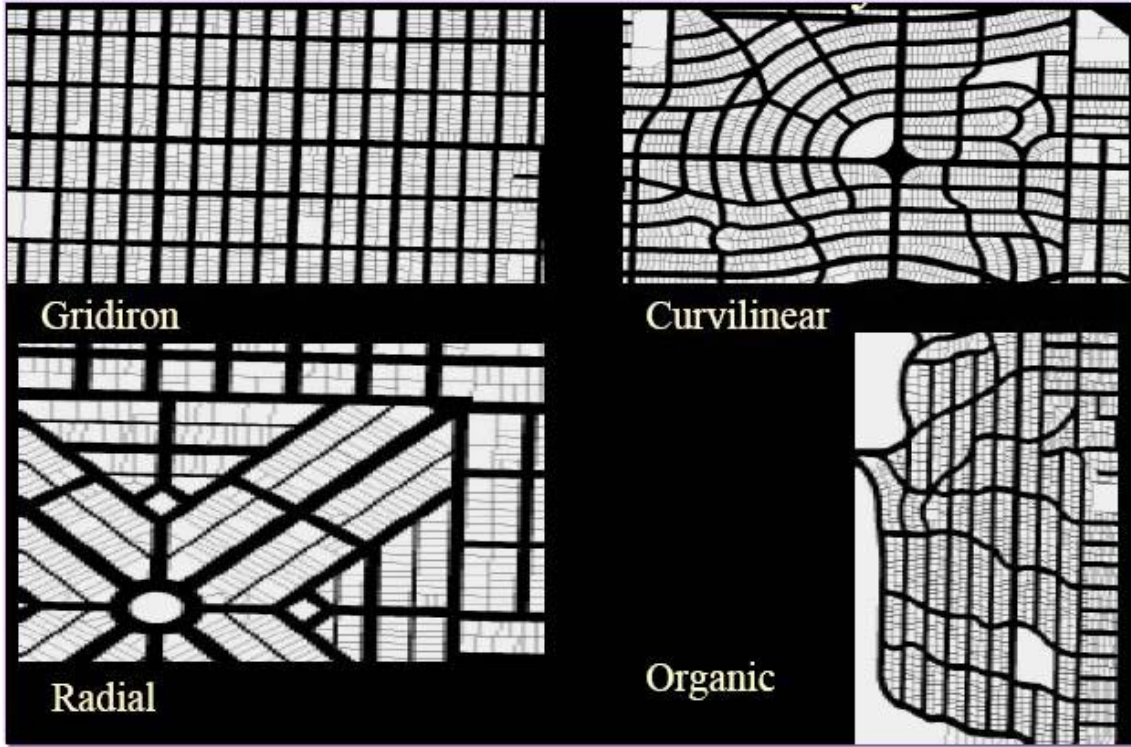
Bike lanes encourage bike commuting:

**Portland, Oregon 2000**

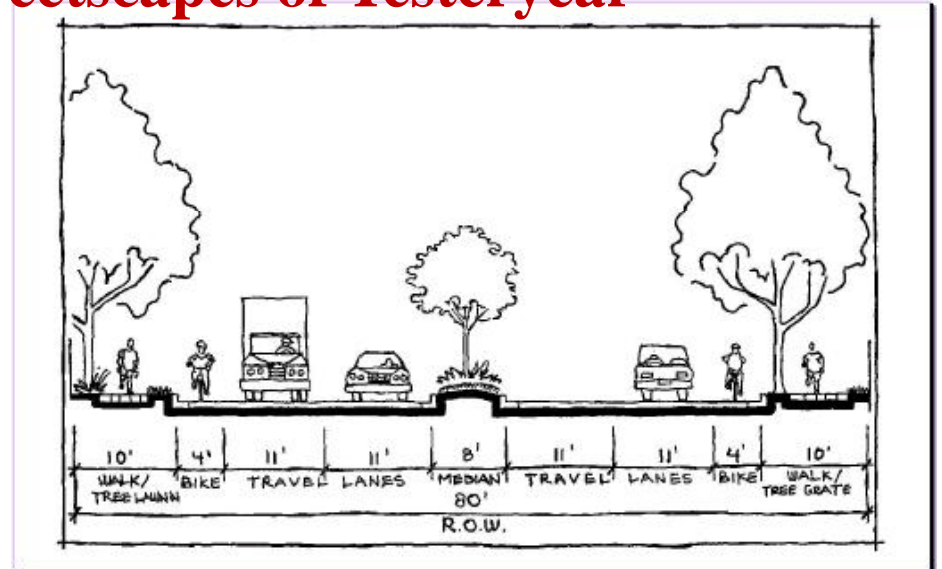
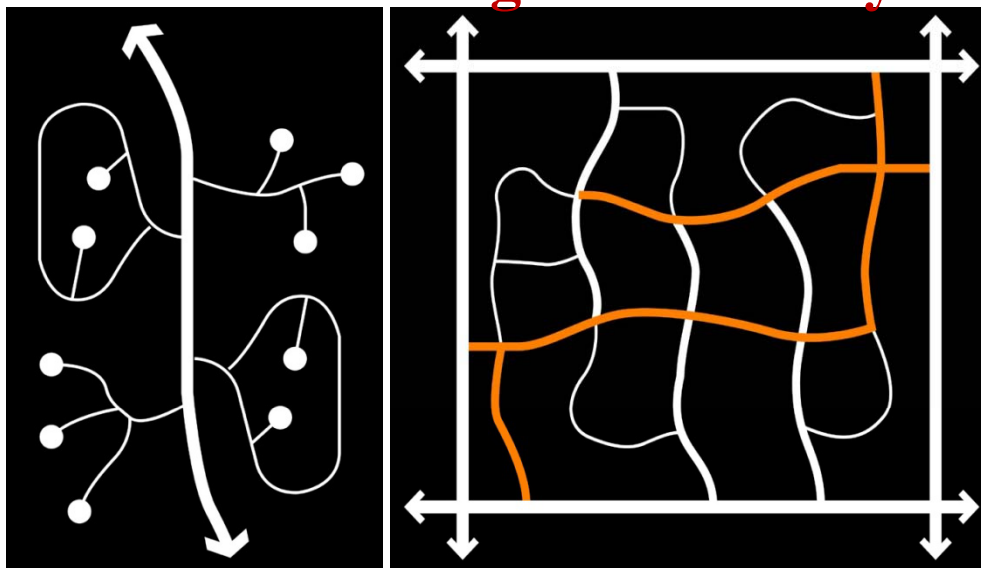
**Build It &  
They Will Come**







