A World of Challenges

- Climate Change
- Energy Security
- Budget Shortfalls
- Health Care Costs
- Oil Dependency
- Water Shortages
- Political Gridlock
- Poverty
- Obesity
- Failing Schools
- Housing Costs
- Energy Prices
- Failing Infrastructure
- Energy Shortages
Land Use & Urbanism
Foundations of Sustainability
Efficient Buildings are Important…..
...but they are NOT enough.
Platinum Sprawl
Where & How Matter for Energy (and almost everything else)

Regional VMT Variation

Source: Holtzclaw, 2002
Location & Community Design Matter

CO₂ Per Sq. Mile

CO₂ Per Household

Source: Center for Neighborhood Technology, TravelMatters.com
Electricity Use

Electricity Use per Household (KWh/year)

- 9,135 kWh
- 4,736 kWh
- 4,739 kWh
- 3,569 kWh

Outer East Bay | Inner East Bay

Source: CEC Title 24 Climate Zones
Regional VMT and Climate Variations

Total Energy Use per Household
(Million BTU/year)

- Single Family: 235 Btu
- Multi Family: 179 Btu

Outer East Bay: 147 Btu
Inner East Bay: 117 Btu
Global CO$_2$ Emissions by Country

North America
- 13 Mexico
- 6,411m
- Down 6.9%

South America
- 14 Brazil
- 1,120m
- Down 3.1%

Central & South America
- 1,120m
- Down 0.7%

Africa
- 1,122m
- Up 3.3%

Europe
- 4,310m
- Down 6.9%

Middle East
- 1,714m
- Up 7.5%

Asia & Oceania
- 13,264m
- Up 2.3%

World
- 30,398m
- Down 0.3%

China
- 7,711m
- Up 13.3%

US
- 5,425m
- 7.0%

Russia
- 1,572m
- Down 9.2%

India
- 1,602m
- Down 7.5%

日本
- 1,100m
- Down 3.0%

South Korea
- 528m
- Down 19.2%

Saudi Arabia
- 453m
- Down 14.9%

Mexico
- 444m
- Down 6.9%

其他国家和地区的排放情况详见图表。
The U.S. emits 5 times the world average of 4.5 metric tons per capita.
Global Carbon by Income 2010

2010 Existing 
31.9 BMT

Middle & Upper Income = 86% of GHG
Global Carbon by Income 2050 Goal

Middle & Upper Income = 60% of GHG

Sweden - 4.8      France - 5.6     Norway - 7.9      California 2011 - 10.4    California 2050 - 3.3
CO2 Energy Emissions per Capita

**World**
- **Transport**: 19%
- **Manufacturing/Construction**: 21%
- **Other Fuels**: 11%
- **Buildings**: 48%
- Total: 4.4 tons

**California**
- **Transport**: 60%
- **Manufacturing/Construction**: 17%
- **Other Fuels**: 6%
- **Buildings**: 17%
- Total: 10.4 tons
Transportation Mode

<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>37%</td>
<td>11%</td>
</tr>
<tr>
<td>China</td>
<td>65%</td>
<td>12%</td>
<td>22%</td>
</tr>
</tbody>
</table>
AB32 – Set Initial Targets
Target: 1990 by 2020
Goal: 80% below 1990 emissions by 2050

SB32 – Codifies 2050, Accelerates Pace
Target: 40% below by 2030, 80% by 2050

E3 Study
Aggressive Technology Implementation falls short of 40% target
Smart Land Use: 24-28 MMT beyond Reference Case

Smart Land Use Closes the Gap to 40% below 1990
Vision California
Southern California Scenarios
Next Generation Scenario Models
Who’s Next? Perspectives on Southern California Growth
Changing Age and Household Types

Growth to 2040: 3.75 million people, 1.53 million households

Current & Future Population by Age Group

Source: CA Department of Finance, 2014

Current & Future Population by Household Type

Source: US Census Bureau, American Community Survey 2012
Perspectives on Southern California Growth

A Life Cycle of Housing Preferences

Housing Preferences by Age

Source: National Association of Realtors (2011)
Perspectives on Southern California Growth

The Market is Changing (or has changed)

November 1, 2013

Americans Prefer to Live in Mixed-Use, Walkable Communities

According to the National Association of REALTORS® 2013 Community Preference Survey, 60 percent of respondents favor a neighborhood with a mix of houses, stores, and other businesses that are within walking distance, rather than neighborhoods requiring driving between home, work, and recreation. Respondents indicated that while the size of a home or yard does matter, most are willing to compromise size for a preferred neighborhood and less commuting.

