The Atlanta Regional Commission
Transportation Model

Presentation Made to the 2004 TMIP
NCDOT Modeling Peer Review
ARC Transportation Planning

• Departmental Organization
  – Long Range Planning
  – Short Range Planning
  – Modeling, Analysis & Data
  – Air Quality
What is the Atlanta Region?

- 10-county ARC planning area
- 19 counties containing a portion of 2000 Atlanta UAB (ARC will likely expand to 18 counties)
- 13 counties classified as Serious ozone nonattainment area by 1990 CAAA (reclassification to Severe effective January 2004)
- 20 counties proposed for 8-hour nonattainment area
Number One Challenge - Growth

Population

Employment


1.2 1.8 2.5 3.0 3.6 4.2

2.0 2.7 3.7 4.2 5.1 6.0

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0

MILLIONS

Population

Employment


1.2 1.8 2.5 3.0 3.6 4.2

2.0 2.7 3.7 4.2 5.1 6.0

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0

MILLIONS

Population

Employment
ARC Travel Demand Modeling Team

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  Modeling Applications & Models Development
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  Highway Network Coding, Performance Measures
Jean Hee Park, Senior Planner
  Transit Network Coding, Development of Regional Impact (DRI)
**ARC Forecasts**

**Two step process**

First produce forecast for entire area (13 Counties) using IPEF (Interactive Population and Econometric Forecasting) model

Disaggregate area forecast to smaller areas using DRAM/EMPAL (Disaggregate Residential Allocation Model / Employment Allocation)
Surveys and Studies

• 2000-1 Household Travel Survey (SMARTRAQ):
  2-day survey, 8000 households surveyed, or about 1/200 household
• 2001 Transit On-Board Survey
• 1999 Establishment Survey
• 2000 Hartsfield Jackson International Airport Survey
• 2000-2001 Speed Studies & Travel Time Studies

Traffic Modeling Platform/Environment

• Converted Model Stream from TRANPLAN to TP+

Socio-Economic (SE) Data

• Updated Using Census 2000 Datasets (CTPP)
• Updated Base Year 2000 Colleges & Universities Enrollment
• 589 Census Tracts (from DRAM/EMPAL) SE Data
  disaggregated into 1683 internal TAZ
ARC Highway Networks & Related TAZ structure

- Expanded Zonal Structure from 948 internal TAZ to 1683, maintained External Stations to 57 zones, for a grand total of 1740 TAZ, compared to 1005 previously
- QA/QC 2000 Base Year Highway Network using GIS-T techniques and Aerial Photography
- Revisited Centroid Connectors to accommodate new internal TAZ geometric reconfiguration
- Expanded facility type definitions
- Refined Facility Types Definitions using ARC CMS Strategic Arterial System Definitions
- Updated Free-Flow Speeds and Capacities Look-Up Tables, based upon 2000-2001 travel times and speed studies
ARC Facility Types

0  Centroid Connectors  
1  Interstate / Freeway  
2  Parkway  
3  HOV Buffer Separated  
4  HOV Barrier Separated  
5  High Speed Ramp / CD Road  
6  Medium Speed Ramp  
7  Low Speed Ramp  
8  Loop Ramp  
9  Off Ramp w/ Intersection  
10 On Ramp w/ Intersection  
11 Expressway  
12 Principal Arterial - Class I  
13 Principal Arterial - Class II  
14 Minor Arterial - Class I  
15 Minor Arterial - Class II  
16 HOV - Arterial (all classes)  
17 Major Collector  
18 Minor Collector / Other Local  
19 Planned Ramps w/ Intersections  
20 Planned Directional Ramps  
50 Transit Only Link: Neighborhood Local  
51 Transit Only Link: Local Roads and Collectors  
52 Transit Only Link: Park-n-ride lot connector  
53 Transit Only Link: Transfer links between rail and bus  
54 Associated with BRT Routes (Future year coding)
“Spaghetti Junction” (I-85 @ I-285)
“Spaghetti Junction” (I-85 @ I-285)
Atlantic Steel Site Development
Atlantic Steel Site
Northside Drive @ I-75
Northside Drive @ I-75
Bouldercrest Road @ I-285
Downtown Connector (I-75 / I-85) @ I-20
ARC-Coded ITS Strategies for Future Network Years (2030)

- Advanced Traffic Signal Coordination and Control
- Fiber-optic Communications
- Video Surveillance and Data Collection on Entire Corridors
- Activity Center Surveillance at Interstate Highway Crossings, Industrial Yards, Shopping Malls, Cross Regional Corridors
- Facilities Parallel to Interstate Highways
- Variable Message Signs (VMS) at Major Decision Points on Freeways
- Transit Vehicle Signal Priority
- Automated Vehicle Location (AVL) for Transit
- Electronic Fare Payment for Transit Service
- Queue Jumper Lanes for Transit
- Ramp Metering on Freeways