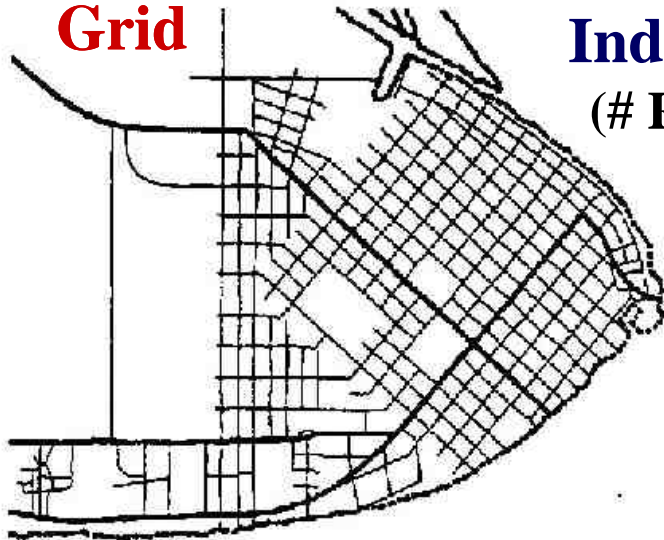
## Re-Creating Ped-Friendly Streetscapes of Yesteryear



# Measuring Connectivity

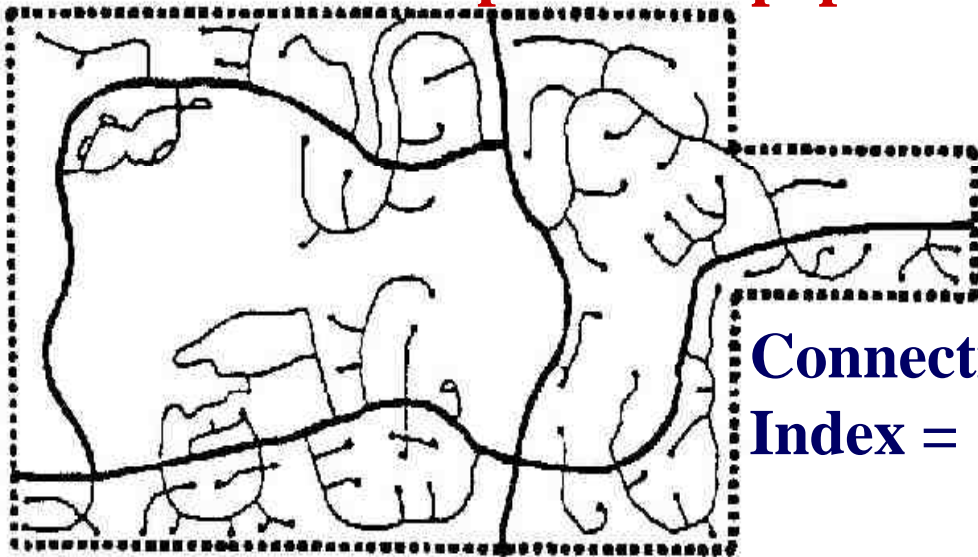
## Connectivity

### Grid



$$\text{Connectivity Index} = \frac{\text{\# Roadway Links}}{\text{\# Nodes}} = 1.7$$

### Curvilinear: Loops & Lollipop



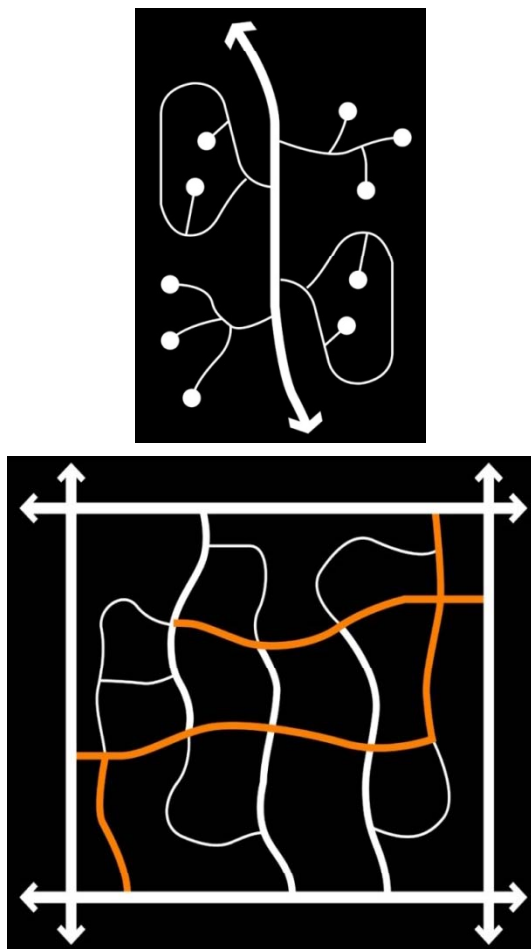
$$\text{Connectivity Index} = 1.2$$

## Traditional Urbanism

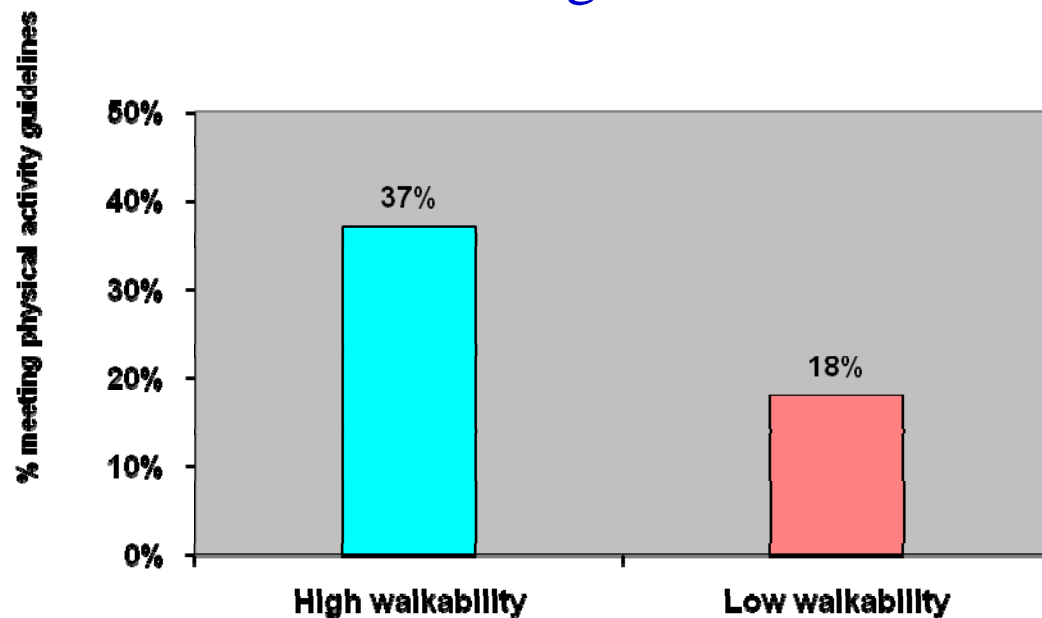
## New Urbanism

	ELMWOOD (1905)	KENTLANDS (1989)	LAGUNA WEST (1990s)
Street Patterns			
Intersections			
Lineal Feet of Streets	18,000	24,000 (alleys 7,000)	19,000
Number of Blocks	23	24 (w.o. alleys 14)	16
Number of Intersections	20	41 (with alleys)	20
Number of Access Points	17	22	14
Number of Loops & Cul-de-sacs	1	10	15

**Atlanta adults:** accelerometer showed people who live in walkable neighborhoods are more likely to meet recommended daily levels of physical activity.



