Our Work
This Afternoon

1. Entering the Post-Petroleum Era
2. Transportation Trajectories
3. Locating the Leading Edge in the US
4. Arizona/Pima County Opportunities
1. Entering the Post-Petroleum Era

Smart Mobility – Arizona & Pima County
The Official Price Forecast

Figure 3. World Oil Prices in Two Cases, 1980-2030

$186/barrel
-13% Consumption

The Official Demand Forecast

Transportation = 74% of growth in oil consumption

India & China will at least double their petroleum demand.
US Oil Consumption (million barrels per day)

EIA, Annual Energy Outlook 2001; "Potential Oil Production from the Coastal Plain of ANWR," - EIA Reserves & Production Division
2007 US Oil Imports by Country

- Canada: 19%
- Saudi Arabia: 15%
- Mexico: 14%
- Venezuela: 12%
- Nigeria: 11%
- Angola: 10%
- Others: 5%
- Algeria: 4%
- Iraq: 3%
- Kuwait: 2%
- Colombia: 1%
- Brazil: 1%

STABILITY OF U.S. RELATIONS

- HIGH: 31%
- MODERATE: 28%
- LOW: 41%

Source: Oil & Gas Journal
Remaining Oil Reserves by Country

Saudi Arabia 20%
Iran 10%
Iraq 9%
Kuwait 8%
U.A.E. 7%
Venezuela 6%
Russia 5%
Libya 3%
Nigeria 3%
Kazakhstan 2%
U.S. 1%
China 1%
Qatar 1%
Others 10%
Canada 14%

Source: Oil & Gas Journal

STABILITY OF U.S. RELATIONS

HIGH
15%
MODERATE
32%
LOW
53%
Production Cost – Sources of Oil

Production Cost Per Barrel of Oil - 2007

- Oil Shale: $57
- Liquefied Coal: $35
- Synfuel: $26
- Tar Sands/Heavy Oil: $23
- Enhanced Recovery: $16
- Conventional Oil: $9

Source: Brandt & Farrell, UC Berkeley
Energy Bottom Line

- Petroleum demand will far exceed supply
- Prices will rise considerably by 2030
- Prices will also tend to be unstable
- 95% of transportation energy today is provided by imported petroleum
- Transportation is the fastest growing petroleum end use category - worldwide
- Energy security will not be achievable until we reduce our reliance on oil for transportation
2. Transportation Trajectories

Smart Mobility – Arizona & Pima County
Trajectories

- VMT and Traffic Congestion
- Climate Change
- Family Budgets
- Personal Health
- Food
VMT and Traffic Congestion

Transportation Trajectories
United States

Population & VMT

<table>
<thead>
<tr>
<th>Year</th>
<th>Pop. (millions)</th>
<th>VMT (trillions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>166</td>
<td>0.6</td>
</tr>
<tr>
<td>1980</td>
<td>227</td>
<td>1.5</td>
</tr>
<tr>
<td>2005</td>
<td>296</td>
<td>3.0</td>
</tr>
</tbody>
</table>

- Pop. increase: 178%
- VMT increase: 500%

Population: 300% increase
VMT: 500% increase
United States
Annual Rate of Change in VMT

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975-1985</td>
<td>3.35%</td>
</tr>
<tr>
<td>1985-1995</td>
<td>3.59%</td>
</tr>
<tr>
<td>1995-2005</td>
<td>2.39%</td>
</tr>
<tr>
<td>2005-2006</td>
<td>0.06%</td>
</tr>
<tr>
<td>2006-2007</td>
<td>0.03%</td>
</tr>
<tr>
<td>2007-2008</td>
<td>2.80%</td>
</tr>
</tbody>
</table>
VMT Trend in 2008

Source: United States Department of Transportation, Traffic Volume Trends, October 2008
### Phoenix Valley Freeways

**TTI Data - 2007**

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2005</th>
<th>+   %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily VMT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19.4</td>
<td>28.4</td>
<td>+ 46%</td>
</tr>
<tr>
<td><strong>Lane Miles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,030</td>
<td>1,405</td>
<td>+ 36%</td>
</tr>
</tbody>
</table>

