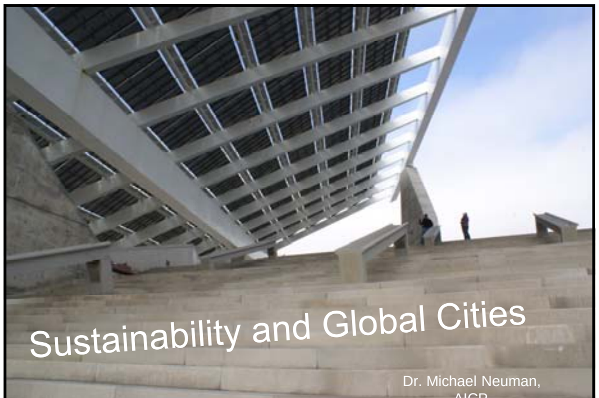
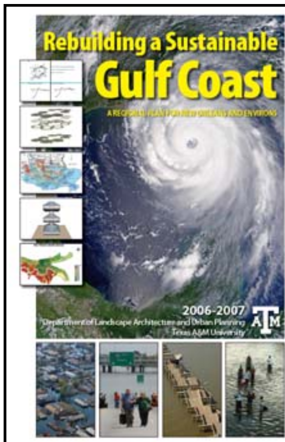


Sustainability and Global Cities

Dr. Michael Neuman, AICP
Professor of Sustainable Urbanism
Faculty of the Built Environment



Regional Analysis and Plan for New Orleans and Environs

Multiple scales -- building to region

Multiple disciplines -- seven

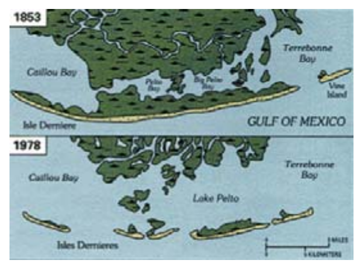
Construction, Architecture,
Urban Planning, Geography,
Environmental Design,
Civil Engineering,
Urban and Regional Science

Michael Neuman and
19 post-graduate students

http://sustainableurbanism.tamu.edu
Click 'Projects'

COASTAL WETLANDS LOST IN LOUISIANA REPRESENT 67% OF ALL WETLANDS LOST IN THE UNITED STATES

RECENT ANNUAL LOSS RATE AT 10,000 HECTARES PER YEAR



EXPECTED LAND LOSS BY 2050 IN SOUTHERN LOUISIANA

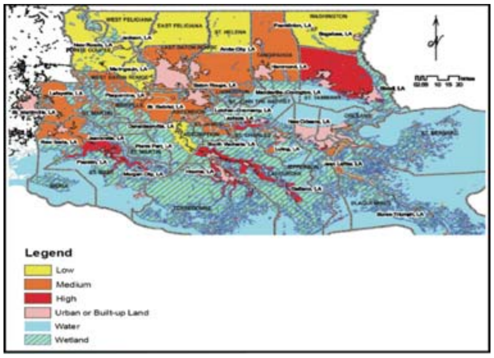
32,000 KM OF PIPELINES IN COASTAL LOUISIANA

38,000 KM OF CHANNELS IN COASTAL LOUISIANA

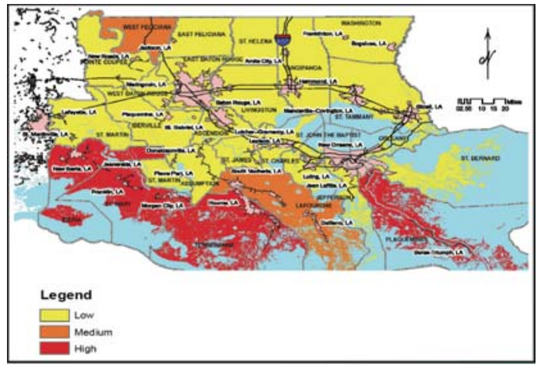
ONE FOOT OF STORM SURGE IS BUFFERED BY FOUR KM OF COASTAL MARSHLAND

PIPES AND CANALS IMPAIR THE FUNCTIONAL INTEGRITY OF WETLANDS TO BUFFER LAND AND CITIES FROM A CYCLONE STORM SURGE

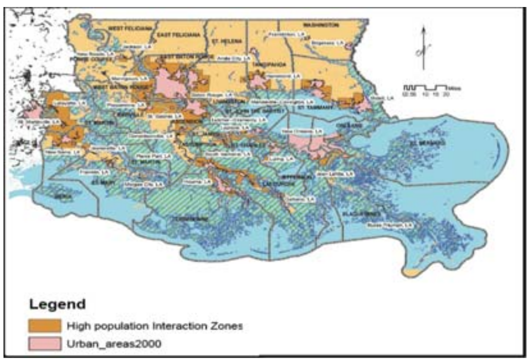
PHYSICAL RISK VULNERABILITY FROM CYCLONES