## Road Designs Matter!



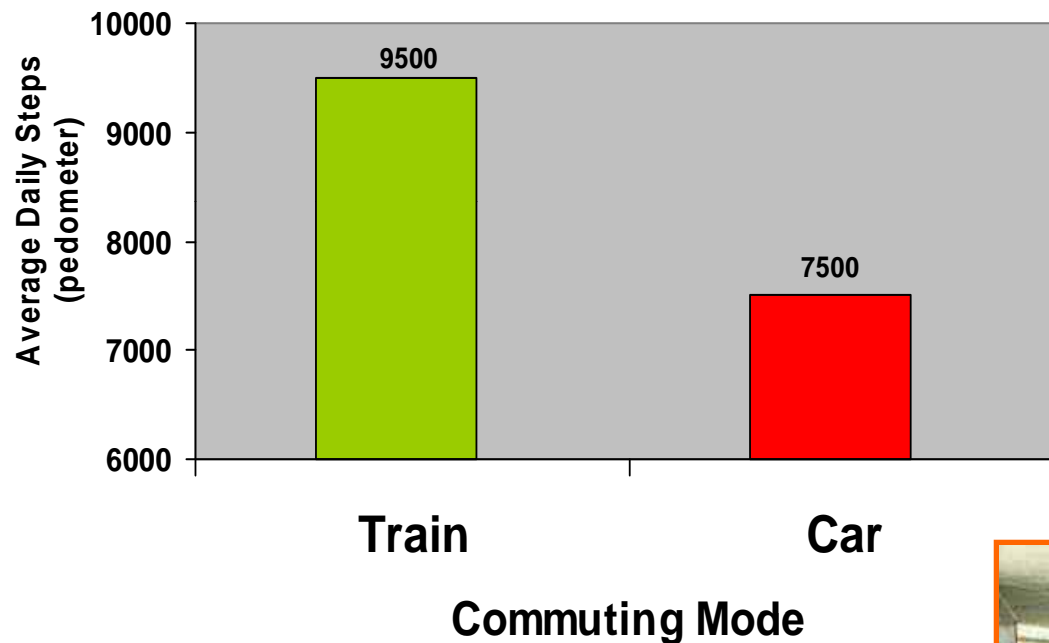
Frank, Schmid, et al., Am J Prev Med, 2005

# Complete Streets



# Walking & Public Transit

Daily steps are higher among adults who commute by train instead of car



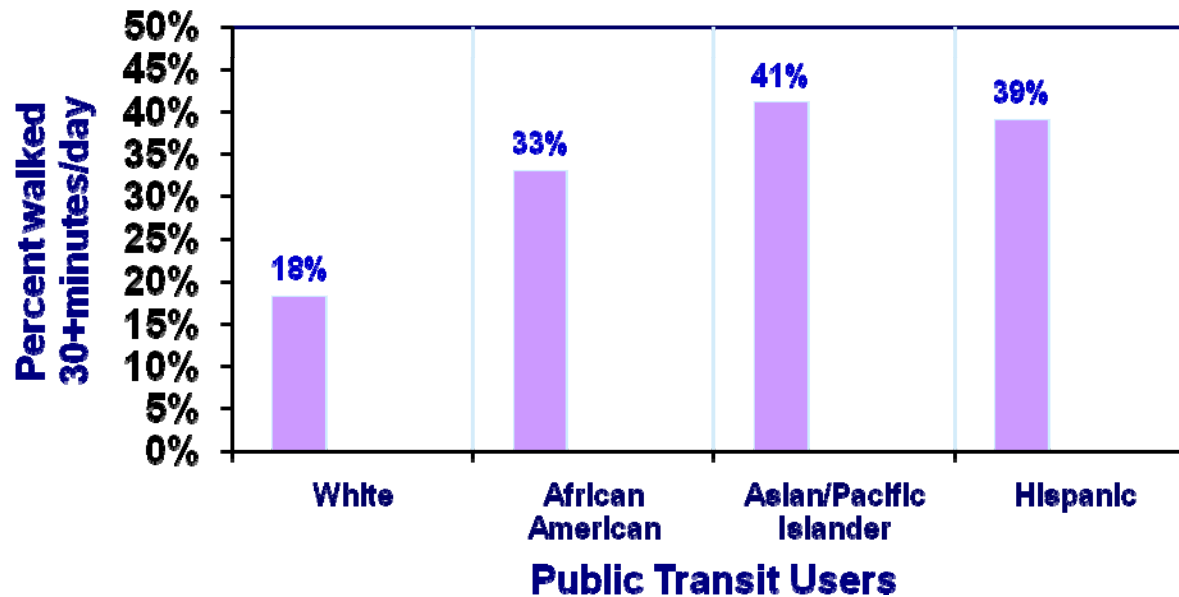
**Pedometer data** collected from over **100 New Jersey train and car commuters** revealed that **those who commuted by train walked 30% more steps a day** and were 4 times more likely to meet recommended 10,000 steps daily than car commuters.

Wener & Evans, Environment and Behavior, 2007



# Walking & Public Transit: Pro-Inclusiveness

2001 National Household Travel Survey (N=3,312): 29% of public transit users achieve the Surgeon General's recommendation of 30 minutes or more of physical activity a day while walking to and from transit. Racial/ethnic minorities reported even greater percentages of achieving the recommended level of activity.



