Scenario Analysis & Peak Oil

How to Plan for an Uncertain Future

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University of Utah

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Uncertainty – Part of the Human Condition
What is “Scenario Planning”?

Scenario:

“an internally consistent view of what the future might turn out to be – not a forecast, but one possible future outcome.”

Scenario Planning:

A process using a range of possible futures that:

- Define outer bounds of impacts from external factors
- Provide a laboratory for testing possible policy responses
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Famous Examples from Military & Business

RAND Corp’s nuclear war scenarios (1950s)
Famous Examples from Military & Business

Royal Dutch/Shell’s “Arab Oil Embargo” scenarios (1970s)
Military/Business Scenario Planning

“3C” Transportation Planning
NEPA Alt. Analyses

Land Use-Transportation Scenario Planning
Incorporating variable land use assumptions, but not broader economic and environmental considerations
Four Scenarios for the Future
# Sacramento Region Blueprint

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Single-Family: Multifamily Housing</th>
<th>% Housing Growth through Infill</th>
<th>% Trips by Auto</th>
<th>% Trips by Transit</th>
<th>% Trips by Walk/Bike</th>
<th>Daily VMT per Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Business as usual (trend)</td>
<td>75:25</td>
<td>27.0</td>
<td>93.7</td>
<td>0.8</td>
<td>5.5</td>
<td>47.2</td>
</tr>
<tr>
<td>B: Higher housing densities than A, with growth focused at the urban fringe</td>
<td>67:33</td>
<td>39.0</td>
<td>83.2</td>
<td>4.0</td>
<td>12.7</td>
<td>37.6</td>
</tr>
<tr>
<td>C: Higher housing densities than A, with growth focused on central infill sites</td>
<td>65:35</td>
<td>38.3</td>
<td>81.8</td>
<td>4.8</td>
<td>13.4</td>
<td>36.7</td>
</tr>
<tr>
<td>D: Higher housing and employment densities, with growth focused on central infill sites</td>
<td>64:36</td>
<td>44.0</td>
<td>79.9</td>
<td>4.8</td>
<td>15.3</td>
<td>35.7</td>
</tr>
<tr>
<td>Preferred Scenario</td>
<td>65:35</td>
<td>41.0</td>
<td>83.9</td>
<td>3.3</td>
<td>12.9</td>
<td>34.9</td>
</tr>
</tbody>
</table>
Sacramento Region Blueprint
U.S. Land Use-Transportation Scenario Planning Projects

Source: Bartholomew & Ewing 2010
Scenario Inputs

- Transportation system elements: *variable*
- Land use/growth allocations (the D’s): *variable*
- Growth levels: *some variable/most constant*
- Economic conditions (real estate markets & fuel prices): *constant*

Assessment Tools

- Land use allocation methods
- Travel demand modeling
- Other tools

Assessment Outputs

- Travel related
- Air quality & CO2
- Public costs
- Other
Scenario Inputs: Transportation System Elements

Road Lane Miles of Alternative Scenarios
percent difference compared to trend scenarios

mean = −1.19%

n = 92
Scenario Inputs: Land Use Elements

Density of Alternative Scenarios
percent difference in persons per developed acre compared to trend scenarios

mean = 19.82%

n = 119
Scenario Inputs: Land Use Elements

Households Near Transit
percent difference in percentage of total households within 1/4 mile of transit vs. trend scenario

n = 62
Assessment Outputs

Vehicle Miles Traveled of Alternative Scenarios
percent difference compared to trend scenarios

mean = −2.51%

n = 119

23.64%
Vehicle Hours of Delay of Alternative Scenarios
percent difference compared to trend scenarios

mean = 16.38%

n = 33

~49.13%
Assessment Outputs

**Agriculture Lands Consumed by Alternative Scenarios**
percent difference compared to trend scenarios

- 13.50%
- -8239.42%

$n = 42$
Assessment Outputs

NO\textsubscript{x} Emissions of Alternative Scenarios

percent difference compared to trend scenarios

$\Delta = 3.16\%$
Greenhouse Gas Emissions of Alternative Scenarios
percent difference compared to trend scenarios

n = 31

45.72%

-23.16%
Assessment Outputs

Road Costs per Person: Alternative vs. Trend Scenarios
M. King Hubbert
Hubbert's Peak
Peaking at the Oil Field Level
Peaking at the National Level

Source: EIA, 2000
Chart 79: UK Liquids Production 1970 - 2008

Source: ASPO Ireland & BP Statistical Review of World Energy

Peaking at the National Level
Peaking at the National Level

Source: ASPO Ireland & BP Statistical Review of World Energy
Declining Country & Well Production
1997 - 2006

Source: Simmons, 2008
Peaking at the Global Level

World Energy Council, 2007
Peaking at the Global Level
## Table 1. WORLD OIL PRODUCTION FORECAST

<table>
<thead>
<tr>
<th>Probability Estimate</th>
<th>Ultimate Recovery BBbls</th>
<th>Annual Demand Growth, %</th>
<th>Peak Year</th>
<th>Peak Rate, MMBbls/yr</th>
<th>Peak Rate, MMBbls/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (95%)</td>
<td>2,248</td>
<td>0.0</td>
<td>2045</td>
<td>24,580</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>2,248</td>
<td>1.0</td>
<td>2033</td>
<td>34,820</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>2,248</td>
<td>2.0</td>
<td>2026</td>
<td>42,794</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>2,248</td>
<td>3.0</td>
<td>2021</td>
<td>48,511</td>
<td>133</td>
</tr>
<tr>
<td>Mean (expected value)</td>
<td>3,003</td>
<td>0.0</td>
<td>2075</td>
<td>24,580</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>3,003</td>
<td>1.0</td>
<td>2050</td>
<td>41,238</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>3,003</td>
<td>2.0</td>
<td>2037</td>
<td>53,209</td>
<td>146</td>
</tr>
<tr>
<td></td>
<td>3,003</td>
<td>3.0</td>
<td>2030</td>
<td>63,296</td>
<td>173</td>
</tr>
<tr>
<td>High (5%)</td>
<td>3,896</td>
<td>0.0</td>
<td>2112</td>
<td>24,580</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>3,896</td>
<td>1.0</td>
<td>2067</td>
<td>48,838</td>
<td>134</td>
</tr>
<tr>
<td></td>
<td>3,896</td>
<td>2.0</td>
<td>2047</td>
<td>64,862</td>
<td>178</td>
</tr>
<tr>
<td></td>
<td>3,896</td>
<td>3.0</td>
<td>2037</td>
<td>77,846</td>
<td>213</td>
</tr>
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</table>

Source: Energy Information Administration


### Peaking at the Global Level
Oil Production Projections: US

Source: EIA, 2012
Oil Price Projections: US

Source: EIA, 2012
Gasoline Prices & Transit Trips: Washington

Source: Stover & Bae, 2011
Gasoline Prices & Transit Trips: Philadelphia

Source: Maley & Weinberger, 2009
Gasoline Prices & Transit Trips: US

Source: Lane, 2011
Percent Change in House Prices: 4th Quarter 2006 to 4th Quarter 2007

Source: Cortright, 2009
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Source: Cortright, 2009
Source: Chakraborty, Kaza, Knaap & Deal, 2011
Synthesis

• Scenario analysis is an effective method for thinking about alternative futures, especially when there is significant uncertainty.

• Regional transportation agencies are now well-practiced with the technique, but only with respect to internal variables.

• Energy prices are volatile and the volatility is likely to increase, thereby increasing uncertainty.

• It is now time to incorporate external variables into scenario analysis, especially those related to energy prices.
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