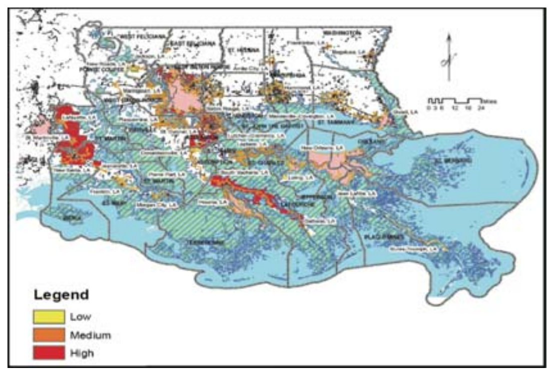
ECONOMIC VULNERABILITY FROM CYCLONE DAMAGE



SOCIAL VULNERABILITY: METRO AREAS PLUS HIGH POPULATION INTERACTION

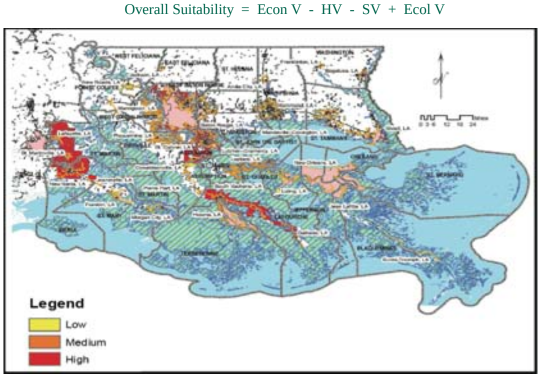


MULTI-FACTOR ECOLOGICAL SUITABILITY FOR URBAN GROWTH

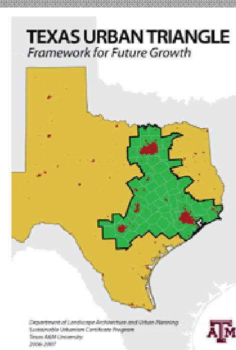


OVERALL DEVELOPMENT SUITABILITY MAP

Overall Suitability = Econ V - HV - SV + Ecol V



TEXAS URBAN TRIANGLE: FRAMEWORK FOR FUTURE GROWTH



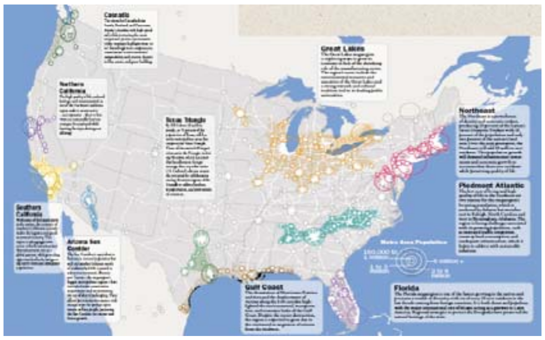
Texas Urban Triangle Regional Analysis

Michael Neuman, Elise Bright, and 25 post-graduate students in 6 disciplines

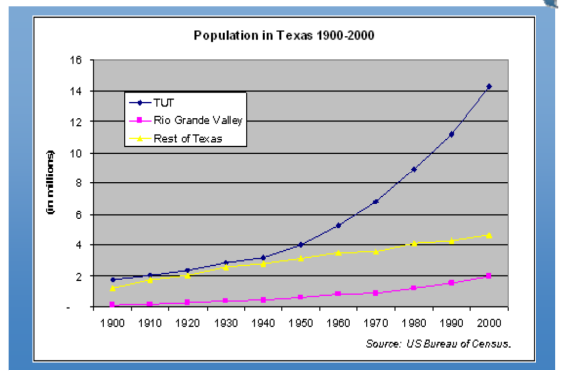
http://sustainableurbanism.tamu.edu

Click 'projects'