Besser & Dannenberg, Am J Prev Med, 2005



Portland  
Oregon's  
Pearl  
District

# Ped-Friendly TOD: Fruitvale BART

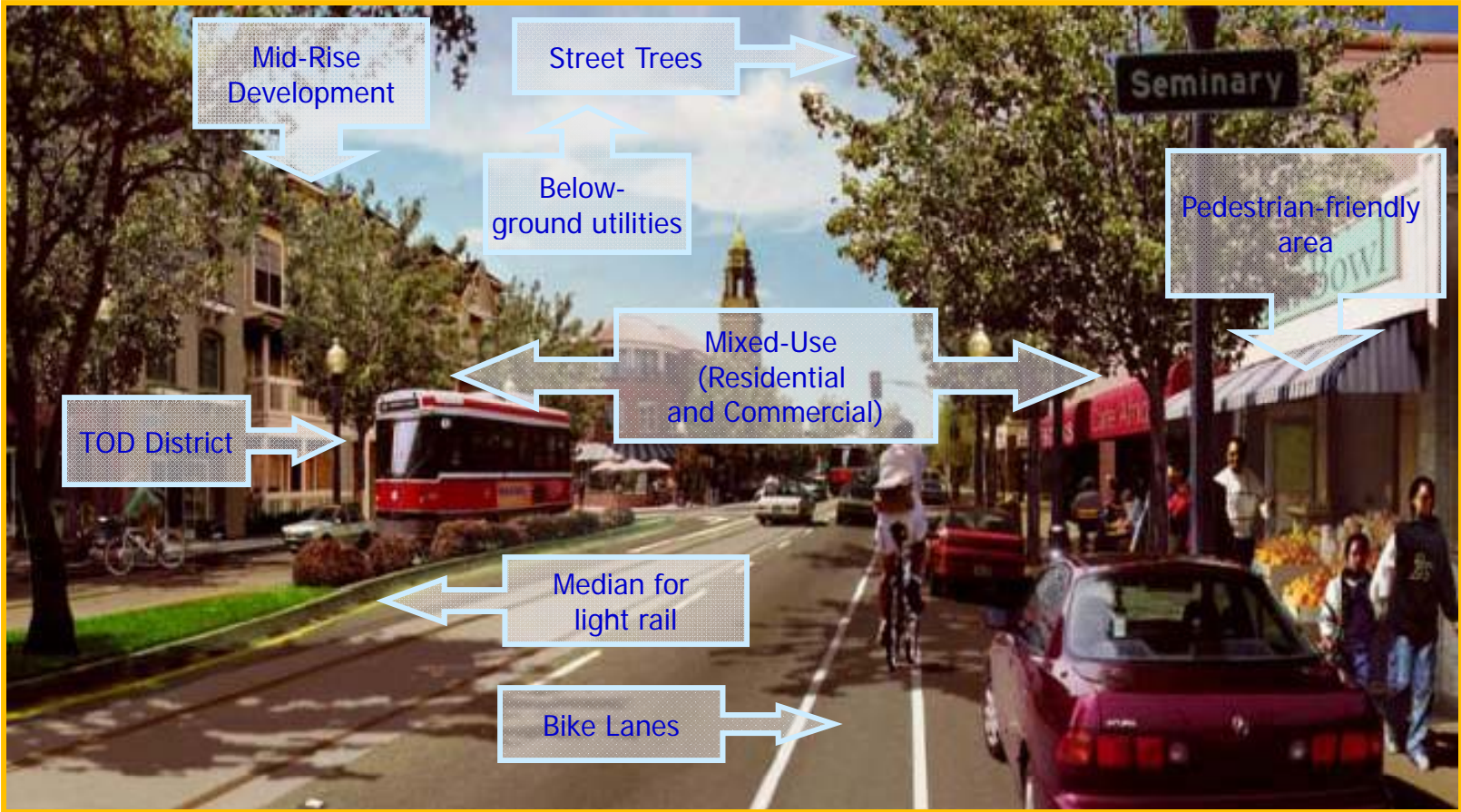


# Smart Growth Street Design





# Smart Growth Street Design





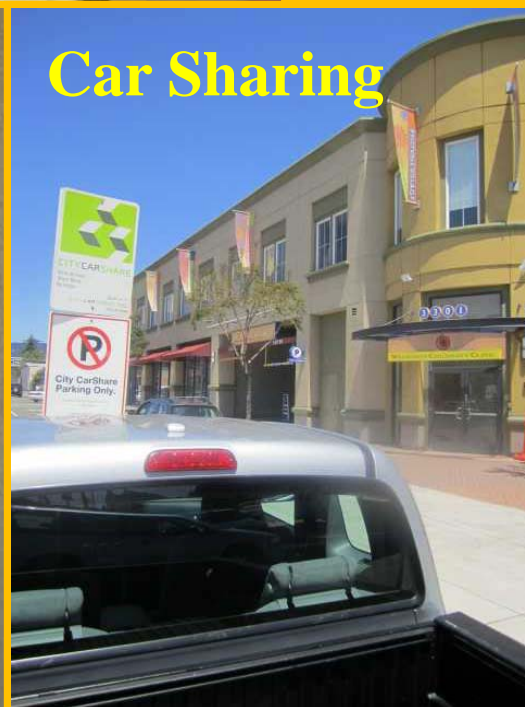
**Day Care**



**Bike Station**



**High School**



**Car Sharing**



**Open Air Market**

# Urban Planner's Role in Transdisciplinary Research

## Influences of Built Environments on Walking and Cycling: Lessons from Bogotá

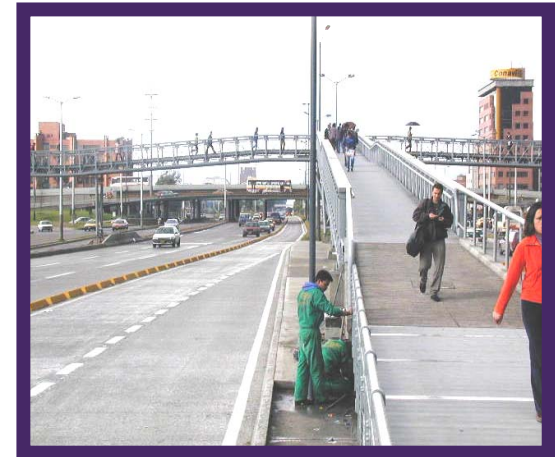
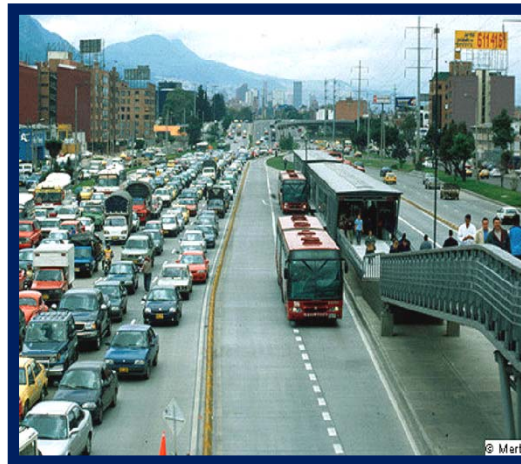
Robert Cervero, Ph.D., University of California, Berkeley

Olga L. Sarmiento, M.D., Los Andes University, Bogotá

Enrique Jacoby, M.D., PanAmerican Health Organization, Washington

Luis Fernando Gomez, M.D., Fundacion Social, Bogotá

*International Journal of Sustainable Transport*, Vol. 3, 2009, pp. 203-226



# Research Design

1. **Physical Activity & Travel Data:** weekly diaries compiled from International Physical Activity Survey (IPAQ) of 1335 HHs; validated by accelerometers

