peter calthorpe

urbanism in the age of climate change
The US emits 5x the world average of 4.5 metric tons per capita.
CO₂ Energy Emissions per Capita

World – 4.4 tons

- Buildings: 49%
- Transportation: 19%
- Manufacturing/Construction: 21%
- Other Fuels: 11%
CO$_2$ Emissions per Capita

California – 10.4 tons

- Transportation: 60%
- Manufacturing/Construction: 17%
- Buildings: 17%
- Other Fuels: 6%
Global CO2 by Income 2010

2010 Existing
31.9 BMT

Carbon Emissions per Capita

0.8 B  2.5 B  2.5 B  1.1 B

0.3  1.6  5.4  11.6 MT/cap

4.5 (current global avg)

Upper Income 86%
Global CO2 2050 Goal

Sweden - 4.8
France - 5.6
Norway - 7.9
California 2011 - 10.4
California 2050 - 3.3

Upper Income 60%
Rich Urban, Urban Poor, Rural

The graph illustrates the population trends in different regions from 1990 to 2040.

- **Total rural** population shows a general increase over the years.
- **More developed regions** have a relatively stable population with a slight increase.
- **Less developed regions** show a consistent increase throughout the period.

The data indicates a growing disparity between more and less developed regions, with urban areas experiencing significant growth compared to rural areas.
USA Challenges

- Climate Change
- Energy Security
- Budget Shortfalls
- Health Care Costs
- Oil Dependency
- Energy Prices
- Political Gridlock
- Obesity
- Housing Costs
- Failing Schools
- Water Shortages
- Failing Infrastructure
China – High Density Sprawl
Mexico – Low Income Sprawl
USA – Middle Income Sprawl
Who We Are (Really)

1970

- Marriages with children: 41%
- Marriages without children: 30%
- Other Households: 11%
- Singles living alone: 17%

2005

- Marriages with children: 23%
- Marriages without children: 28%
- Other Households: 17%
- Singles living alone: 26%
Transportation Mode By Country

各国出行模式分担率

<table>
<thead>
<tr>
<th>Country</th>
<th>Auto</th>
<th>Walk/Bike</th>
<th>Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>86%</td>
<td>11%</td>
<td>03%</td>
</tr>
<tr>
<td>France</td>
<td>48%</td>
<td>42%</td>
<td>10%</td>
</tr>
<tr>
<td>Sweden</td>
<td>52%</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>China</td>
<td>65%</td>
<td>22%</td>
<td></td>
</tr>
</tbody>
</table>
UrbanFootprint Scenario Ecosystem

Data Development and Organization

Scenario Development

Analysis

Base Data

Existing Plan Translation

Future Plan / Scenario Data

Scenario Painting / Editing

Public Health

Local Fiscal Impacts

Land Consumption

Household Costs

Greenhouse Gas Emissions

Transportation

Building Energy Use

Building Water Use

CALTHORPEASSOCIATES

U R B A N  D E S I G N E R S,  P L A N N E R S,  A R C H I T E C T S
Three Urban Types:
SF Bay Area

San Francisco Urban

Rockridge Compact

San Ramon Sprawl
San Ramon - Sprawl
Rockridge - Compact
San Francisco - Urban
California Rapid Fire Scenarios
Land Use Mix for Growth Increment (2005-2050)

- **Business As Usual**
  - Urban: 70%
  - Compact: 25%
  - Standard: 5%

- **Growing Smart**
  - Urban: 35%
  - Compact: 55%
  - Standard: 10%

Images show examples of urban, compact, and standard land use scenarios.
Greenhouse Gas Emissions
Annual in 2050

Equal to Emissions offset of a forest covering more than 1/2 of California.
Land Consumed
For New Growth to 2050 (mi²)

More land than Delaware and Rhode Island combined

![Field Image]

- Business As Usual: 5,600
- Growing Smart: 1,850
Infrastructure Cost for New Growth
Capital Costs for New Growth to 2050

$4,000 Saved per New Housing Unit : $710 Million/Year

Business As Usual : $165.4 Billion
Growing Smart : $133.4 Billion

*Includes local roads, waste water and sanitary sewer, water supply, and parks & recreation.
O&M Costs for New Growth
Engineering & Public Works Costs for New Growth to 2050

