SmartGAP(RPAT) & Application for Evaluating the Impact of Smart Growth Policies on Travel Demand*

* Funded BY FHWA
What is SmartGAP (RPAT)?

A Planning and Policy assessment tool which is free, open-sourced, and user-friendly

• Input different smart growth scenarios and estimate the effect on regional travel demand and other parameters
• Evaluates effects on sprawl, energy-reduction, active travel, and carbon footprints.
• Compares different scenarios
• Provides empirical evidence regarding the relationship of smart growth and travel demand.
• Assess what types of smart growth development are most suitable for given areas
Features of SmartGAP (RPAT)

• A sketch planning tool
• Runs at the regional level but can use dis-aggregated data as inputs, such as parcel data, land use data, TAZ data, etc.
• Quick response: taking about 10-20 minutes to run one scenario. For example, it takes 20 minutes to run the ARC (Atlanta) SmartGAP model
• Multiple scenario comparison in one panel
• Performance metrics are designed to address a variety of impacts useful for decision-making: travel demand, environment and energy, financial and economic, community.
SmartGAP Implementations

- FHWA SHRP-2 C16 Pilot Tests
  - Maryland Department of Transportation (MDOT)
  - Atlanta Regional Commission (ARC)
  - Thurston Regional Planning Commission (TRPC)
- Pilot tests for the SHRP 2 C16 workshop at 2013 New Partners for Smart Growth conference:
  - Capital District Transportation Council (CDTC)
  - Houston-Galveston Area Council (HGAC)
- Scenario testing as part of the Elmira-Chemung Transportation Council (ECTC) LRTP
C16 Project Overview for Triangle Region

DCHC MPO, CAMPO, NCDOT & ITRE/NCSU work together on adopting SmartGAP:

- Supporting the pre-screening of transportation and land use scenarios in the MTP process

- Addressing policy questions, such as the impact of smart growth on travel demand, greenhouse gas emission, safety and economic efficiency
Test Scenarios - Triangle Region

- Test Scenarios from the 2040 MTP (* implies a test scenario)

<table>
<thead>
<tr>
<th>Supply (&amp; Network) Scenarios</th>
<th>Demand (&amp; Landuse) Scenarios</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Community Plan (CommP)</td>
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<tr>
<td>Highway Intensive (Hwy)</td>
<td>*</td>
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<tr>
<td>Transit Intensive (TRN)</td>
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<tr>
<td>Moderate (MOD)</td>
<td>*</td>
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<tr>
<td>Metro Transp Plan (MTP-S)</td>
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Triangle Region Application Design

Split the region to run SmartGAP and sum up results:

1) CAMPO Extended Area
2) DCHC Extended Area
SmartGAP (RPAT) Interface

- **Model Flow** showing model components
- "Inputs", "Outputs", and "Reports" tabs
- Drop down menus for project and scenario management and help
- Run button executes complete model
- "Model Flow" showing model components
- Individual inputs that can be selected, edited and commented
SmartGAP (RPAT) Structure

• Model and Parameters
• Input Data
  – Built environment: Place Type
  – Demand
  – Policy
  – Transportation Supply
• Output
• Report and Visualization
SmartGAP Input Data for Base and Scenario Runs
### Performance Metrics (Model Outputs)

<table>
<thead>
<tr>
<th>Community Impacts</th>
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</thead>
<tbody>
<tr>
<td>View</td>
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<tr>
<td>View</td>
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<td>View</td>
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<table>
<thead>
<tr>
<th>Direct Travel Impacts</th>
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<tr>
<td>View</td>
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<thead>
<tr>
<th>Environment and Energy Impacts</th>
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<td>View</td>
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<th>Financial and Economic Impacts</th>
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<td>View</td>
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<td>View</td>
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<table>
<thead>
<tr>
<th>Location Impacts</th>
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<tbody>
<tr>
<td>View</td>
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</tbody>
</table>
Software Tool Design

Developed for regional decision-makers of transportation and land use policies

Evaluates regional scenarios
- Built environment
- Travel demand
- Transportation supply
- Policies

Considers households and firms individually

Easy to use and freely distributed

PLACE TYPES

<table>
<thead>
<tr>
<th>Development Type</th>
<th>Urban Core</th>
<th>Close in Community</th>
<th>Suburban</th>
<th>Rural</th>
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</thead>
<tbody>
<tr>
<td>Residential</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Employment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mixed-Use</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transit Oriented</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Development</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rural/Greenfield</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
SmartGAP (RPAT) Process