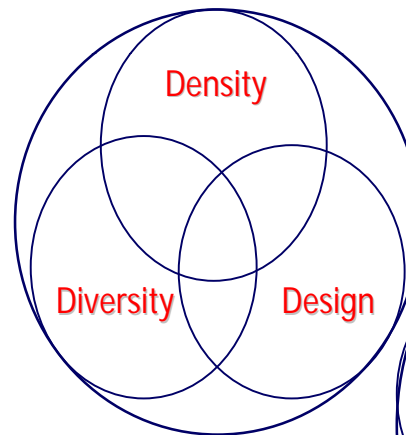
2. **Built Environment Data:** 5 D's compiled using cadastral data & GIS

3. **Modeling:**

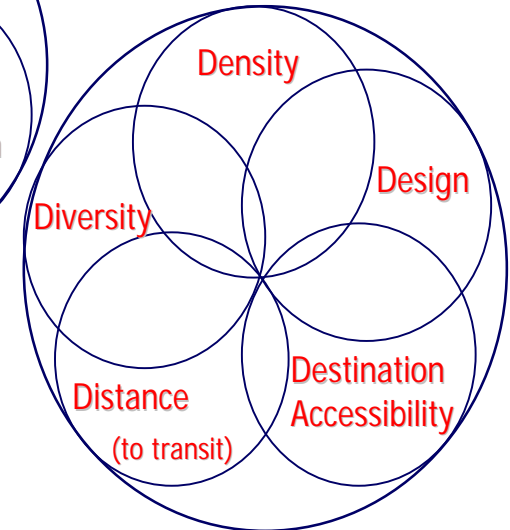
*Ecological Approach –*

- \* **Socio-economic factors**
- \* **Attitudinal factors**
- \* **Policy variables**
- \* **Environmental factors**
  - **Built Environment**
  - **Natural Environment**

*3 D's of the Built Environment*



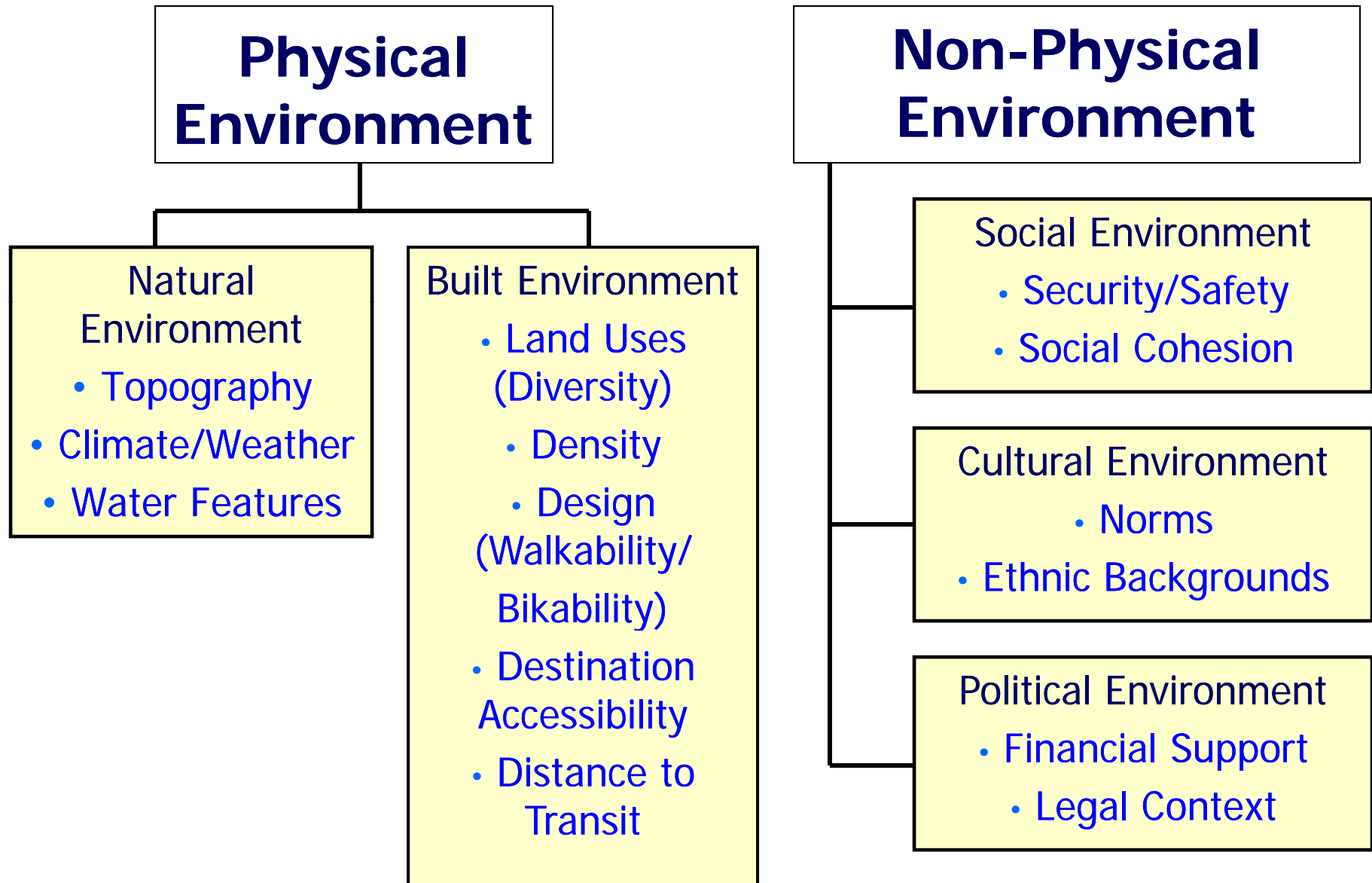
*5 D's of the Built Environment*



R. Cervero & K. Kockelman,  
Travel Demand & the 3Ds:  
Density, Diversity, Design,  
*Transportation Research D*, 1997.

**Used Multi-Level Modeling: People nested within Neighborhoods**

# Defining Environments



## Scales of Analysis for Built Environment Variables

**BLOCK**  
**500 meter buffer**  
**around the block**  
**centroid**  
(immediate  
neighborhood  
environment)



**DISTRICT**  
**1000 meter buffer**  
**from the**  
**neighborhood**  
**boundaries**  
(expanded  
neighborhood  
environment)



<b>Dimension</b>	<b>Candidate Variables</b>
<b>(1) DENSITY</b>	Persons per hectare; dwelling units per hectare; % of land area occupied by buildings; average building floor height; plot ratio (building m <sup>2</sup> /land m <sup>2</sup> )
<b>(2) DIVERSITY</b>	Entropy index of land-use mix (0-1 scale); proportion of buildings vertically mixed; proportion of total floorspace in buildings with 2+ uses
<b>(3) DESIGN</b> <i>Amenities</i>	Public park area as % of total land area; average park size (hectares); % of road links with median strips; traffic light density (traffic lights/street length); tree density (trees/street length);
<b>(3) DESIGN</b> <i>Site &amp; Street Design</i>	Average lot size (m <sup>2</sup> ); quadrilateral lots as % of total; percent of blocks with contained housing and access control; street density (street area/land area); proportion of intersections with: 1 point (cul de sac), 3 points, 4 points, 5+ points; bike lane density (lineal m of bikelane/lineal m of streets); route directness (0-1 scale measuring shortest street distance/straightline distance between neighborhood centroid and 8 compass points); connectivity index (intersection nodes/street links); number of bridges; ciclovía two-way length (lineal m)
<b>(3) DESIGN</b> <i>Safety</i>	Number of pedestrian bridges; pedestrian accidents per year; average automobile speeds on main streets; deaths (all types) in traffic accidents per year; number of reported crimes per year
<b>(4) DESTINATION ACCESSIBILITY</b>	Number of: public schools; hospitals; public libraries; shopping centers (> 500m <sup>2</sup> ); churches; banks
<b>(5) DISTANCE TO TRANSIT</b>	Number of TransMilenio (BRT) stations; shortest network distance to closest TransMilenio station; number of feeder TransMilenio stations.