$15 Billion Saved : $334 Million Per Year

Business As Usual  Growing Smart

$84.9

$15 Billion Saved*

$69.9

*Dollars Billions
*Includes City General Fund engineering and public works functions
Revenues from New Growth
City Tax and Fee Revenue from New Growth to 2050

$2.7 Billion/Year in Additional Revenue to Cities

*Includes City revenues from Vehicle License Fees, Property Tax, and Sales Tax
Vehicle Miles Traveled (VMT)
Miles Per Household in 2050

10,500 Fewer Miles Per Household

Flickr: trash-photography

27,557
17,041

Business As Usual
Growing Smart
Building Energy
Cumulative to 2050

Would Power ALL Homes in California for 20 Years

74 Quadrillion BTUs

16 Quadrillion BTUs Saved

58 Quadrillion BTUs

Business As Usual  Growing Smart
Residential Water Use
Cumulative to 2050

Water Savings Could Fill the San Francisco Bay 15 Times

Acre Feet Millions

328

78 Million Acre Feet Saved

250

Business As Usual  Growing Smart
Respiratory Health Costs
Total Annual in 2035

Saves $1.66 billion annually by 2035

Based on Analysis of Vision CA Results by TIAX, LLC
Activity-Related Health Indicators

SCAG 2035 MVA/Person
Annual Household Costs
Per Household Annual in 2050

$10,500 Savings Per Household in 2050
California 2050 GHG Emissions
Getting to 80% Below 1990

<table>
<thead>
<tr>
<th></th>
<th>CO\textsubscript{2}e MMT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1990</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BAU/Adopted Policy</strong></td>
<td>109</td>
</tr>
<tr>
<td>+ Smart Growth</td>
<td>156</td>
</tr>
<tr>
<td>+ Vehicle Efficiency</td>
<td>102</td>
</tr>
<tr>
<td>+ Low Carbon Fuels</td>
<td>100</td>
</tr>
<tr>
<td>+ Bldg Efficiency</td>
<td>69</td>
</tr>
<tr>
<td>+ Renewable Power</td>
<td>55</td>
</tr>
<tr>
<td>80% Below 1990</td>
<td>22</td>
</tr>
</tbody>
</table>
Los Angeles Regional Plan
Mobility

Transit Systems
Growth that Supports Transit
Urban Infill - Oakland Uptown
University Avenue
Jackson Taylor Neighborhood
San Jose, CA
Toronto: Places to Growth Plan
Existing Conditions: Land Use
Preferred Concept Plan
Livability & Urbanism: A Vibrant Mixed-Use Public Realm
Transit & Transportation:
“Transit Mall” Concept
Livability & Urbanism: Small Blocks

- Small, varied blocks create good pedestrian environment

- Size varies, but typical dimension is 70m by 85m (0.6 ha)

- Compare with Portland, OR: typical Portland block is 60m x 60m.
Livability & Urbanism: Streets for People

- Corner sidewalk “bulbouts” favor pedestrians
- Plentiful street trees
- Varied building setbacks
Livability & Urbanism: Interconnected Street Grid

- Network of streets is framework for good urbanism
- Some streets are ped only, others for people and cars
- More street connections makes walking easier
Design Guidelines: Tower Placement & Control

• Tower placement specified in certain locations

• Tower placement suggested in other locations

• Criteria: axial vistas & urban design statements

• Minimum distance between towers is 20 m
Non-Auto Mode Split

- **York Region**: 71%
  - Bus: 5
  - Rail: 8
  - Carpool: 18
  - Subway: 25
  - Walk/Bike: 15

- **South Oakville**:
  - Bus: 6
  - Rail: 9
  - Carpool: 11
  - Subway: 18
  - Walk/Bike: 6

- **North York**:
  - Bus: 6
  - Rail: 9
  - Carpool: 11
  - Subway: 18
  - Walk/Bike: 6

- **St Lawrence**:
  - Bus: 6
  - Rail: 9
  - Carpool: 11
  - Subway: 18
  - Walk/Bike: 6
Mexico – Low Income Sprawl
Job Concentrations