**New roads needed to avoid increase in congestion:**

*412 lane miles per year*
Road Building Has Not Reduced Delay

Figure 1-6  Growth of Annual Hours of Delay per Capita
Source: Schrank and Lomax 2005.
United States

Per Capita Traffic Delay

(person hours per year)

All Large Metros

1985 1990 1995 ‘00 ‘03

5 minutes/day

Phoenix

30
20
10

5 minutes/day

1985 1990 1995 ‘00 ‘03

(person hours per year)
What about congestion alleviation?
Have you ever noticed...?
Rational Transportation “Planning”

1. What do we want?
2. How much traffic will there be?
3. What should we do?
Actual Transportation "Planning"

1. What do we want?
2. How much traffic will there be?
3. What should we do?
Actual Transportation “Planning”

1. How much traffic will there be?

2. What should we do?

3. What do we get?
Induced Traffic
Types of Induced Traffic

Changes in travel route .................... Immediate
Changes in mode of travel .................. < 6 months
Changes in time of travel ................... < 6 months
Changes in amount of travel ............... < 6 months
Changes in origins & destinations ........ < 10 years
% of new capacity consumed by induced traffic...

Short Term: less than five years

Long Term: five to 10 years
If you build it . . .

. . . they will come
If you build it . . .

. . . they will come
Are we responding to traffic growth... 
...or are we causing it?

“Project & Provide”
Effects of “Project & Provide”

- High rates of driving & vehicle ownership
- High risk of accidents
- Lower rates of walking
- Higher levels of air pollution, esp. ozone
- High levels of GHG emissions
- **No reduction in congestion delay**
Climate Change

Transportation Trajectories
The Keeling Curve

SOURCE: Scripps Institute of Oceanography
Receding Glaciers
Sea level rise due to global warming

**Sea level rise over the last century**

- Annual sea level change
- 5-year running mean

**Sea level rise scenarios for 2100**

Solid lines represent various scenarios including changes in aerosols beyond 1990. Dashed lines show the scenarios with constant 1990 aerosol.

Source: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996; Sea level rise over the last century, adapted from Gornitz and Lebedeff, 1987.
Basics: Climate Change 1

- Greenhouse gases associated with human activities are contributing to global warming with potentially serious consequences.
Scientific consensus:

- We must limit global temperature increases to no more than 2° to 3° C
- To do that we must cut GHG emissions by 60% to 80% below 1990 levels by 2050
Basics: Climate Change 3

- GHGs persist in the atmosphere – we do not start over each year
- If we hesitate to begin reducing GHG emissions, the amount we have to reduce in later years increases exponentially
- What we do now is more important than what we do in 2050
Figure 3. The Interior West: Epicenter of Warming in the Contiguous U.S. (2000 - 2007 Average Temperatures Compared to 20th Century Averages)
A Warmer West: Five-year Average Temperatures in 11 Western States Compared to 20th Century Average

Data from the National Oceanic and Atmospheric Administration’s climate division series. Analysis by the Rocky Mountain Climate Organization.
Ambient Temperature Change 1908 – 2007 (° F)

World: + 1.0°  Western US: + 1.7°  Arizona: + 2.2°
U.S. Greenhouse Gases

Transportation 28%

Utilities 33%

Industrial 19%

Commercial 6%

Residential 5%

Agriculture 8%

Other 1%
Transportation: 24%
RCI: 18%
Industrial: 2%
Electrical Generation: 37%
Agriculture: 8%
Waste Management: 2%
Ind. Process/Fossil Fuel: 9%

Colorado
California

- Transportation: 41%
- Industrial: 23%
- Electrical Generation: 20%
- Agricultural: 8%
- Commercial: 3%
- Residential: 6%
Arizona

- Transportation: 39%
- Electrical Generation: 38%
- Industrial: 6%
- Ind. Process/Fossil Fuel: 5%
- Waste Management: 2%
- Agriculture: 5%
- RCI: 5%
Figure 4. Contributions to Emissions Growth, 1990-2020: Reference Case Projections (MMTCO2e)
Figure 0-2