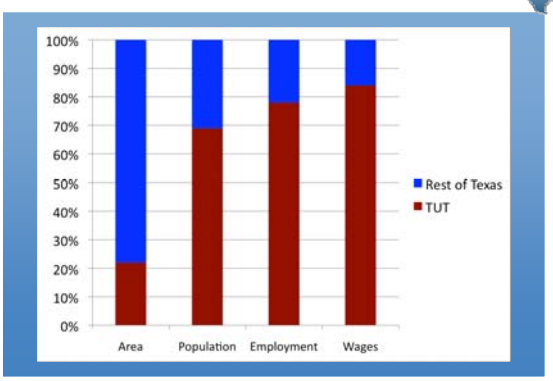
NATIONAL CONTEXT


Urban mega-regions identified by the www.america2050.org

TEXAS URBAN TRIANGLE POPULATION CHANGE 1990-2000



TEXAS URBAN TRIANGLE AS A PROPORTION OF TEXAS 2007



Source: United States Bureau of Census (2008)

LAND SUITABILITY ANALYSIS

Land suitability analysis developed

by Ian McHarg in his book

Design With Nature (1969)

- Used as a regional planning and conservation tool
- Identifies areas most suited (sustainable) for different land uses
- Basis for GIS and SDSS used today

SUITABILITY ANALYSIS FACTOR CATEGORIES

POPULATION
- Population Density
- Total Population Change
- Population Growth and Implications

ECONOMICS
- Unemployment Rates

HOUSING
- Housing Vacancy Rates

LAND USE
- Urban Area Buffers (2000)
- National Land Cover Database (1992)

ENVIRONMENT
- Visual Quality
- Air Quality
- Surface Water

GEOLOGY, SOILS & TOPOGRAPHY
- Prime Farmlands
- Aquifer Recharge Zones
- Slope
- Soil Salinity

WATER
- Water Supply

HAZARDS
- Hurricane Risk Zones
- Tornado Risk Zones
- Location of Hazardous Materials Facilities

TRANSPORTATION
- Road Network

COMMUNICATIONS
- Fiber Optic Availability
- Cell Phone Signal Strength
- Number of Cell Phone Carriers
- Number of Internet Providers

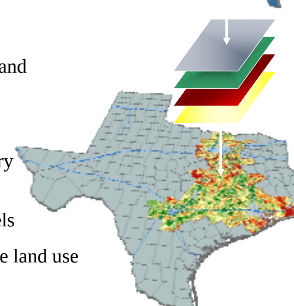
EDUCATION
- Academic Accountability Rating
- Property Wealth
- Expenditures per Student
- Student-to-Teacher Ratio

PUBLIC SERVICES
- Police Protection
- Crime Rates
- Infant Mortality
- Cancer Death Rates

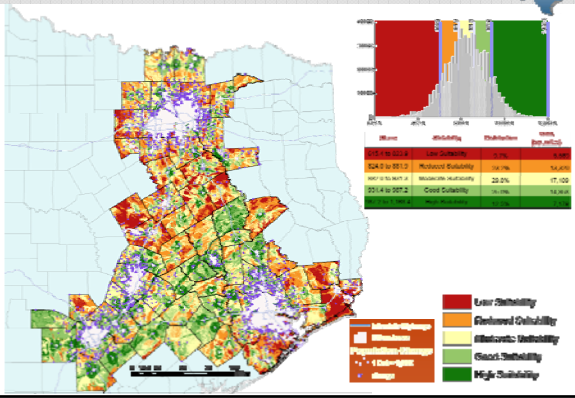
ENERGY
- Location of Coal Deposits
- Location of Power Generators
- Air Emissions (due to electric generation)

METHODOLOGY

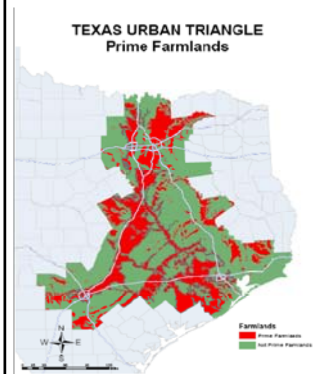
- ❑ Analyze major environmental and land use factors
- ❑ Categorize each factor
- ❑ Assign weights to each category for each future land use
- ❑ Divide the study area into pixels
- ❑ Add the weights for each future land use for each pixel
- ❑ Select the pixels that get the highest scores for each land use