**ITS benefits expressed in terms of:**
- travel time savings
- delay reductions
- free-flow speeds increases
- localized transit mode share increases
ARC’s Transit Networks

• Developed a Bus Speed Model
  – Empirical model to hook bus speeds with congested highway travel times, reflecting mixed flow of traffic operating conditions
  – Stratified by area types and facility types
• Defined 3 types of transit service access
  – Walk to local bus service
  – Walk to premium (with local bus & rail)
  – Drive to transit
• Separated walk to local from walk to premium
• Automated procedures for walk-to-transit links, with maximum length based on area of zone
• Separated Park-And-Ride (PNR) lots by types, local VS premium
  – Local, max access time = 15 minutes
  – Premium, max access time = 60 minutes
• Created procedures to build drive to premium PNR lots to focus on appropriate market, minimizing illogical paths. Max access time increases as market direction is approached
• Refined mode-to-mode transfer prohibitions, improving transit paths
• Improved Bus Rapid Transit (BRT) coding methods
ARC’s Drive Connectors to PNR Lot on Highway Network
ARC TRANSIT CODING EXAMPLE

PNR connection coded in "Pnrcode.dat"

Bus to Rail Transfer

Rail Station

Rail Link coded in trainlink.txt
ARC’s Trip Generation

• Production Model: Set of Logit Models stratified by trip purposes and person types
  – 6 Trip Purposes
    • HBW Home-Based Work
    • HBShop Home-Based Shop
    • HBO Home-Based Other
    • HBU Home-Based University (age of traveler: 19+)
    • HBSchool Home-Based Grade School (age of traveler: under 19)
    • NHB Non-Home Based
  – 3 Person Types
    • Adult worker (age 16+ with full or part time job)
    • Non-Working Adult
    • Child (age 15 or younger)
  – 5 Socio-Economic Independent Variables, by household
    • Household size (1,2,3,4+)
    • Household income ($0-$20K, 20-50, 50-100, $100K+)
    • Workers per Household (0,1,2,3+)
    • Children per Household (0,1,2,3+)
    • Autos per Household (0,1,2,3+)
ARC’s Trip Generation – Production Model

- Estimates probabilities of a person making:
  - 0 trip, 1 trip, 2 trips, 3 trips, 4+ trips
- Converts to trip rates/person by person type
- Estimates non-motorized trips, including consideration of household access by income for transit and highway time
- Based on 2000-2001 household travel survey

ARC’s Trip Generation – Attraction Model

- Cross classification for HBW, HBShop, HBO, NHB Regression for HSchool, HBU
- Stratified by 4 trip purposes, all 4 are a 2-way cross-class matrix of trip rates per employee, or person, or household.
- Trip rates for each of the 4 purposes, one for each type of demographic data: types of households, persons and employment (8 types, construction, manufacturing, retail, TCU, wholesale, FIRE, service, government), and one for each of the 7 area types (based on density, CBD, Urb Com, Urb Res, Suburb Com, Suburb Res, Exurb, Rural)
- Based on 1999 Establishment Survey
ARC’s Trip Distribution

- Use separate gravity model for each of the 6 trip purposes
- Separate friction factors for each of the 6 trip purposes by the 4 income groups
- Composite time (highway and transit time) used as impedance variable
- HBW uses AM peak period skims
- All other trip purposes use free-flow skims with separate topographic penalties added, those are area biases, such as the Chattahoochoee River
ARC’s Trip Length Frequency Distribution (TLFD)
HBW Income Group 1 Trips (O-D vs. GM)
Using AM Peak Period Composite Time

O-D Average Trip Length = 23.79 Min.
Intrazonal Trips = 3,449

GM Average Trip Length = 23.60 Min.
Intrazonal Trips = 2,684
ARC’s Mode Split

- Fully Nested Logit for HBW, HBO (or HBNW, Non-Work), NHB
- HBW uses AM peak period skims
- HBO & NHB use mid-day skims
- Use TP+ procedures for % walk to transit by taz, via a grid with results similar to GIS TIGER path
- Added bus miles, local only transit service and suburban drive variables
- Automated bus miles calculations
- Calibration targets from MARTA/CCT boarding and local surveys, using ALOGIT software
- Works with FTA’s New Starts ‘Summit’ Program
ARC Special Generator: Airport Passenger Model

- Estimates average daily air passengers to and from the airport by:
  - Purpose (business VS leisure)
  - Residence Type (resident VS non-resident)

- Total air passengers are allocated to ground site locations based on:
  - Households by income level
  - Total employment

- Features a nested logit model with different structures and modal options for residents and non-residents