Legend

- Federal District
- Municipal Boundaries
- Jobs Density (2008)

Jobs per Hectare
- 1 - 5
- 5 - 25
- 25 - 50
- 50 - 100
- 100 - 189

Kilometers

0 5 10 20 30 40
Modeling Framework

Regional location

- Job proximity
- Transit proximity

26% 9% 9% 67%
Modeling Framework

Urban configuration
Place type definition

16 Possible combinations

<table>
<thead>
<tr>
<th>REGIONAL LOCATION</th>
<th>URBAN CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A: 10% 1A 1% 1C 1% 1D</td>
</tr>
<tr>
<td>2</td>
<td>B: 6% 1% 1% 1%</td>
</tr>
<tr>
<td>3</td>
<td>C: 6% 1% 1% 1%</td>
</tr>
<tr>
<td>4</td>
<td>D: 37% 8% 7% 15%</td>
</tr>
</tbody>
</table>

X 3 socioeconomic strata = 48 typologies
Metrics analysis

- Land Consumption
- Infrastructure Costs
- Energy Consumption
- Water Consumption
- Public Transport
- Private Transport
- GHG Emissions
- Costs Per Household
Scenario definition

<table>
<thead>
<tr>
<th>TREND</th>
<th>LAND</th>
<th>EMPLOYMENT</th>
<th>TRANSPORT</th>
<th>URBAN CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion</td>
<td>Desproportionate housing (centralized)</td>
<td>Moderate extension</td>
<td>Without scale nor density</td>
<td>INEFFICIENT LAND CONSUMPTION</td>
</tr>
<tr>
<td>Moderate infill</td>
<td>Partially aligned with housing</td>
<td>BRT &amp; subway extension</td>
<td>With scale or with density</td>
<td>INVESTMENT IN TRANSPORT</td>
</tr>
<tr>
<td>Smart consolidation</td>
<td>In proportion with housing</td>
<td>Regional connectivity (megapolis)</td>
<td>With scale and density (complete communities*)</td>
<td>BALANCED CONSOLIDATION</td>
</tr>
</tbody>
</table>
Metrics analysis

- **TREND**
  - Land Consumption: 640 km² (similar in size to Puebla)
  - Infrastructure Costs: $33,070 mill.
  - Energy Consumption: 4,160 quad. Btu
  - Water Consumption: 52,450 mill. m³
  - Traveled KM (private): 42,000 mill. vehicle km traveled
  - Travel Time (public & private): 13,200 person hours traveled
  - Costs per Household (annualized): $7,022 annual/household
  - GHG Emissions (annualized): 26 mill. Ton CO₂

- **MODERATE**
  - Land Consumption: 255 km² (similar in size to Toluca)
  - Infrastructure Costs: $11,338 mill.
  - Energy Consumption: 4,140 quad. Btu
  - Water Consumption: 52,200 mill. m³
  - Traveled KM (private): 8% less vehicle km traveled
  - Travel Time (public & private): 15% less person hours travelled
  - Costs per Household (annualized): $6,601 annual/household
  - GHG Emissions (annualized): 24 mill. Ton CO₂

- **VISION**
  - Land Consumption: 140 km² (similar in size to Queretaro)
  - Infrastructure Costs: $6,983 mill.
  - Energy Consumption: 4,120 quad. Btu
  - Water Consumption: 45,900 mill. m³
  - Traveled KM (private): 13% less vehicle km traveled
  - Travel Time (public & private): 23% less person hours travelled
  - Costs per Household (annualized): $6,342 annual/household
  - GHG Emissions (annualized): 23 mill. Ton CO₂
China’s Development Challenge

中国城市开发的挑战
Congestion in big cities (Beijing, Shenzhen, Chongqing, Shanghai)
大城市的拥堵问题严重
COST OF MORTALITY FROM OUTDOOR PM$_{2.5}$ EXPOSURE AS % OF GDP (MEDIAN ESTIMATES), 2010, 15 LARGEST CO$_2$ EMITTERS
《城市形态是否影响能耗》