SUITABILITY AND POPULATION GROWTH



PRIME FARMLANDS



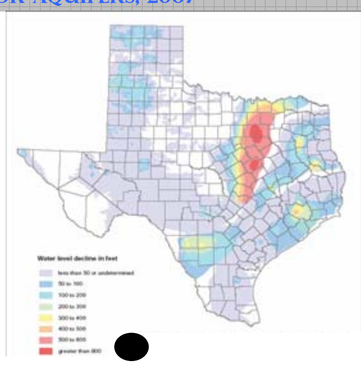
"*Very good soils are not extensive enough in Megalopolis to be wastefully abandoned to non-agricultural uses*"

- Jean Gottman

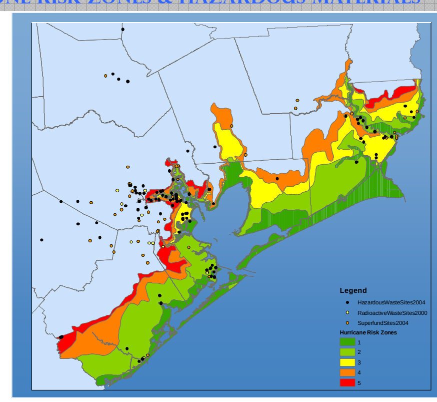
- **1992-2000: ½ million** acres of ranchland lost in Texas to non-agricultural land uses.

- **1990-2000: 180,000** acres of Blackland prairie lost to urbanization.

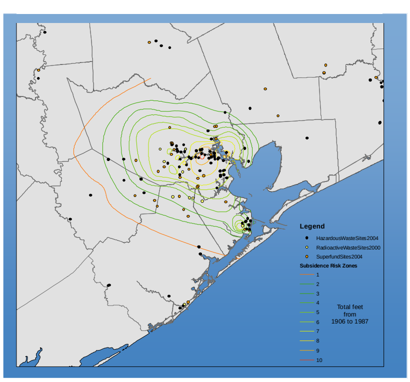
ESTIMATED TOTAL WATER LEVEL DECLINES IN MAJOR AQUIFERS, 2007



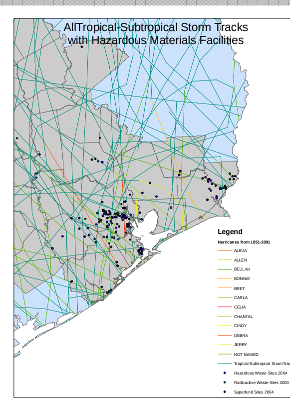
CYCLONE RISK ZONES & HAZARDOUS MATERIALS



SUBSIDENCE RISK ZONES & HAZARDOUS MATERIALS



TROPICAL STORM TRACKS & HAZARDOUS MATERIALS



SDSS DEVELOPMENT PROCESS

1. Identify factors to be considered for the model – 83 TOTAL
2. Identify factor specialists
3. Select factors to be included in the model – 42 SELECTED
4. Identify data sources for the factors and collect data
5. Determine rankings for all the factors
6. Determine weights for each factor
7. Create a cost surface using the 42 factors
8. Find an optimized route based on the suitability score
9. Conform route to horizontal turning radius allowance

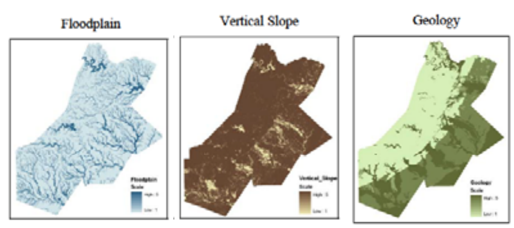
FACTOR WEIGHTS MATRIX – SEVEN FACTORS

Table 3. Factor Weight Matrix Using AHP and Reliability Test.