- Based on 2000 Hartsfield Air Passenger Survey
ARC’s Highway Assignment

- Created 4 time of day (TOD) assignments:
  - AM peak (6am-10am)
  - Mid-day (10am-3 pm)
  - PM peak (3pm-7pm)
  - Evening/Night (7pm-6am)

- VDF curves grouped by facility types and TOD

- Revised toll diversion model, where time penalty use value-of-time conversion (fixed toll on GA-400)

- Managed lanes (HOT lanes): toll for SOV and trucks based on previous assignment iteration’s link v/c ratio, where the toll is distance-based (toll on a per mile basis)

- Feedback loop extends from trip generation to highway assignment (5 feedback loops, 25 equilibrium iterations)

- Tested Induced Demand / Induced Travel effects caused by highway improvements. ARC model includes induced trip effects, both in route diversion and total trip changes. The model shows induced effects, in route diversion, similar to the elasticity produced by research and observed traffic changes.
AM Period Volume-Delay Functions

V/C Ratio

Percent of Freeflow Speed

Freeway / Expressway / Principal Arterial
Minor Arterial
Collector / Local
Midday Period Volume-Delay Functions

Percent of Freeflow Speed

V/C Ratio

Freeway / Expressway / Principal Arterial
Minor Arterial
Collector / Local
Atlanta 2000 Travel Demand Model Scatter Plot

$R^2 = 0.9184$

Count -vs- Volume

- Linear (Count -vs- Volume)
Module 1. Highway Network Building
*Build Highway Networks and Develop Highway Skims*

Module 2. Feedback Loops
*Trip Generation, Transit Networks, Trip Distribution, Triptable Manipulations, Mode Choice, 1hr AM Highway Assignment*

Module 3. Transit Assignments
*Work & Non-Work*  
*Walk-to-Local / Walk-to-Premium / Drive-to-Transit*

Module 4. Time of Day Assignments
*Trip Table Preparation, AM, MD, PM, NT Highway Assignments*

Miscellaneous Post Processors
(Value Pricing, Emissions, etc.)
ARC Modeling Directory Structure

- **ROOT FOLDER**
  - DATA
  - EXEC
  - EXT
    - NEWFM
    - NEWPC_IE
    - NEWTRKS
  - NETWORKS
  - TOD
  - TRANSIT
    - TRN00

Two-digit year
Welcome to the Atlanta Travel Demand Model -- Version 2003

Enter Parameters

Year (Two-digit)  20  
Max Assignment Iterations  25  
Number of Feedback Loops  5  
Total Zones (w/Externals)  1740  
Range of Internal Zones  1-1683  
Last Internal Before External  1683  
First External Station  1684  
Last External Station  1740  
Airport Zone Number  1322  
Hartsfield Annual Enplanements  39277901  
Dobbins Zone Number  803  

Select the MODULES to Run

- Highway Network Building
- Feedback Loops
- Transit Assignment
- Time of Day Assignments

MODULE: Highway Network Building

- Assign Area Types
- Build Networks
- Build Peak Period Skims
- Build Free-Flow Skims
- Build Midday Skims
Module: Feedback Loops

- Congested Times Option for the First Loop
  - AM Speed Lookup Table
  - Assign Existing AM Trip Table (Select Only for Specific Applications)

- AM Peak Period Assignment
- Update Peak Period Travel Skims
- Transit Support Links - Bus Miles - Percent Walk - Walk Time
- Transit Skims
- Trip Generation
- Trip Distribution
- Mode Choice
- Merge Trip Tables
MODULE: Transit Assignment

- Transit Assignment

MODULE: Time-of-Day Assignments

- Time-of-Day Matrix Setup
- Update Speeds and Capacities
- AM
- MD
- PM
- NT
- Merge and Summarize
## ARC 2000 Base Year & 2030 Model Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Base Year 2000</th>
<th>2030 Model Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POPULATION</strong></td>
<td>3,630,560</td>
<td>5,869,086</td>
</tr>
<tr>
<td><strong>HOUSEHOLDS</strong></td>
<td>1,356,058</td>
<td>2,323,443</td>
</tr>
<tr>
<td><strong>EMPLOYMENT</strong></td>
<td>2,067,000</td>
<td>3,310,428</td>
</tr>
</tbody>
</table>

### HOME-BASED WORK

- Walk to Local Transit Trips: 41,727, 81,018
- Walk to Premium Transit Trips: 88,009, 156,553
- Drive to Transit Trips: 33,039, 58,105

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Base Year 2000</th>
<th>2030 Model Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Occupancy (SOV) Vehicle Trips</td>
<td>2,101,702</td>
<td>3,326,176</td>
</tr>
<tr>
<td>Low Occupancy (SOV) Person Trips</td>
<td>2,101,702</td>
<td>3,326,176</td>
</tr>
<tr>
<td>High Occupancy (HOV) Vehicle Trips</td>
<td>100,773</td>
<td>161,864</td>
</tr>
<tr>
<td>High Occupancy (HOV) Person Trips</td>
<td>265,608</td>
<td>425,497</td>
</tr>
</tbody>
</table>

