urbanism in the age of climate change
Global CO2 by Country

[Image of a bubble diagram showing CO2 emissions by country.]

- **US**: 5,425 million tonnes, Down 7.0%
- **China**: 7,711 million tonnes, 11.5%
- **Europe**: 2.358 million tonnes, Down 9.2%
- **Japan**: 1,098 million tonnes
- **India**: 1,602 million tonnes
- **Brazil**: 527 million tonnes
- **South Africa**: 516 million tonnes
- **Australia**: 415 million tonnes
- **Canada**: 341 million tonnes
- **Russia**: 1,572 million tonnes

Detailed data: Full list of each country's CO2 emissions and movement in the world emissions league table.
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%
$\text{CO}_2$ Emissions per Capita

California – 10.4 tons

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

2010 Existing
31.9 BMT

Upper Income 82%
Global CO2 2050 Goal

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

Cost
Real 2005 dollars per ton CO₂e

Potential
Gigatons/year

Source: McKinsey analysis
Abatement benefit
$ per tCO$_{2}$e

Abatement potential
GtCO$_{2}$e per year

New Climate Economy project analysis.
USA – Low Density Sprawl
Vision California

Trend

Blueprints
Three Urban Types: SF Bay Area

San Francisco Urban

Rockridge Compact

San Ramon Sprawl
San Ramon - Sprawl
Rockridge - Compact
San Francisco - Urban
## Comparing Neighborhoods

<table>
<thead>
<tr>
<th>Urban</th>
<th>Compact</th>
<th>Sprawl</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 METRIC TONS</td>
<td>10 METRIC TONS</td>
<td>21 METRIC TONS</td>
</tr>
<tr>
<td>2 ACRES</td>
<td>7 ACRES</td>
<td>30 ACRES</td>
</tr>
<tr>
<td>7,300 MYPH</td>
<td>12,200 MYPH</td>
<td>30,000 MYPH</td>
</tr>
<tr>
<td>98</td>
<td>74</td>
<td>46</td>
</tr>
<tr>
<td>$550 /SQ FT</td>
<td>$420 /SQ FT</td>
<td>$320 /SQ FT</td>
</tr>
</tbody>
</table>

- **Annual Carbon Emissions**
- **Land Consumption**
- **Household VMT**
- **Walk Score**
- **Property Value**
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%
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

Business As Usual  Growing Smart

5,600

1,850
Infrastructure Cost for New Growth
Capital Costs for New Growth to 2050

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

*Includes local roads, waste water and sanitary sewer, water supply, and parks & recreation
Revenues from New Growth
City Tax and Fee Revenue from New Growth to 2050

$2.7 Billion/Year in Additional Revenue to Cities

*Dollars Billions

Business As Usual: $744.2
Growing Smart: $864.5

*Includes City revenues from Vehicle License Fees, Property Tax, and Sales Tax

www.livinginplainfield.com
Vehicle Miles Traveled (VMT)
Miles Per Household in 2050

10,500 Fewer Miles Per Household

Flickr: trash-photography
Building Energy
Cumulative to 2050

Would Power ALL Homes in California for 20 Years

74 Quad Btu
16 Quadrillion BTUs Saved
58 Quad Btu

Business As Usual  Growing Smart
Residential Water Use
Cumulative to 2050

Water Savings Could Fill the San Francisco Bay 15 Times

<table>
<thead>
<tr>
<th>Acre Feet Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>328</td>
</tr>
<tr>
<td>78 Million Acre Feet Saved</td>
</tr>
<tr>
<td>250</td>
</tr>
</tbody>
</table>

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

Flickr: Lance Page
Activity-Related Health Indicators

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

$10,500 Savings Per Household in 2050

Flickr: Diablo_Solar
California 2050 GHG Emissions

- **Buildings**
- **Travel**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>CO₂e MMT</th>
<th>Buildings</th>
<th>Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do Nothing Trend</td>
<td>109</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Smart Growth</td>
<td>253</td>
<td>253</td>
<td></td>
</tr>
<tr>
<td>+ Vehicle Efficiency</td>
<td>102</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>+ Low Carbon Fuels</td>
<td>100</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>+ Bldg Efficiency</td>
<td>100</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>+ Renewable Power</td>
<td>69</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>80% Below 1990</td>
<td>55</td>
<td>28</td>
<td>22</td>
</tr>
</tbody>
</table>
Growth that Supports Transit
Mexico – Low Income Sprawl
Income Location

Legend

- Federal District
- Municipal Boundaries

2007 U.S. Dollars

- Yellow: 4,000 - 7,000
- Light Yellow: 7,000 - 8,500
- Pale Yellow: 8,500 - 10,500
- Orange: 10,500 - 15,000
- Dark Orange: 15,000 - 23,500
Modeling Framework

Regional location

Job proximity

Transit proximity
Modeling Framework

Urban configuration
Place type definition
16 Possible combinations

URBAN CONFIGURATION

1. Regional Location

A. 10% 1A
B. 1% 1B
C. 4% 1C
D. 1% 1D

2. Regional Location

A. 6% 2A
B. 1% 2B
C. 1% 2C
D. 1% 2D

3. Regional Location

A. 6% 3A
B. 1% 3B
C. 1% 3C
D. 1% 3D

4. Regional Location

A. 37% 4A
B. 8% 4B
C. 7% 4C
D. 15% 4D

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>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>
</tr>
</tbody>
</table>