	Density	Slope	Roads	Hydrology	Floodplain	Geology	Soils	Eigen Vector	%
Density	0.33	0.40	0.29	0.24	0.20	0.20	0.23	0.27	29.0%
Slope	0.22	0.27	0.43	0.24	0.16	0.23	0.23	0.26	27.0%
Roads	0.17	0.09	0.14	0.24	0.18	0.23	0.29	0.19	19.0%
Hydrology	0.07	0.05	0.03	0.05	0.08	0.02	0.02	0.04	5.0%
Floodplain	0.07	0.07	0.03	0.02	0.04	0.02	0.02	0.04	4.0%
Geology	0.11	0.08	0.04	0.17	0.16	0.07	0.09	0.10	9.0%
Soils	0.08	0.07	0.03	0.17	0.14	0.04	0.06	0.08	8.0%
SUM	1.04	1.02	0.99	1.15	0.96	0.80	0.94	1.00	100%

λ_{max} = 7.7070, Consistency Index (CI) = 0.1178, Random Index (RI) = 1.32 (n = 7)
Consistency Ratio (CR) = 0.0893 -> 8.93% < 10.0%
(CR less than 10% considered a consistent preference matrix)

SAMPLE FACTOR MAPS



Floodplain	Scale
500-year	1
100-year	2
1% annual –*	3
1% annual	4
1% annual +*	5

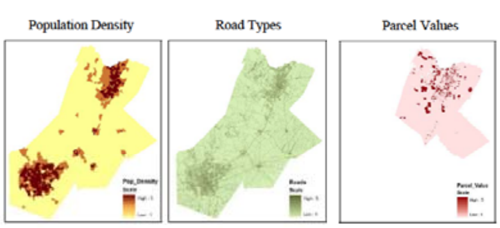
*1%+ requires most strict policy.
*1%– requires least strict policy.

Vertical Slope	Scale
0.0~0.9%	1
1.0~1.9%	2
2.0%~	5

Slope 2% is the max. value for HSR

Geology	Scale
Limestone	1
Stone	2
Gravel	3
Clay	4
Sand	5

SAMPLE FACTOR MAPS - 2



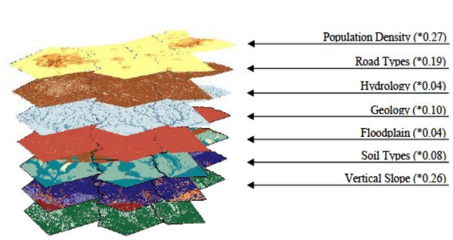
Pop. Density	Scale
0~0.49	1
0.5~2.99	2
3.0~9.99	3
10.0~29.9	4
30.0~	5

Roads	Scale
Local streets	1
County roads	2
FM roads	3
State hwy.	4
U.S. and interstate hwy.	5

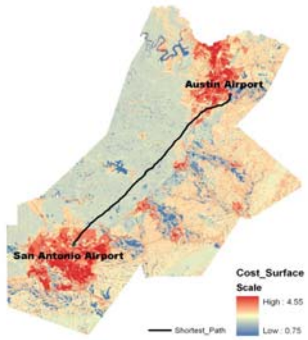
Parcel Value*	Scale
$0~$299k	1
$300k~$1,499k	2
$1,500k~$4,999k	3
$5,000k~$11,999k	4
$12,000k~	5

*Shows only available counties.

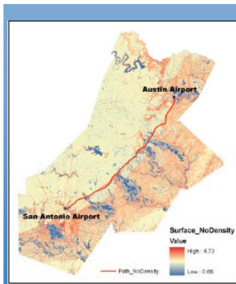
VISUAL RELATIONSHIP BETWEEN FACTORS & WEIGHTS



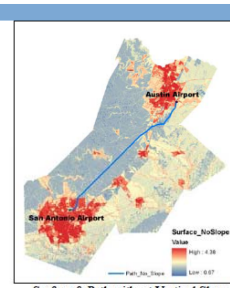
SHORTEST PATH USING COST SURFACE MAP & FACTOR WE...