Source: National Association of Realtors (2013)
Perspectives on Southern California Growth

The Market is Changing (or has changed)

Younger Americans Place Higher Priority on Alternatives to Driving, Affordable Housing and Urban/Suburban Revitalization

Walkability and Age-Diversity Gaining in Importance

Source: National Association of Realtors (2013)
Perspectives on Southern California Growth

Housing Demand by Home Type

2010-2035

<table>
<thead>
<tr>
<th>Home Type</th>
<th>2010</th>
<th>2010-2035</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily</td>
<td>27%</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>Townhome</td>
<td>15%</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>Small Lot</td>
<td>16%</td>
<td>23%</td>
<td>29%</td>
</tr>
<tr>
<td>Larger Lots</td>
<td>0%</td>
<td>18%</td>
<td>42%</td>
</tr>
</tbody>
</table>

Perspectives on Southern California Growth

New Mobility Options
Explore SoCal Scenario Alternatives

Base + Change = Future Scenario

Analysis
UrbanFootprint – SimCity for the Real World
Build Scenarios, Test Impacts, Inform Decisions
1. Trend

Preliminary/Illustrative
2. 2012 Plan Update

Preliminary/Illustrative
3. Policy A

Preliminary/Illustrative
4. Policy B

Preliminary/Illustrative
## Place Types

### 35 Detailed Types

- Mixed Use
  - Skyscraper Mixed Use
  - High-Rise Mixed Use
  - Mid-Rise Mixed Use
  - Low-Rise Mixed Use
  - Parking Structure/Mixed Use
  - Main Street Commercial/Mixed Use High (3-5 Floors)
  - Main Street Commercial/Mixed Use Low (1-2 Floors)

- Residential
  - Skyscraper Residential
  - High-Rise Residential
  - Urban Mid-Rise Residential
  - Urban Podium Multi-Family
  - Standard Podium Multi-Family
  - Suburban Multifamily
  - Apt/Condo
  - Urban Townhome/Live-Work
  - Standard Townhome
  - Garden Apartment

### ~ 100 Building Types

- Office Focus
- Mixed Office and R&D
- Office / Industrial
- Industrial Focus
- Low-Density Employment Park

### Studies of Places Across California and the West

- Buildings
- Streets
- Parks / Civic

- Site Size
- Block Size
- Densities
- Floor Area Ratio
- Land Use
- Population
- Housing
- Employment
- Streets
Place Types

35 Detailed Types

<table>
<thead>
<tr>
<th>Key Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
</tr>
<tr>
<td>Mix of Uses</td>
</tr>
<tr>
<td>Street Connectivity</td>
</tr>
<tr>
<td>Location/Accessibility</td>
</tr>
</tbody>
</table>

Land Patterns

Urban

Compact

Standard
Urban
Compact Walkable
Compact Walkable
Standard Suburban
Walkability

Standard
- 15 / mi²
- 80 / mi²
- 130 / mi²

Compact
- 65 / mi²
- 225 / mi²
- 160 / mi²

Urban
- 210 / mi²
- 255 / mi²
- 160 / mi²

Auto-Oriented ~150 / mi² Walkable

60 / mi²
65 / m²
160 / m²
210 / m²
225 / mi²
110 / m²
130 / m²
160 / m²
255 / m²
160 / m²
210 / m²
225 / mi²
110 / m²
130 / m²
160 / m²
255 / m²
Intensity and Mix of Use