# Measure: DESIGN

## Walking/Biking Quality

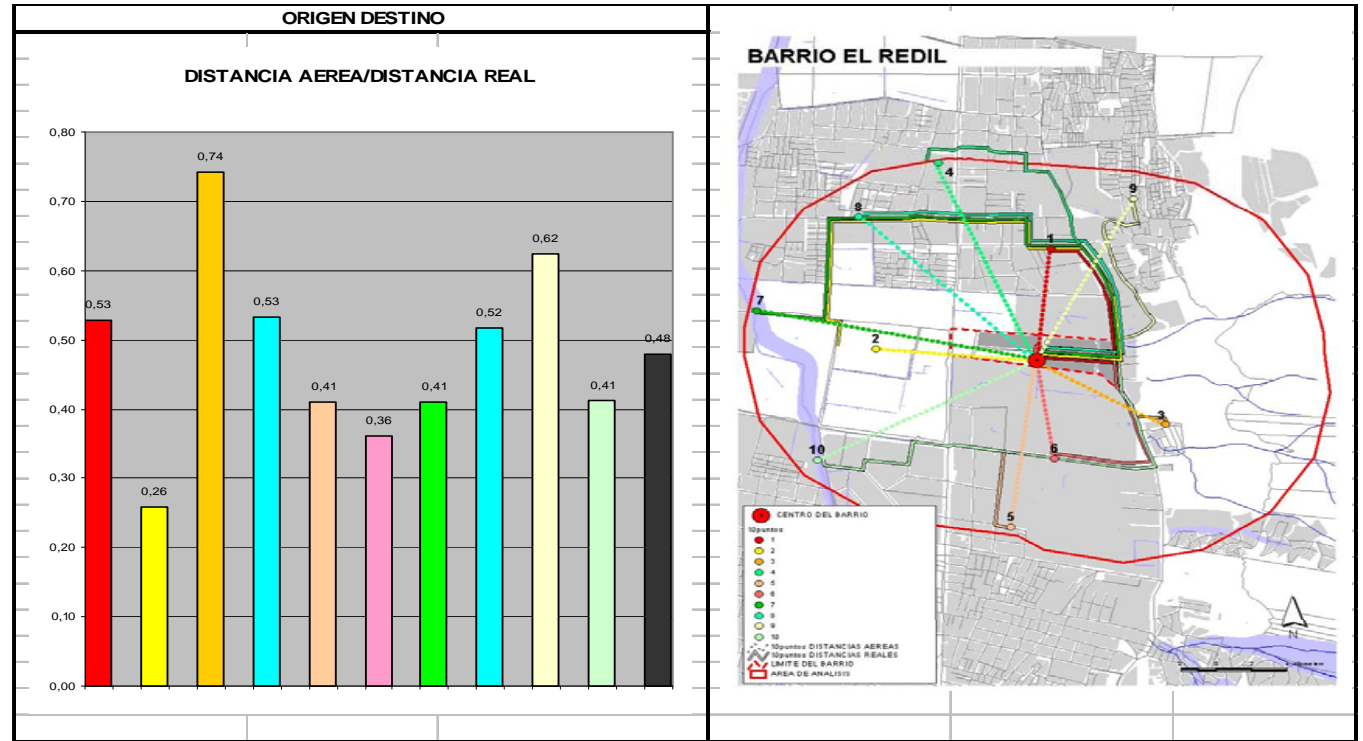


- **Network Connectivity Indicator** =  $(\# \text{ links}) / (\# \text{ nodes})$
- **Sidewalk completeness** = Length of sidewalks / Length of public street (centerline distances)
- **Bikelane completeness** = Length of bikelanes / Length of public streets (centerline distances)
- **Route directness** = Avg. straight-line distance to neighborhood center / Avg. shortest road distance to neighborhood center
- **Proportion of blocks (or block faces) with:**
  - sidewalks; street trees; overhead street lights; quadrilateral shape; bicycle lanes; mid-block crossings



## “Route Directness”

(avg. straight-line distance to neighborhood center) /  
 (avg. shortest road distance to neighborhood center)



INDICADOR	ESCALA	VARIABLES	UNIDADES	VALORES	VALOR DEL INDICADOR
PROMEDIO DE LA DISTANCIA AEREA AL CENTRO DEL BARRIO(PARA 10 PUNTOS)/PROMEDIO DE LA DISTANCIA DE LAS CALLES POR LA RUTA MAS DIRECTA AL CENTRO DEL BARRIO	AREA DE ANALISIS	P1 DISTANCIA AEREA	METROS LINEALES	668,991	<b>0,53</b>
		P1 DISTANCIA REAL	METROS LINEALES	1265,644	
		P2 DISTANCIA AEREA	METROS LINEALES	796,363	<b>0,26</b>
		P2 DISTANCIA REAL	METROS LINEALES	3081,329	
		P3 DISTANCIA AEREA	METROS LINEALES	727,582	<b>0,74</b>
		P3 DISTANCIA REAL	METROS LINEALES	980,705	
		P4 DISTANCIA AEREA	METROS LINEALES	1257,5	<b>0,53</b>
		P4 DISTANCIA REAL	METROS LINEALES	2362,936	
		P5 DISTANCIA AEREA	METROS LINEALES	970,905	<b>0,41</b>
		P5 DISTANCIA REAL	METROS LINEALES	2361,627	
		P6 DISTANCIA AEREA	METROS LINEALES	580,142	<b>0,36</b>
		P6 DISTANCIA REAL	METROS LINEALES	1603,521	
		P7 DISTANCIA AEREA	METROS LINEALES	1401,952	<b>0,41</b>
		P7 DISTANCIA REAL	METROS LINEALES	3411,191	
P8 DISTANCIA AEREA	METROS LINEALES	1211,729	<b>0,52</b>		
P8 DISTANCIA REAL	METROS LINEALES	2348,756			
P9 DISTANCIA AEREA	METROS LINEALES	1066,25	<b>0,62</b>		
P9DISTANCIA REAL	METROS LINEALES	1710,535			
P10 DISTANCIA AEREA	METROS LINEALES	1204,694	<b>0,41</b>		
P10 DISTANCIA REAL	METROS LINEALES	2927,269			
		PROMEDIO CONSOLIDADO			<b>0,48</b>
ACCESIBILIDAD	MANZANA	ISOCRONAS POR USOS?			