SURFACES AND PATHS WITH DIFFERENT FACTOR SETTINGS

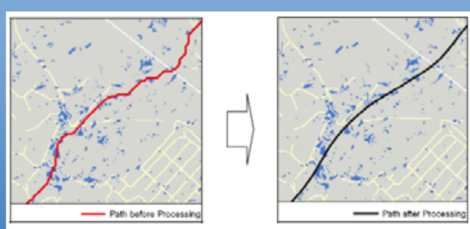


Surface & Path without Population Density



Surface & Path without Vertical Slope

PATH BEFORE AND AFTER SMOOTHING PROCESS



RADIUS OF CURVATURE FORMULAE FOR SMOOTHING

The analytical expression for the radius of curvature, TR, for a curve f(x) is

$$\mathrm{TR} = \frac{(1 + d_x f^2)^{3/2}}{|d_{x,x} f|}$$

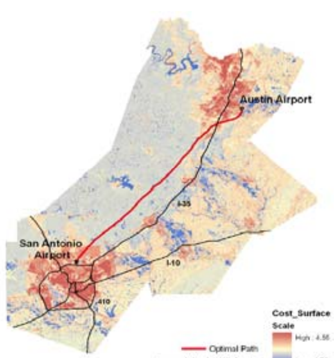
In order to interpolate a general sequence of location points in two dimensions, a parameter representation is required: f[t] = (x[t], y[t]). Here f[t] represents a curve that passes through all the points. The points are independent of each other, so only three points will be considered at a time.

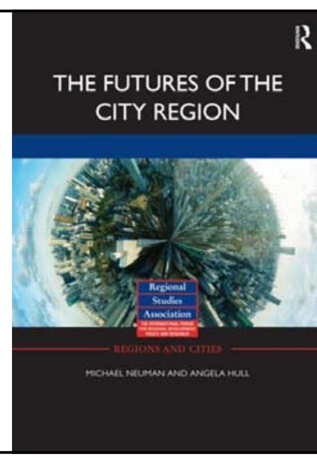
To interpolate a curve that passes through three arbitrarily points, the Lagrange polynomial is used:

$P[x] = f_0 L_{3,0} + f_1 L_{3,1} + f_2 L_{3,2}$ will be used for x[t] and y[t].

Given the curve C={x[t],x[t]}, then the radius of curvature is $r = \frac{1}{\kappa(t)} = \frac{(x'^2 + y'^2)^{3/2}}{|x'y'' - y'x''|}$ and the center of the circle is $(x_c, y_c) = (x, y) + r\,(y', -x') \big/ \sqrt{x'^2 + y'^2}$.

FINAL COST SURFACE AND PATH AFTER SMOOTHING

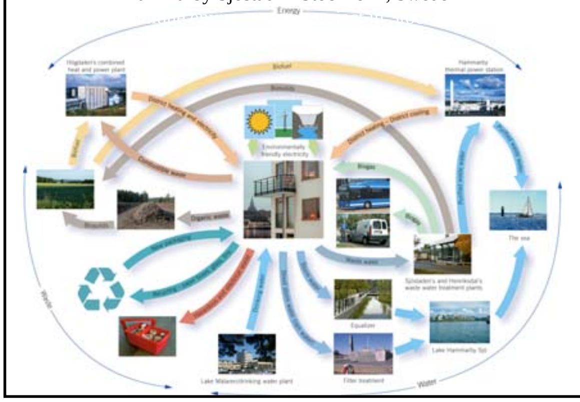




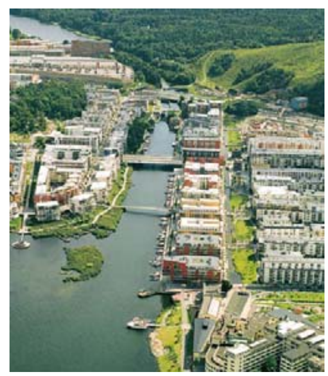
Hammarby Sjöstad

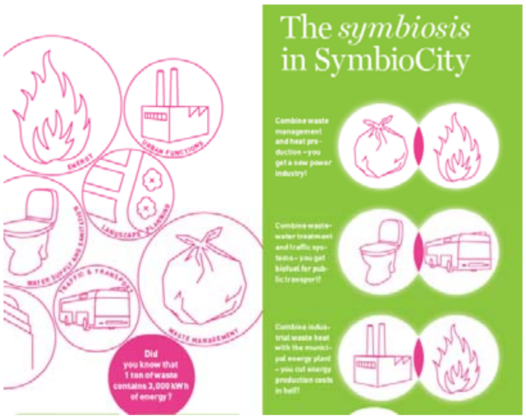
– a unique environmental project in Stockholm