Projected Growth in CO₂ Emissions from Cars and Light Trucks

Vehicle Technology Alone Will Not Solve the Problem

Projected Growth in CO2 Emissions from Cars and Light Trucks Assuming Stringent Nationwide Vehicle and Fuel Standards*

Sources: VMT: EIA with 10% rebound  MPG: US Senate,  Fuels: C.
...Even With Very Stringent Standards

Sources: VMT: EIA with 10% rebound, MPG & Fuel: Trend Extrapolation
Arizona Gross Greenhouse Gas Emissions
All Sources – Climate Action Plan

Governor’s Policy

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (Million Metric Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>66.0</td>
</tr>
<tr>
<td>2000</td>
<td>89.0</td>
</tr>
<tr>
<td>2020</td>
<td>160.3</td>
</tr>
</tbody>
</table>

- 80% below 2000 levels

Governor’s Policy back to 2000 levels

50% below 2000
Arizona Gross Greenhouse Gas Emissions

Transportation Sources

- 1990: 25.3
- 2000: 35.0
- 2020: 58.6 (50% below 2000 levels)
- 2040: 82.2 (-80%)

Governor's Policy
Annual Growth Rate to 2020: AZ Vehicle Miles of Travel

- Passenger Vehicles: 2.4%
  - +61% in 20 years

- Freight Vehicles: 3.7%
  - >100% in 20 years
Summary: Climate Change

- Arizona must reduce its emissions of greenhouse gases – including those from transportation
- The required reduction cannot be achieved through alternative fuels or new technologies
- We must begin efforts to reduce growth in per capita VMT
- Delay in starting will add to the cost
Family Budgets

Transportation Trajectories
Household Expenditures

- Tobacco products and smoking supplies: 0.7%
- Alcoholic beverages: 1.0%
- Personal care products and services: 1.3%
- Miscellaneous: 1.5%
- Education & Reading: 2.2%
- Cash contributions: 3.4%
- Apparel and services: 4.0%
- Entertainment: 5.0%
- Healthcare: 5.9%
- Personal insurance and pensions: 9.9%
- Food: 13.1%
- Transportation: 19.1%
- Housing: 32.9%

% of Household Expenditures
A HEAVY LOAD:
The Combined Housing and Transportation Burdens of Working Families
## TYPICAL HOUSEHOLD BUDGET IN 28 METROPOLITAN AREAS

(Expenses as a share of income)

<table>
<thead>
<tr>
<th></th>
<th>All Households</th>
<th>Working Families Incomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$20,000 – $50,000</td>
</tr>
<tr>
<td>Housing</td>
<td>27.4%</td>
<td>27.7%</td>
</tr>
<tr>
<td>Transportation</td>
<td>20.2%</td>
<td>29.6%</td>
</tr>
<tr>
<td>Food</td>
<td>10.6%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>4.7%</td>
<td>7.7%</td>
</tr>
</tbody>
</table>
Share of Family Income Spent On Housing & Transportation

Family Income = $35,000 - $50,000

- **Central City**
  - Housing: 23%
  - Transportation: 16%
  - Total: 39%

- **Near Jobs**
  - Housing: 26%
  - Transportation: 23%
  - Total: 49%

- **Away From Jobs**
  - Housing: 25%
  - Transportation: 26%
  - Total: 51%
Share of Family Income Spent On Housing & Transportation

Family Income = $20,000 - $35,000

Central City
- Housing: 32%
- Transportation: 22%
- Total: 54%

Near Jobs
- Housing: 35%
- Transportation: 31%
- Total: 66%

Away From Jobs
- Housing: 33%
- Transportation: 37%
- Total: 70%
Family Costs Rising Faster Than Incomes (2000 - 2005)

- Housing: +15.4%
- Transportation: +13.4%
- Income: +10.3%
Personal Health

Transportation Trajectories
We cannot escape our DNA...
...no matter how hard we try
1985 Obesity Trends* Among U.S. Adults

No Data           <10%          10%–14%
1987

Map of the United States showing data distribution across states.