Evaluates transportation impacts of smart growth strategies
Congestion Impacts

Accounts for recurring and nonrecurring congestion on local streets, arterials and freeways

- Autos
- Light Trucks
- Heavy Trucks
- Buses
- Freeways
- Arterials
- Uncongested
- Moderately Congested
- Heavily Congested
- Severely Congested
- Extremely Congested

Change in VMT by Place Type

Effect of local street guide on Arterials

Freeway Speeds and Fuel Economy

Arterial Speeds and Fuel Economy
Induced Demand and Urban Form Effects on Travel

Predicts the change in VMT for each household due to changes in urban form and the short and long term induced demand effects of increases in transportation supply.

<table>
<thead>
<tr>
<th>Category</th>
<th>Urban Form Description</th>
<th>Elasticity for Change in VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Household/Population Density</td>
<td>-0.04</td>
</tr>
<tr>
<td>Diversity</td>
<td>Land Use Mix (entropy)</td>
<td>-0.09</td>
</tr>
<tr>
<td>Design</td>
<td>Intersection/Street Density</td>
<td>-0.12</td>
</tr>
<tr>
<td>Distance to Transit</td>
<td>Distance to Nearest Transit Stop</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Primary Source: Meta Analysis

Primary Source: GreenSTEP
Transportation Policies

Predicts the Change in VMT for each Household due to Transportation Policies

Pricing Policies

- VMT charges (cents per mile)

<table>
<thead>
<tr>
<th>VMT Charge (Cents per Mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>0.0%</td>
</tr>
</tbody>
</table>

- Parking pricing based on
  a) Percent of workplace and non-workplace parking that is priced
  b) Parking rates per space

ITS strategies

- Percentage of freeways with ITS strategies
- Percentage of arterials with ITS strategies

Primary Source: GreenSTEP
Travel Demand Management Strategies

Predicts the Change in Work Trip VMT for each Household due to TDM

<table>
<thead>
<tr>
<th>Vanpool Program</th>
<th>Percent VMT Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level of Participation</td>
<td>0.30%</td>
</tr>
<tr>
<td>Medium Level of Participation</td>
<td>6.85%</td>
</tr>
<tr>
<td>High Level of Participation</td>
<td>13.40%</td>
</tr>
</tbody>
</table>

Primary Source: CAPCOA

<table>
<thead>
<tr>
<th>Telecommuting</th>
<th>VMT Reduction based on Percent Employees Participating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
</tr>
<tr>
<td>9/80 Schedule</td>
<td>0.07%</td>
</tr>
<tr>
<td>4/40 Schedule</td>
<td>0.15%</td>
</tr>
<tr>
<td>Telecommuting 1.5 days a week</td>
<td>0.22%</td>
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</tbody>
</table>
More on Travel Demand Management Strategies

Predicts the Change in Work Trip VMT for each Household due to TDM based on Development Settings

VMT Reduction for Work Trips

<table>
<thead>
<tr>
<th>Ridesharing Program</th>
<th>Rural</th>
<th>Suburban</th>
<th>Close In Community</th>
<th>Urban Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMT Reduction for Work Trips</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
</tbody>
</table>

VMT Reduction for Work Trips

<table>
<thead>
<tr>
<th>Transit Pass Subsidy Level</th>
<th>Rural</th>
<th>Suburban</th>
<th>Close In Community</th>
<th>Urban Core</th>
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</thead>
<tbody>
<tr>
<td>$ 0.75</td>
<td>0%</td>
<td>2.0%</td>
<td>3.4%</td>
<td>6.2%</td>
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<tr>
<td>$ 1.49</td>
<td>0%</td>
<td>3.3%</td>
<td>7.3%</td>
<td>12.9%</td>
</tr>
<tr>
<td>$ 2.98</td>
<td>0%</td>
<td>7.9%</td>
<td>16.4%</td>
<td>20.0%</td>
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<tr>
<td>$ 5.96</td>
<td>0%</td>
<td>20.0%</td>
<td>20.0%</td>
<td>20.0%</td>
</tr>
</tbody>
</table>

Primary Source: CAPCOA
Model Reports

- Community Impacts
- Direct Travel Impacts
- Environment and Energy Impacts
- Financial and Economic Impacts
- Location Impacts
- Input Summaries
Sample Model Reports

Comparison of Daily Vehicle Miles Traveled by Scenario

Comparison of Daily Transit Trips by Area Type
Where do the models and metrics come from?