Standard

Compact

Urban

Auto-Oriented ~150 / mi²

Walkable

<2-50+ du/ac

<10-70+ emp/ac

~12-40 du/ac

~10-70 emp/ac

40+ du/ac

70+ emp/ac
Household Driving & Walking

Standard Compact Urban

12,000 miles/year
4,500 miles/year

76 miles/day
35 miles/day
13 miles/day

7 min/day
23 min/day
35 min/day

* Regional average
<table>
<thead>
<tr>
<th>Land Development Category Comparison (Typical Household, 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Household VMT</strong></td>
</tr>
<tr>
<td>Residential Energy Use</td>
</tr>
<tr>
<td>Residential Water Use</td>
</tr>
<tr>
<td>Carbon Emissions</td>
</tr>
<tr>
<td>Household Costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urban</th>
<th>Compact</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,500 mi/yr</td>
<td>12,000 mi/yr</td>
<td>26,500 mi/yr</td>
</tr>
<tr>
<td>35 min/day</td>
<td>23 min/day</td>
<td>7 min/day</td>
</tr>
<tr>
<td>55,000 gal/yr</td>
<td>82,000 gal/yr</td>
<td>142,000 gal/yr</td>
</tr>
<tr>
<td>39 mil btu/yr</td>
<td>58 mil btu/yr</td>
<td>79 mil btu/yr</td>
</tr>
<tr>
<td>5 MT/year</td>
<td>9 MT/year</td>
<td>16 MT/year</td>
</tr>
<tr>
<td>$4,400 $/year</td>
<td>$9,600 $/year</td>
<td>$19,000 $/year</td>
</tr>
</tbody>
</table>

From driving, residential energy, water-related energy. Excludes commercial energy use.
**Land Patterns**  
**New Growth (2012-2040)**

- **URBAN**  
  Higher-density, downtown and infill
  - Existing (2012): 81%
  - Trends: 86%
  - 2012 Plan Update: 56%
  - Policy A: 32%
  - Policy B: 21%

- **COMPACT**  
  Mid-density, walkable, and/or transit-oriented
  - Existing (2012): 17%
  - Trends: 11%
  - 2012 Plan Update: 31%
  - Policy A: 55%
  - Policy B: 63%

- **STANDARD**  
  Lower density auto-oriented suburban
  - Existing (2012): 2%
  - Trends: 3%
  - 2012 Plan Update: 13%
  - Policy A: 13%
  - Policy B: 16%
Land Patterns  End State (2040)

- **URBAN**
  - Higher-density, downtown and infill
  - Existing (2012): 17%
  - Trends: 16%
  - 2012 Plan Update: 20%
  - Policy A: 25%
  - Policy B: 26%

- **COMPACT**
  - Mid-density, walkable, and/or transit-oriented
  - Existing (2012): 81%
  - Trends: 82%
  - 2012 Plan Update: 76%
  - Policy A: 71%
  - Policy B: 69%

- **STANDARD**
  - Lower density auto-oriented suburban
  - Existing (2012): 2%
  - Trends: 2%
  - 2012 Plan Update: 4%
  - Policy A: 4%
  - Policy B: 5%
Transit and Walkability Focus

Households and Jobs in High Quality Transit Areas (HQTAs) and Transit Priority Areas (TPAs) - 2040

Households in HQTAs
- Existing (2012): 20%
- Trends: 29%
- 2012 Plan Update: 32%
- Policy A: 33%
- Policy B: 31%

Households in TPAs
- Existing (2012): 15%
- Trends: 19%
- 2012 Plan Update: 21%
- Policy A: 22%
- Policy B: 20%

Jobs in HQTAs
- Existing (2012): 22%
- Trends: 23%
- 2012 Plan Update: 32%
- Policy A: 34%
- Policy B: 32%

Jobs in TPAs
- Existing (2012): 20%
- Trends: 22%
- 2012 Plan Update: 32%
- Policy A: 34%
- Policy B: 32%
Base Year
TPAs & HQTAs
Base Year Land Use by LDC

2012
HQTA & TPA
HH: 35%
Jobs: 45%
2040 TPAs & HQTAs (Policy A)
2040 Land Use by LDC (Policy A)

2012
HQTA & TPA
HH: 35%
Jobs: 45%

2040
HQTA & TPA
HH: 53%
Jobs: 63%
Land Development Category (LDC)

Standard Suburban
Land Development Category (LDC)

Compact Walkable
Land Development Category (LDC)

Standard Suburban
Land Development Category (LDC)

Compact Walkable
Scenarios Analysis
Multi-Metric Analysis = More Informed Decisions
Land Consumption

New (greenfield) land consumed to accommodate new growth, 2012-2040

Compared to Trend:
Land saved in Policy A is equivalent to 3 times that of the City of Anaheim.
Household Driving