# Measure: DESIGN Walking Quality

- **Lighting:** # street lights/road length (centerline)
- **Trees:** # street trees/road length
- **Furniture:** # benches/road length
- **Prop. of signals with:**
  - Ped phase
  - Marked crosswalks
- **Ped Signal Lengths:** average of:  
(Duration of Ped. Lights / Total Signal Cycle Length)
- **Average block length**
- **Average street width**
- **Prop. of road links with median strips**
- **Bike-lane density:** bikelane distance  
(centerline) / km<sup>2</sup> of land
- **Distance between overhead lights**
- **Ped. Accident rates**
- **Average auto speeds**



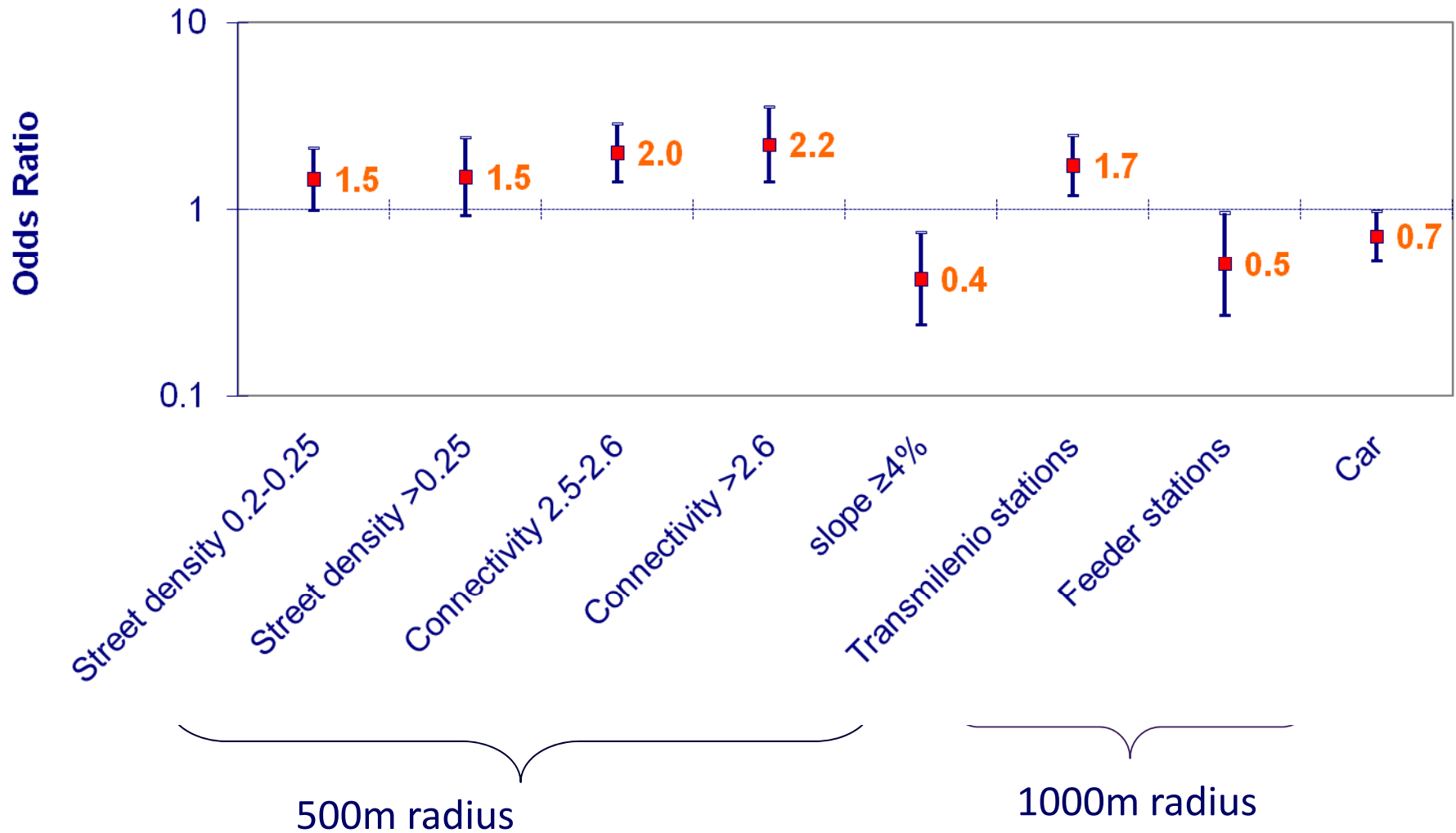