• GreenSTEP (Oregon Department of Transportation GHG model)
• 5Ds Meta Analysis (Prof. Robert Cervero)
• CAPCOA Report: Quantifying GHG Mitigation Measures
• SHRP2 Research
  – Original research during the Transportation Research Board SHRP 2 C16 project by RSG, Fehr and Peers, and other team members
SmartGAP (RPAT) Framework: Incorporating Empirical Evidence

A. Variables/Metrics
   • Density
   • Diversity
   • Design
   • Distance to Transit
   • Destination Accessibility
   • Development Site
   • Demand Management
   • Demographics

B. Cases/Project Examples
   • Street/Neighborhood: Complete Streets
   • Community: TOD, Neo-traditional
   • Regional: Jobs-housing

C. Travel Demand Impacts
   • Trip Rates (purpose, time of day)
   • Modal Splits
   • Vehicle Miles Traveled
   • Vehicle Hours Traveled

D. Outcomes
   • Delay: Congestion
   • Emissions (CO₂, air quality)
   • Energy Consumption

E. Responses
   • Supply-Side: Road expansion, Transit investments, ITS, Bicycle and pedestrian enhancements
   • Demand-side: TDM, pricing

Translating 8 D’s to Travel Demand

5/8/2015
Travel & the “D”s

5D’s of the Built Environment

- Density
- Diversity
- Design
- Distance to Transit
- Destination Access

Impacts

VMT/Capita

Transit Trips /Capita

R. Cervero & K. Kockelman, Travel Demand and the 3Ds: Density, Diversity, Design, Transportation Research, 1996; R. Ewing & R. Cervero, Built Environment and Travel, TRR, 2001; JAPA, 2010
Example Implementations: ARC

ARC 20-County Modeling Area:
6,400 Sq. Mi., 2010 Pop: 5.3M, 2040 Pop: 8.3M
Example Implementations: ARC

2040 Pop. & Emp. by Area Type: Base Scenario from Unified Growth Policy Map
Example Implementations: ARC

2040 Pop. & Emp. by Development Type: Base Scenario from Unified Growth Policy Map
Example Implementations: ARC

8 Scenarios Tested

1. Baseline: ARC Plan 2040, 2010-2040
2. 20% Increase in Transit Service
3. 20% Increase in Roadway Construction
4. 20% Increase in Lane-Miles with ITS
5. Shift 10% Growth to More Dense Areas
6. Shift 20% Growth to More Dense Areas
7. Shift 30% Growth to More Dense Areas
8. Scenarios 2, 4 & 7 combined altogether
Example Implementations: ARC

Vehicle-Miles of Traffic by Scenario

1. Baseline
2. VMT Reduction (~1%)
3. VMT Increase
4. Effect Negligible (~0%)
5. VMT Reduction
6. VMT Reduction
7. VMT Reduction (~5%)
8. VMT Reduction (~6%)
Example Implementations: ARC

Vehicle-Hours of Traffic by Scenario

1. Baseline
2. VHT Reduction (~1%)
3. 4% VHT Reduction (Added Capacity, Induced Demand)
4. 3% VHT Reduction (Same Capacity, Improved Traffic Flow)
5. VHT Reduction
6. VHT Reduction
7. VHT Reduction
8. Best VHT Reduction
Example Implementations: ARC

Delay (Congestion) by Scenario

1. Baseline
2. Delay Reduction (~1%)
3. 25% Reduction in Delay
4. 15% Reduction in Delay
5. Delay Reduction
6. Delay Reduction
7. Delay Reduction
8. Delay Reduction
Summary: Lessons Learned & Other

• Effective & Flexible
• Quick-Response Sketch-Modeling Tool
• Not for Individual Project-Level Evaluation
• SmartGAP & Trip-Based Model => Limited Use
• Activity-Based Model & PECAS Land Use Model & SmartGAP => Greater Use
  – Transit Oriented Development
  – Travel Demand Management
  – Intelligent Transportation System
• Potential Use in Upcoming ARC Major Plan Update
• Other