Traditional Grid Enclave Superblock

Traditional 传传统社区
Grid 紧致格网
Enclave 单位大院
Superblock 超大街区
Travel Distance by Neighborhood Types
不同类型社区的出行距离

Kilometers per HH per week

- **Traditional**: 传统社区
- **Grid**: 紧致格网
- **Enclave**: 单位大院
- **Superblock**: 超大街区

- **walk**: 步行
- **bike**: 自行车
- **ebike**: 电单车
- **motorcycle**: 摩托车
- **bus**: 巴士
- **taxi**: 出租车
- **car**: 私人机动车
TOD Design Steps

A  Locating Transit Oriented Districts

B  Concentrating density at Transit Stations

C  Developing a new Circulation System

D  Zoning for mixed-use with ‘Small Blocks’

TRANSFORMATION OF A SUPERBLOCK PLAN
Current Plan

现有规划

Yuelai : Superblock
悦来生态城 : 超大街区
Proposed Plan

Yuelai: Urban Network
悦来生态城：城市格网
Yuelai Urban Network Comparison

Yuelai: Superblock
悦来生态城：超大街区

Yuelai: Urban Network
悦来生态城：城市格网
Preserve natural ecologies, agrarian landscapes and cultural heritage sites

Seek a compact regional footprint that conserves natural resources and employs redevelopment and revitalization

- New development should avoid agricultural lands and destruction of natural resources.
- Steep slopes of 20% or more, riparian setbacks, wetlands, and other unique landscapes should be preserved within urbanized areas.

Create an Urban Growth Boundary that preserves ecosystems and agricultural lands while enhancing compact development

- The UGB should be based upon a rigorous analysis of ecological assets, environmental capacity, and the efficiency and productivities of various land uses.
- The UBG can expand beyond the existing urban footprint only if there are no suitable infill locations as indicated by an intensity of urban land use of at least 10,000 residents per square kilometer.
**Focus**

**Match density and mix to transit capacity in TODs**

**Match density to the maximum peak-hour capacity of a transit system**
- The area within 500-800 meters of major transit stations, such as the metro or bus rapid transit (BRT), or within 500 meters of nearest bus or transit stops (in case BR or Metro is not available) should have FAR at least 50% higher than the average of the district.
- Both residential and commercial density of a TOD should be proportional to the area’s peak-hour transit, walk and bike capacity.
- Major job centers should only be located where high-capacity transit services are available.

**Create a jobs/housing balance within a short commute distance**
- Create smaller decentralized job centers that encourage reverse commutes. Locate job centers to limit commutes to approximately 10 kilometers or 15 minutes on transit.
- The job-resident ratio (the number of people employed divided by the number of residents) should be between 0.5 and 0.7 over every commuting district, which should have a spatial area that is no more than 15 km².
- For big cities, at least 70% of residents should live in TOD areas characterized by convenient mass transit service.
ENCOURAGE AN OPTIMAL OF BALANCE OF HOUSING AND SERVICES IN EACH RESIDENTIAL DISTRICT

- Housing options should accommodate a mix of income levels and age groups.
- Shops and local services should line the ground floor of most streets fronts within easy walking distance of housing and jobs.
- Residential units should be close to at least six kinds of amenities within 500-meter radius of building entrance (amenities include schools, post offices, banks, retails, clinics, activity centers, restaurants, etc.).

PROVIDE A VARIETY OF ACCESSIBLE PARKS, CIVIC CLUSTERS AND OPEN SPACE

- Neighborhood parks should be located within 500 meters of housing; large regional parks within 1 kilometer.
- Publicly accessible and usable green space should comprise 20-40% of the construction areas (residential area should be at the higher end of this range).
- Clusters of schools and civic destinations should form neighborhood centers within 500 meters of residential buildings. This includes age-specific services, such as day care.
Create dense street networks that enhance walking, bicycling, and vehicle traffic flow

- Plan for a minimum of 50 intersections per square kilometer or at least 70% of blocks shall be 2ha or less
- Limit traffic speeds on local streets to 40 km/hour.
- Design local streets with traffic-calming features to help enforce speed limits.