**TREND**

<table>
<thead>
<tr>
<th>MODERATE</th>
<th>MODERATE</th>
<th>INVESTMENT IN TRANSPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate infill</td>
<td>Partially aligned with housing</td>
<td>BRT &amp; subway extension</td>
</tr>
</tbody>
</table>

**MODERATE**

<table>
<thead>
<tr>
<th>VISION</th>
<th>VISION</th>
<th>BALANCED CONSOLIDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart consolidation</td>
<td>In proportion with housing</td>
<td>Regional connectivity (megalopolis)</td>
</tr>
</tbody>
</table>

**VISION**
## Metrics Analysis

<table>
<thead>
<tr>
<th>Trend</th>
<th>Land Consumption</th>
<th>Infrastructure Costs</th>
<th>Energy Consumption</th>
<th>Water Consumption</th>
<th>Traveled KM (private)</th>
<th>Travel Time (public &amp; private)</th>
<th>Costs Per Household (annualized)</th>
<th>GHG Emissions (annualized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREND</td>
<td>640 km² (similar in size to Puebla)</td>
<td>$33,070 mil.</td>
<td>4,160 Quad. Btu</td>
<td>52,450 mil. m³</td>
<td>42,000 mil. veh km traveled</td>
<td>13,200 person hours traveled</td>
<td>$7,022 annual/household</td>
<td>26 mil. Ton (CO₂)</td>
</tr>
<tr>
<td>MODERATE</td>
<td>255 km² (similar in size to Toluca)</td>
<td>$11,338 mil.</td>
<td>4,140 Quad. Btu</td>
<td>52,200 mil. m³</td>
<td>8% less veh km traveled</td>
<td>15% less person hours travelled</td>
<td>$6,601 annual/household</td>
<td>24 mil. Ton (CO₂)</td>
</tr>
<tr>
<td>VISION</td>
<td>140 km² (similar in size to Queretaro)</td>
<td>$6,983 mil.</td>
<td>4,120 Quad. Btu</td>
<td>45,900 mil. m³</td>
<td>13% less veh km traveled</td>
<td>23% less person hours travelled</td>
<td>$6,342 annual/household</td>
<td>23 mil. Ton (CO₂)</td>
</tr>
</tbody>
</table>

- Cost of land: $33,070 mil.
- Energy consumption: 4,160 Quad. Btu
- Water consumption: 52,450 mil. m³
- Travel distance: 42,000 mil. veh km
- Travel time: 13,200 person hours
- Cost per household: $7,022 annually
- GHG emissions: 26 mil. Ton (CO₂)
China – High Density Sprawl
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
China – Superblocks
CHONGQING

重庆建成区

Study Area

研究区域

Chongqing

重庆建成区
Current and Proposed Plan Comparison

现有规划与新版规划对比

Yuelai: Superblock
悦来生态城：超大街区

Yuelai: Urban Network
悦来生态城：城市格网
Open Space

Yuelai Eco-City Phase 1
MALUAN BAY
马銮湾概念方案
Xiamen, China

August 25 2014
MASTER PLAN  中心区规划边界
KUNMING

呈贡新城
Develop Neighborhoods that Promote Walking
建设步行优先的邻里社区

Shorten street crossings and emphasize pedestrian safety and convenience
缩短街道穿行距离，保证行人安全和方便

Encourage ground-level activity and create places to relax along primary pedestrian routes
鼓励步行，为主要步行路沿街提供丰富的城市生活和休闲场所
Prioritize Bicycle Networks
优先发展自行车网络

Design streets that emphasize bike safety and convenience
设计道路时突出自行车的安全和便捷

Create auto-free streets and greenways to encourage non-motorized travel
建设慢行道网络，鼓励使用非机动车
Create Dense Networks of Streets and Paths

Create dense street networks that enhance walking, bicycling, and vehicle traffic flow

Disperse high traffic volumes over narrow, parallel routes
Support High Quality Transit
支持高质量的公共交通服务

Ensure frequent and direct transit service
确保频繁、直接的公共交通服务

Locate transit stations within walking distance of homes, jobs, and services
在住宅、工作和服务场所步行可达的距离内设置公交站点
Zone for Mixed Use Neighborhoods

Balance of housing and services through zoning codes

Provide a variety of accessible parks and open space
Match Density to Transit Capacity
将土地开发强度和公共交通承载力相匹配

Match density to the maximum peak-hour capacity of a transit system
将开发密度和公交系统高峰小时的最大运送能力相匹配

In key employment areas, zone for mixed-use districts that combine everyday uses
在主要就业区规划多功能的混合利用区，满足日常所需
Focus development in areas adjacent to existing cities
在紧靠现有城区地区或者现有城区内部安排发展，避免无序蔓延

Create a jobs/housing balance within a short commute distance
在较短通勤距离内实现职住平衡
Create Energy Efficient Buildings & Community Systems to Reduce Carbon Emissions

Employ climate-responsive design and conservation features in all new buildings
将环保设计以及节能技术应用到每一座新建筑中

Create district cogeneration systems
建造地区性热点联产系统来发电并回收建筑余热

Provide ecological water and waste recycling
建造社区尺度废水垃圾循环系统

Employ local renewable energy sources
尽可能使用可再生能源