Diverse Streetscapes

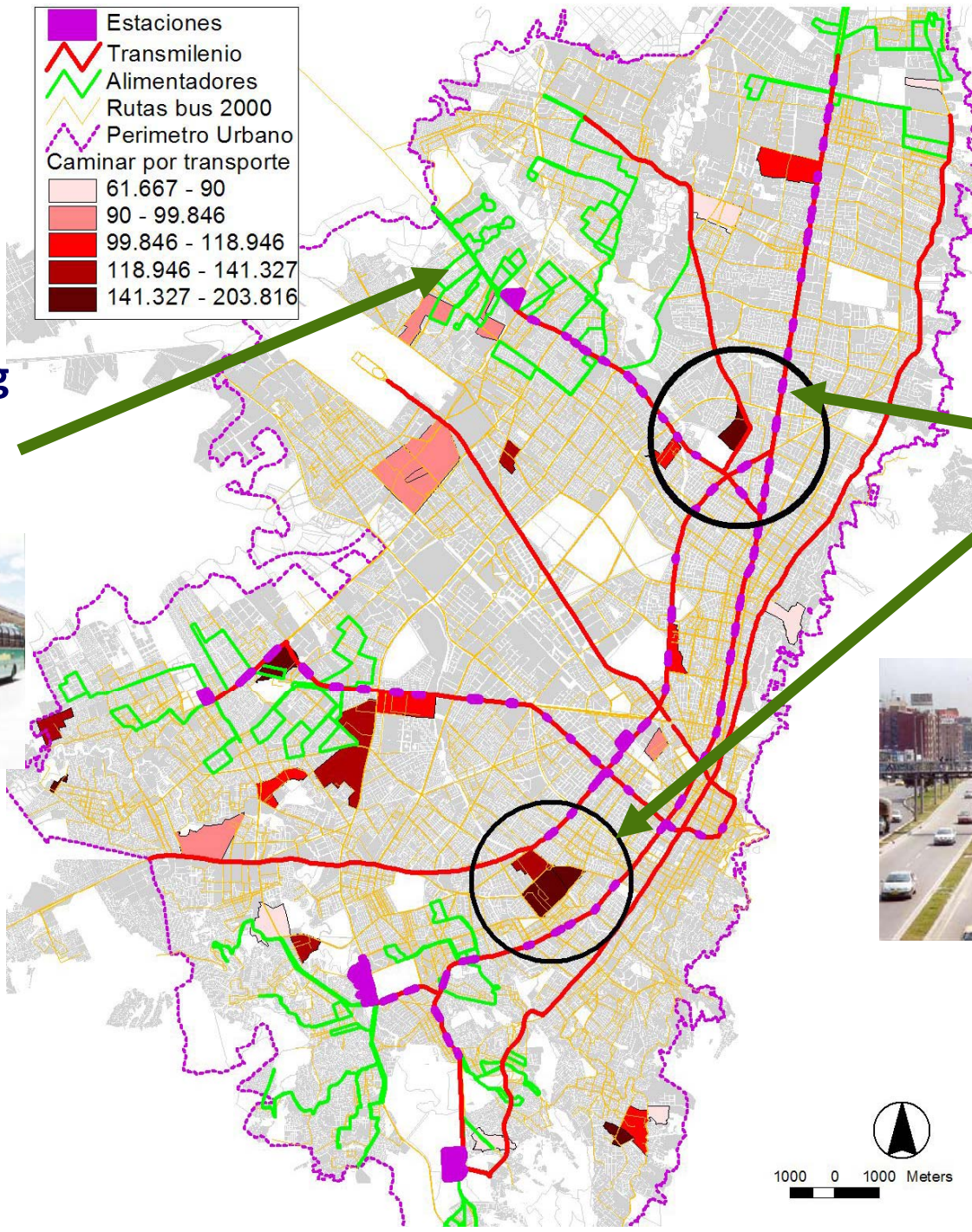
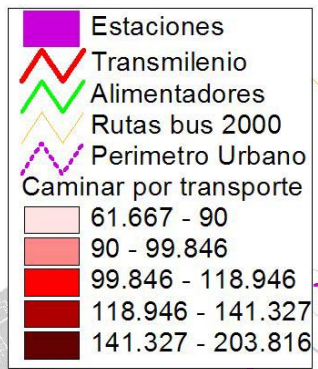


# Distance to Transit and Destination accessibility



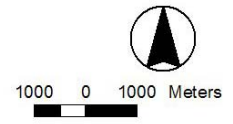
**Odds Ratios & 95% Conf. Intervals for MLM on  
*Walking ≥ 30 Minutes per Weekday  
for Utilitarian Purposes***





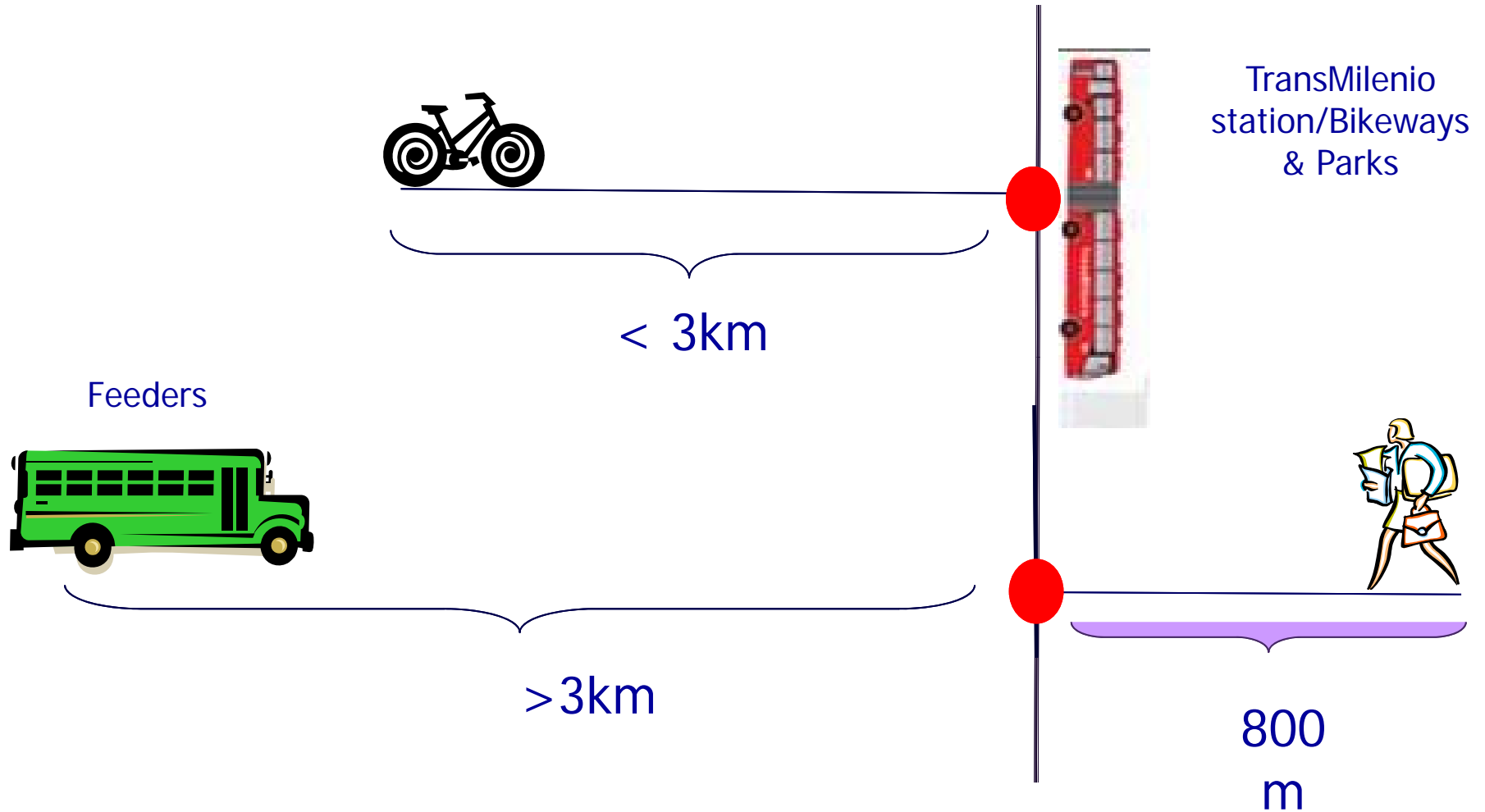
**Low walking incidence & Bus Feeders**

**High walking incidence & Transmilenio Stations**



# TransMilenio Offers Physical Activity Opportunities

## Multi-Modal Planning & Design



**Policy Choices:**  
Invest in Feeder Buses or **"Green Connectors"**?