*Passenger Vehicle Miles Traveled (VMT) per Household*

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>Trend</th>
<th>2012 Plan Update</th>
<th>Policy A</th>
<th>Policy B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles</td>
<td>24,450</td>
<td>23,950</td>
<td>21,400</td>
<td>20,500</td>
<td>19,550</td>
</tr>
</tbody>
</table>

**Reduction from Trend**

|                | -2,500 mi/yr | -3,500 mi/yr | -4,400 mi/yr |

**Compared to Trend:**

*Households in Policy A are driving 3,500 fewer miles per year.*
Household Driving

Base Year (2012) VMT Per Capita
Household Driving

Annual Passenger Vehicle Miles Traveled (VMT), 2040

Compared to Trend:
VMT reduction in Policy A is like taking 2 million cars off SoCal roads.
Fuel Use

Passenger Vehicle Fuel Use, Cumulative, 2012-2040

- Trend: 161.4 billion gallons
- 2012 Plan Update: 151.5 billion gallons
- Policy A: 148.1 billion gallons
- Policy B: 144.4 billion gallons

Reduction from Trend:
- 10 billion gallons
- 13 billion gallons
- 17 billion gallons

2040 on road passenger vehicle fleet average = 28mpge
Costs of Driving

Fuel, Ownership, & Maintenance Costs Use, Annual, 2040

Compared to Trend:

**Policy A saves SoCal households $131 Billion in automobile-related costs from 2012-2040, or $2,000/year per household.**

2040 gasoline price = $6.00/gallon (2015 dollars)
Respiratory Health Impacts

Cost Reduction from ‘Trend’ Due to Criteria Pollutant-Related Health Incidences, Annual in 2040

<table>
<thead>
<tr>
<th></th>
<th>Trend</th>
<th>2012 Plan Update</th>
<th>Policy A</th>
<th>Policy B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions</td>
<td>$0</td>
<td>-$498</td>
<td>-$671</td>
<td>-$859</td>
</tr>
</tbody>
</table>

Compared to Trend:
Policy A reduces health incidences by 14% and saves more than $670 million in 2040.
Active Transportation & Health Impacts

Base Year (2012)
Walking (min/day)
Base Year Land Use by LDC

2012
HQTA & TPA
HH: 35%
Jobs: 45%
2012
HQTA & TPA
HH: 35%
Jobs: 45%

2040
HQTA & TPA
HH: 53%
Jobs: 63%
2012 Walking Minutes per Day
2040 Walking Minutes per Day (Policy A)
### Active Transportation & Health Impacts

#### Adults: Ages 18-65

<table>
<thead>
<tr>
<th>Activity</th>
<th>Base Year 2012</th>
<th>Net Change: (2012 – 2040)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recreation Physical Activity</strong></td>
<td>13 min</td>
<td>+ 9%</td>
</tr>
<tr>
<td><strong>Walking</strong></td>
<td>23 min</td>
<td>+ 10%</td>
</tr>
<tr>
<td><strong>Biking</strong></td>
<td>3 min</td>
<td>+ 12%</td>
</tr>
<tr>
<td><strong>Auto</strong></td>
<td>55 min</td>
<td>- 6%</td>
</tr>
<tr>
<td><strong>Obese Population (%)</strong></td>
<td>21.5%</td>
<td>- 3%</td>
</tr>
<tr>
<td><strong>Poor Health Population (%)</strong></td>
<td>24.1%</td>
<td>- 13%</td>
</tr>
<tr>
<td><strong>High Blood Pressure (%)</strong></td>
<td>19.6%</td>
<td>- 1%</td>
</tr>
<tr>
<td><strong>Diabetes - Type 2 (%)</strong></td>
<td>5.6%</td>
<td>- 11%</td>
</tr>
</tbody>
</table>
Land Development Category (LDC)

Standard Suburban
Land Development Category (LDC)

Compact Walkable
Building Energy Use

Residential & Commercial Buildings, Cumulative (2012-2040)

Compared to Trend:
Policy A saves the average SoCal household 10% on their electric and gas bills.
Building Energy Costs

Residential & Commercial Buildings, Cumulative (2012-2040)

Compared to Trend:
Policy A saves SoCal households $2.1 billion in annual electricity and gas costs.
Building Water Use

Residential & Commercial Buildings, Cumulative (2012-2040)