Disperse high traffic volumes over narrow, parallel routes

- Create a grid of varied street types to provide multiple parallel routes for all types of traffic.
- Incorporate through-roads that connect adjacent neighborhoods at least every 300 meters.
- Replace major arterials wider than 45 meters with efficient one-way couplets (a pair of two narrower one-way thoroughfares).
WALK
Design walkable streets and human scale neighborhoods

Shorten street crossings and emphasize pedestrian safety and convenience
• Limit street widths to 45 meters for through traffic and 25 meters for local access.
• Create direct routes and permeable blocks by limiting average block length to 150 meters in new development and creating public paths through existing superblocks.
• Provide safe, well-defined and uninterrupted pedestrian zones at least 4 meters wide on each side of every major street.

Encourage ground-level activity and create places to relax along primary pedestrian routes
• To encourage sidewalk activity, visibility and safety, buildings with public uses and shops should front the sidewalk where feasible
• Residential developments should have multiple access points along sidewalks
• Limit the setback between buildings and the sidewalk
Design streets that emphasize bike safety and convenience

- Create dedicated and protected bike lanes, at least 3 meters wide in each direction, on all streets except low-speed local streets.
- Provide secure bike parking in buildings, on streets and at transit stations.

Create auto-free streets and greenways to encourage non-motorized travel

- Establish car-free corridors across the city grid, no more than 800 meters apart. These should accommodate biking paths of at least 10 km in length per square kilometer.
Ride

Develop high quality transit and affordable BRT

Ensure frequent and direct transit service

- Establish a grid of high-capacity, high-speed transit corridors approximately every 1000 meters with dedicated transit lanes.
- Provide an integrated multi-modal system and ensure seamless transfers to all available transit options. Minimize the number of transfers needed for most passengers.
- Create multiple high capacity transit connections to all new development areas.

Locate transit stations within walking distance of homes, jobs, and services

- All major housing and job centers should be within 500 meters of a local transit station and 1000 meters of regional transit service.
- For the city as a whole, at least 90% of developments should be within 800-meter radius of a public transit station.
SHIFT MODE
Increase mobility by regulating parking and road use

Limit parking in key employment districts to discourage driving during peak traffic periods
• Limit parking ratios in employment areas to 0.2 stalls per worker.
• Eliminate long-term street parking to ease congestion and reduce street width.
• Remove all parking-space minimums for residential buildings and establish city-wide parking-space maximums consistent with targets for private car use.

Adjust car fees by time of day and destination
• Institute a congestion-management system that limits auto use in key urban and employment districts at peak traffic hours.
• Charge tolls for use of overloaded roads and bridges and use the fees to support transit.
• Vary parking charges by time of day and location to insure high turnover.
GREEN BUILDING
Employ best practice in building conservation

Create energy standards for residential buildings employing conservation, natural systems and renewables
• At least 70% of buildings should be MOHURD One-Star,
• 20-40% of buildings should be MOHURD Two-Star
• 5-15% of buildings should be MOHURD Three-Star

Create energy standards for commercial buildings employing efficient lighting and HVAC systems along with shading and high R-Value skins
SUSTAINABLE INFRASTRUCTURE

Community systems should be based on conservation, renewables and recycling

Deploy Renewable and District Energy energy systems for heat and electricity

- Every project should analyze the potential for district energy, such as combined heat and power (CHP), waste to energy, and waste heat re-use. There should be 5-15% local renewable energy generation for residential areas and 2-5% for commercial areas.

Use Waste management systems that recycle and reuse solid waste through on site separation and industrial capture

- All buildings should have waste classification facilities. All household waste must be sorted and collection of hazardous waste must be prioritized. At least 30-50% of waste should be composted and 35-50% recycled or re-used.

Enhance Water efficiency through conservation appliances and recycling greywater

- All buildings must have 100% adoption of water saving appliances, and green spaces surrounding buildings must adopt low water-use plants. All water consumption should be metered and at least 20-30% of water supply must be recycled from either wastewater or rainwater.
China’s urban policy unit just met for the first time in 38 years. Here’s what it recommended

By Wade Shepard and CC Huang