- **No Data**
- **<10%**
- **10%–14%**

Legend:
- No Data
- <10%
- 10%–14%
1998

No Data          <10%           10%–14%  15%–19% ≥20%
U.S. Walk Trips 1977-1995

Source: Nationwide Personal Transportation Survey, 1995
% of Trips in Urban Areas – 1995

Pucher J and Dijkstra L. Promoting Safe Walking and Cycling to Improve Public Health: Lessons From The Netherlands and Germany. AJPH, September 2003;93(9):1509-16.
Higher density and connectivity: lower obesity—Atlanta study 2004

Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars

Lawrence D. Frank, PhD, Martin A. Andresen, MA, Thomas L. Schmid, PhD
Children Are Walking Less and Becoming Increasingly Overweight

Percent of Children’s Trips Made on Foot

Percent of Children Who Are Overweight

Surface Transportation Policy Project Data Analysis - 2001
Walk/Bike to School

- 1974: 66% of children
- 2000: 13% of children
U.S. Health Care Expenditures as Percent of GDP Projections

Keehan et al: Health Affairs
March/April 2008 27: 145-155

Graham Environmental Sustainability Institute | http://provost.umich.edu/gesi
Food

Transportation Trajectories
20 tons of bottled water annually
Salmon

Caught in Alaska

Filleted in China

Served in California
## Cost of Shipping One Standard 40’ Container

<table>
<thead>
<tr>
<th>Oil Price Per Barrel</th>
<th>Cost to Ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20..................</td>
<td>$3,000</td>
</tr>
<tr>
<td>$125.................</td>
<td>$8,000</td>
</tr>
<tr>
<td>$200.................</td>
<td>$15,000</td>
</tr>
</tbody>
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3. The Leading Edge in the US

Smart Mobility – Arizona & Pima County
Leading Edge

- State of Florida
- State of Washington
- State of California
Florida
- Growth Management Act
- State Funding for Transit
Florida Growth Management Act

- All counties, cities have growth plans
- Plans reviewed by state for compliance
- Citizens, other counties & cities have right to review & comment (and sue)
- Concurrency requirement
- Plans must be updated frequently
- Plans must include implementation elements
Florida Transit Block Grants

- Implemented in 1990
- Allocated by state law from the proceeds of state sales taxes
- Only capital projects are eligible
- Program > $70 million annually
- Funds are used to match federal transit capital grants
California
- AB32
- SB 375
California AB 32

1. Establishes regulatory & market mechanisms to achieve GHG reductions
2. Air Resources Board (ARB) responsible for monitoring & reducing GHG emissions
3. Climate Action Team coordinate state efforts
4. Authorizes Governor to invoke safety valve in event of extraordinary circumstances, catastrophic events or the threat of significant economic harm, for up to 12 months at a time
CARB Will:

- Adopt mandatory reporting rules for significant sources of greenhouse gases by January 1, 2008.
- Adopt a emissions plan by Jan 1, 2009 outlining needed regulations, market mechanisms and other actions.
- Adopt regulations by January 1, 2011.
- Convene an Environmental Justice Advisory Committee and an Economic and Technology Advancement Advisory Committee.
- Ensure public notice & opportunity for comment for all ARB actions.
- Evaluate impacts on state economy, environment, and public health; equity between regulated entities; electricity reliability, conformance with other environmental laws, and ensure rules do not disproportionately impact low-income communities.
- Adopt discrete, early action measures by July 1, 2007 that can be implemented before January 1, 2010.
California SB 375

1. Creation of regional targets for GHG emissions reduction tied to land use

2. Requirement that regional planning agencies create a plan to meet those targets, even if that plan is in conflict with local plans

3. Requirement that regional transportation funding decisions be consistent with this new plan.

4. Directly connecting regional transportation planning and housing efforts for the first time.

5. CEQA exemptions and streamlining for projects that conform to the new regional plans, even if they conflict with local plans
Washington
- 1990 Growth Management Act
- 2008 GHG/VMT Bill
Wa GMA Comp Plan Elements

- Land Use
- Housing
- Capital Facilities Plan
- Utilities
- Rural Element
- Transportation
- Economic Development
- Parks and Recreation
Wa GMA & Transportation

- Six-Year Transit Plans
- Non-Motorized Transportation
- Roadway LOS
- Collaborative Plan Review/Project Review
- Functional Classification of Highways
- Ten-Year Programs
- Urban Arterial Trust Account
- Regional Transportation Plan
State GHG emission reduction goals:

- Reduce emissions to 1990 levels by 2020
- Reduce emissions to 25 percent below 1990 levels by 2035
- Reduce emissions to 50 percent below 1990 levels by 2050 (70% below forecast)
Wa 2008 GHG, VMT Bill

➤ State to achieve emission reduction goals by:
  ✓ Participating in design of a regional multi-sector market-based system for regulating emissions
  ✓ Improving accountability through a system for reporting, monitoring & tracking emissions
  ✓ Adopting statewide goals to reduce annual per capita vehicle miles traveled (VMT) by 2050
  ✓ Ensuring that the state has a well-trained “clean energy” workforce
Wa 2008 GHG, VMT Bill

- Statewide baseline of 75 billion VMT used to establish benchmarks:
  - Reduce annual per capita VMT by 18% by 2020
  - Reduce annual per capita VMT by 30% by 2035
  - Reduce annual per capita VMT by 50% by 2050
4. Opportunities for Arizona & Pima

Smart Mobility – Arizona & Pima County
What Would “Smart” Transportation Policy Do?

- Improve personal mobility
- Reduce energy used/mile of travel
- Decouple transportation from imported petroleum
- Increase % of family travel budgets that are avoidable
- Use “smart growth” policies to improve transportation viability:
  - Shorten trip lengths
  - Facilitate mode shifts
Opportunities

- Location Efficiency
- Context Sensitive Facilities
- Complete Streets
- 20-Minute Neighborhoods
- Transit & Intercity Rail
Location Efficiency

Opportunities
5.1 Million People
14.1 Million People
Urban Design & VMT

- Compact cities generate less VMT/capita
- The difference (>20%) is permanent

Source: Growing Cooler

Figure 0-5

Average Daily Vehicle Miles Traveled

<table>
<thead>
<tr>
<th></th>
<th>10 Most Sprawling Metropolitan Areas</th>
<th>10 Most Compact Metropolitan Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27</td>
<td>21</td>
</tr>
</tbody>
</table>

Location Efficiency

- Compact regional urban form
- Focus commercial development in transit-served centers
- Mixed use/functional neighborhoods
- Walkable environments
- New residential growth oriented to transit-served districts
Location Efficiency Benefits

- Less traffic, less driving (20 - 40%)
- Reduced public expenditure/capita
- Preserve open space and ag lands
- Higher quality of life
- Greater economic resiliency
- Improved overall sustainability
The Changing Demographics of Metro Areas

- Married couples with kids are no longer dominant
- “Empty-Nesters” are on the rise
- Single-person households want “urbanity”
- “The Rise of the Creative Class”
Married Couples with Children No Longer Dominant

- 27% of households in 1990
- 23% of households today
Empty-Nesters: The Effect of Aging Baby Boomers on the U.S. Population

Age and Sex Distribution of the Total Population: 1900, 1950, and 2000

Source: U.S. Census Bureau, decennial census of population, 1900, 1950, and 2000.
Housing Supply & Demand

The chart shows the comparison between 2003 supply, 2025 demand, and net new units needed for different categories of housing units:

- **Attached**: 2003 Supply: 25000, 2025 Demand: 35000, Net New Units Needed: 10000
- **Small lot**: 2003 Supply: 20000, 2025 Demand: 30000, Net New Units Needed: 10000
- **Large lot**: 2003 Supply: 30000, 2025 Demand: 50000, Net New Units Needed: 20000

The graph indicates a significant increase in demand for large lots, with a substantial net new units needed compared to the other categories.
14.1 Million People
Context Sensitive Facilities

Opportunities
Complete Streets

Opportunities
Streets Designed for Use by All Modes
The 20-Minute Neighborhood

Opportunities
20-Minute Neighborhood:
- Walk to essential services
- Walk to retail
- Walk to work
- Walk to school
- Walk to amenities
Transit & Intercity Rail

Opportunities
Intercity Rail
Active Intercity Rail Corridors
Thank You
Food for thought:

“We are all faced with a series of great opportunities...

... brilliantly disguised as insoluble problems.”

John W. Gardner