<table>
<thead>
<tr>
<th>Policy</th>
<th>Water Use (Acre Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trend</td>
<td>118.4</td>
</tr>
<tr>
<td>2012 Plan Update</td>
<td>116.8</td>
</tr>
<tr>
<td>Policy A</td>
<td>116.0</td>
</tr>
<tr>
<td>Policy B</td>
<td>115.2</td>
</tr>
</tbody>
</table>

Reduction from Trend:
- 1.6 M Acre Feet
- 2.4 M Acre Feet
- 3.2 M Acre Feet
Building Water Use

Residential & Commercial Buildings, Cumulative (2012-2040)

Water Savings Would Supply Homes For a Year

- 3.7 mill homes
- 5.7 mill homes
- 7.6 mill homes

<table>
<thead>
<tr>
<th>Category</th>
<th>2012 Plan Update</th>
<th>Policy A</th>
<th>Policy B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trend</td>
<td>118.4</td>
<td>116.8</td>
<td>115.2</td>
</tr>
<tr>
<td>2012 Plan Update</td>
<td>116.8</td>
<td>116.0</td>
<td></td>
</tr>
<tr>
<td>Policy A</td>
<td>116.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policy B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Acre Feet (AF) Millions
Building Water Costs

Residential & Commercial Buildings, Cumulative (2012-2040)

- $2.2 bill
- $3.3 bill
- $4.4 bill

Compared to Trend:

Policy A saves SoCal households $230 million on annual water bills.
Local Infrastructure & Service Costs

Capital and Operations & Maintenance Costs to Support New Growth, 2012-2040

Capital Costs includes local roads, waste water and sanitary sewer, water supply, and parks & recreation
Operations & Maintenance includes City General Fund engineering and public works functions

Compared to Trend:
Policy A saves $168 million per year on capital and O&M costs.
Greenhouse Gas Emissions
Annual in 2050

Emissions offset by 47,000 square miles of trees in a year.
A forest covering 1/4 of California.

Passenger Vehicles
Buildings

Business As Usual
Growing Smart
California 2050 GHG Emissions
Getting to 80% Below 1990

- CO$_2$e MMT

1990: 109
BAU/Adopted Policy: 117
+ Smart Growth: 102
+ Vehicle Efficiency: 100
+ Low Carbon Fuels: 100
+ Bldg Efficiency: 69
+ Renewable Power: 55
80% Below 1990: 22

Getting to 80% Below 1990

Buildings
Travel

CO$_2$e MMT
California Energy Commission
Policy Testing and Development, Tools & Data for Local Agency Energy & Planning

Energy Use Per Acre

Energy Use Per Household
Serving State Policy Development

California Energy Commission AB 758 Draft Action Plan

Robust Base Data for Testing Policy Assumptions and Sensitivity
Example: Targeting Existing Single Family Residential Building Upgrades

**Building Type**

Input Data Sources:
- Assessor’s parcel data
- Emerging datasets:
  - Public or privately developed
  - Empirical, estimated, or modeled

Potential Limitations:
- Availability
- Consistency
**Example: Targeting Existing Single Family Residential Building Upgrades**

**Vintage**

Input Data Sources:
- Assessor’s parcel data
- Other public or privately developed datasets

Potential Limitations:
- Availability
- Consistency
Example: Targeting Existing Single Family Residential Building Upgrades

**Income**

Input Data Sources:
- Census ACS
- Other data held by jurisdictions (e.g., existing program participation data)

Potential Limitations:
- Data scale
- Representativeness in targeting buildings
Example: Targeting Existing Single Family Residential Building Upgrades

Energy Use Intensity (EUI)

Input Data Sources:
• CEC RASS survey data by type, climate zone
• Empirical usage or billing data
• Modeled asset data

Potential Limitations:
• Availability
• Consistency
• Accuracy
**Sub Selection**

- Single Family
- Pre-1978
- Lower Income
- EUI

**Example: Targeting Existing Single Family Residential Building Upgrades**
Energy-Aware Local Planning

Support Data Development, Broad Data Access, and Accessible Tools

Community Engagement
General Planning
Health Impact Assessments
Climate Action Planning
Getting to Zero Net Energy/Carbon

1. Smarter Land Use
2. More Efficient Buildings
3. Clean Energy Production

CalThorpe Analytics