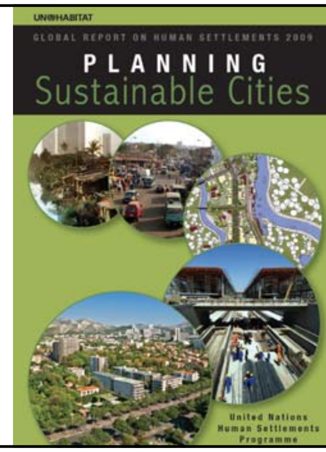
Urban Recycling for Sustainability:
Hammarby Sjöstad in Stockholm, Sweden



SOLID WASTE DISPOSAL







TAMPA, FLORIDA GENERAL PLAN SUSTAINABILITYAUDIT

THE AUDIT ANALYZES AND ASSESSES THE GOALS, OBJECTIVES, AND POLICIES OF THE CITY OF TAMPA'S GENERAL PLAN USING MEASURABLE & REPLICABLE *SUSTAINABILITY INDICATORS*

INDICATOR GROUP	SOCIAL	ENVIRON-MENTAL	ECONOMIC
Automobile Emissions		•	
Public Transportation and Connectivity	•		•
Infrastructure	•		•
Green Infrastructure	•	•	
Energy Consumption		•	•
Wetlands		•	
Air Quality	•	•	
Habitat		•	
Biodiversity		•	
Consumption & Production Patterns		•	•
Storm Water Management			•
Water Supply	•		•
Water Quality	•	•	
Community Programs	•		
Public Health	•		
Walkability	•		•
Street Pattern & Livability	•		•
Social Equity	•		
Economic Sustainability			•
Coastal Habitats		•	

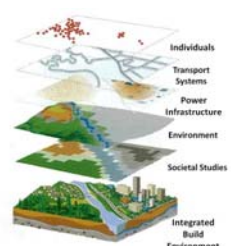
CITY OF TAMPA OVERALL SUSTAINABILITY AUDIT SCORES

INDICATOR GROUP	AVERAGE SCORES	GENERAL COMMENTS
Storm Water Management	2.1	Tampa has adopted development regulations to manage the impacts on storm water drainage and the protection of wetlands. Plan would benefit from measureable objectives.
Water Supply	1.9	Water quantity and conservation is highlighted strongly. More specific indicators could be covered: Total Water Resources Used, Water Resources, Water Rights Held by Tampa
Water Quality	2.2	The plan successfully identifies the importance of water quality. There should be more quantitative indicators about specific chemicals to ensure water safety.
Public Health	2.0	Access to medical care, access to recreation and public space facilities, physical activity-fitness / wellness, and access to community gardens & farmers' markets.
Active Transport	2.6	The Plan for Tampa did a fine job identifying walking and biking indicators to enhance livability and promote sustainability.
Street Pattern & Livability	1.6	Plan covers safety, street connectivity, street landscaping and seating, street ornamentation, street typology, building façade design, and frequency of use.
Social Equity	2.0	Specific criteria can be developed for a range of social issues.

CENTER FOR TRANSPORT AND ELECTRICITY CONVERGENCE (CTEC)

NATIONAL SCIENCE FOUNDATION INDUSTRY-UNIVERSITY COOPERATIVE RESEARCH CENTER (IUCRC)

FOUNDED JOINTLY BETWEEN NSF, THE UNIVERSITY OF TEXAS, TEXAS A&M UNIVERSITY, AND 8 INDUSTRY PARTNERS

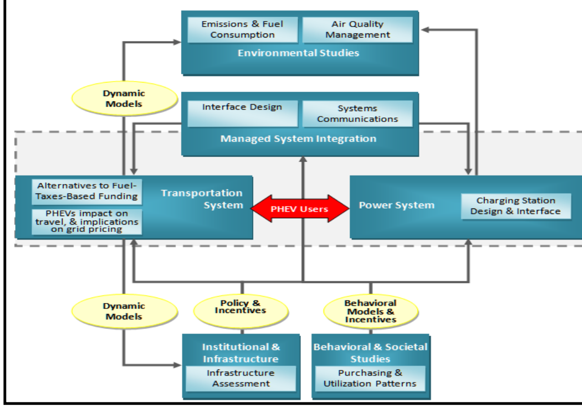


CTEC VISION

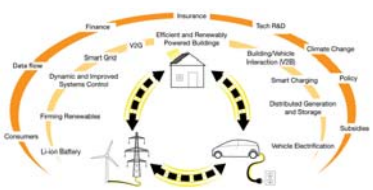
- DEVELOP NEW ANALYTICAL AND OPERATIONAL SOLUTIONS TO SUPPORT AND ACCELERATE THE CONVERGENCE OF TRANSPORT AND ELECTRICITY NETWORKS
- INNOVATE AND INTEGRATE ACROSS NUMEROUS FIELDS RELATED TO PLUG-IN ELECTRIC-HYBRID VEHICLES:

  SOCIO-ECONOMIC TECHNICAL
  COMMERCIAL INFRASTRUCTURE
  ENVIRONMENTAL REGULATORY
  INDUSTRIAL COMPONENTS

RESEARCH FRAMEWORK

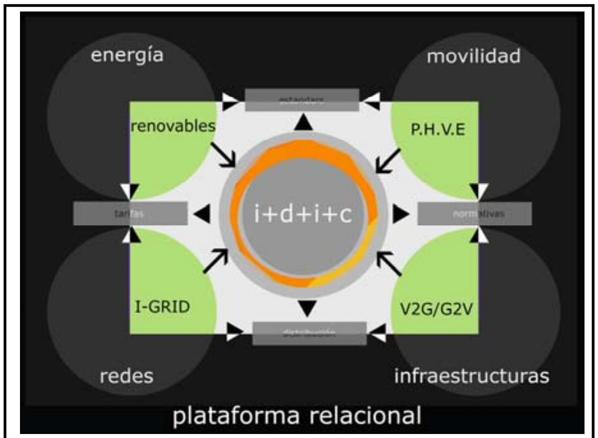


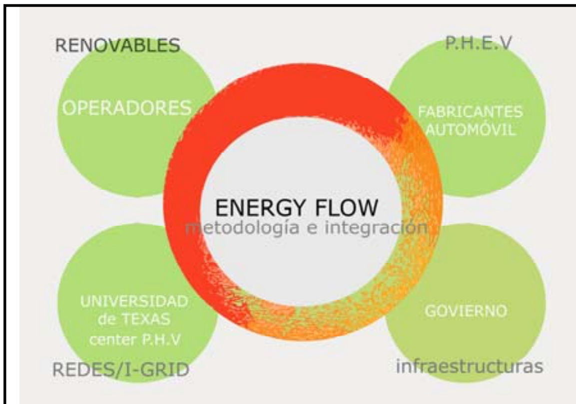
BUILT ENVIRONMENT CONVERGENCE: PHEV, SMART GRID, TRANSPORT INFRASTRUCTURE



STRATEGIC ATTRIBUTES

- I-GRID & MICRO-GRID
- G2V & V2G



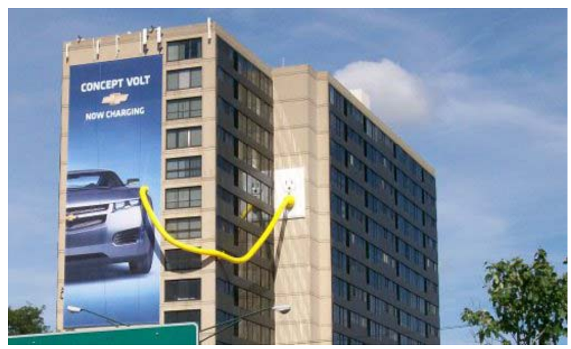


Manufacturers

Manufacturers

Manufacturers

Connectivity



LIFE CYCLE SUSTAINABILITY

REPLENISH ≥ WITHDRAWAL

$$\sum_{k=1}^{z_i} \frac{dw_k}{dt} \geq \sum_{j=1}^{z_0} \frac{dw_j}{dt}$$

$$\frac{dw_{aquifer\_input}}{dt} \geq \frac{dw_{aquifer\_withdrawal}}{dt}$$

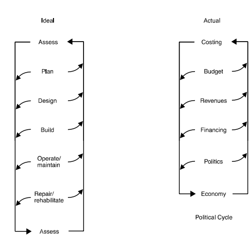


Figure 6.1—Life-Cycle Capital Investment Management

Corporate ownership in Munich's film and TV industry, 2002.

Zademach H J Econ Geogr 2009;9:697-722

Journal of Economic Geography