- Total HBW Transit: 162,775, 295,676
- Total HBW Vehicles: 2,202,475, 3,488,040
- Total HBW Persons: 2,530,085, 4,047,349

### Percent HBW Mode Split

- Base Year 2000: 6.4%
- 2030 Model Results: 7.3%
**MODE CHOICE SUMMARY AFTER APPLICATION OF AIR PASSENGER**

<table>
<thead>
<tr>
<th>Category</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL TRANSIT TRIPS</td>
<td>300,394</td>
<td>536,311</td>
</tr>
<tr>
<td>Total Walk to Local Transit</td>
<td>67,607</td>
<td>127,385</td>
</tr>
<tr>
<td>Total Walk to Premium Transit</td>
<td>174,396</td>
<td>305,416</td>
</tr>
<tr>
<td>Total Drive to Transit</td>
<td>58,391</td>
<td>103,510</td>
</tr>
</tbody>
</table>

| TOTAL VEHICLE TRIPS           | 8,704,643 | 13,913,716 |
| Total SOV Vehicle Trips       | 7,086,937 | 11,418,287 |
| Total HOV Vehicle Trips       | 1,617,706 | 2,495,429 |

| TOTAL PERSON TRIPS            | 11,919,551 | 18,939,249 |
| Total SOV Person Trips        | 7,086,937  | 11,418,287 |
| Total HOV Person Trips        | 4,532,220  | 6,984,651  |
| Total Transit Trips           | 300,394    | 536,311    |

| TOTAL MODE SPLIT (Percent)    | 2.5%      | 2.8%      |
## EXTERNAL-EXTERNAL VEHICLE TRIPS

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Cars</td>
<td>46,347</td>
<td>82,116</td>
</tr>
<tr>
<td>Trucks</td>
<td>15,482</td>
<td>25,538</td>
</tr>
<tr>
<td><strong>TOTAL E-E TRIPS</strong></td>
<td><strong>61,829</strong></td>
<td><strong>107,654</strong></td>
</tr>
</tbody>
</table>

## PERSON TRIP TABLE BY PURPOSE

<table>
<thead>
<tr>
<th>Purpose</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home-Based Work</td>
<td>2,530,080</td>
<td>4,047,349</td>
</tr>
<tr>
<td>Home-Based Other</td>
<td>5,597,463</td>
<td>8,701,930</td>
</tr>
<tr>
<td>Non Home-Based</td>
<td>3,689,765</td>
<td>5,960,941</td>
</tr>
<tr>
<td><strong>TOTAL PERSON TRIPS</strong></td>
<td><strong>11,817,308</strong></td>
<td><strong>18,710,220</strong></td>
</tr>
</tbody>
</table>
## INTERNAL-EXTERNAL TRIPS

### WORK TRIPS

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-E Work - Interstate</td>
<td>136,630</td>
<td>258,988</td>
</tr>
<tr>
<td>I-E Work - Non-Interstate</td>
<td>153,887</td>
<td>310,221</td>
</tr>
<tr>
<td>Total I-E Work Trips</td>
<td>290,517</td>
<td>569,209</td>
</tr>
</tbody>
</table>

### NON-WORK TRIPS

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-E Non-Work - Interstate</td>
<td>172,343</td>
<td>324,150</td>
</tr>
<tr>
<td>I-E Non-Work - Non-Interstate</td>
<td>194,604</td>
<td>392,302</td>
</tr>
<tr>
<td>Total I-E Non-Work Trips</td>
<td>366,947</td>
<td>716,452</td>
</tr>
</tbody>
</table>

**TOTAL I-E TRIPS** 657,464 1,285,661

### TRUCK TRIPS

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-I Light Duty Trucks</td>
<td>1,002,446</td>
<td>1,601,795</td>
</tr>
<tr>
<td>I-I Heavy Duty Trucks</td>
<td>325,539</td>
<td>526,210</td>
</tr>
<tr>
<td>I-E Light Duty Trucks</td>
<td>67,423</td>
<td>121,047</td>
</tr>
<tr>
<td>I-E Heavy Duty Trucks</td>
<td>41,308</td>
<td>73,564</td>
</tr>
<tr>
<td>Total Truck Trips</td>
<td>1,436,716</td>
<td>2,322,616</td>
</tr>
</tbody>
</table>

## TOTAL DAILY VEHICLE TRIP TABLE

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck Vehicle Trips</td>
<td>1,452,644</td>
<td>2,348,623</td>
</tr>
<tr>
<td>SOV Vehicle Trips</td>
<td>7,791,171</td>
<td>12,786,515</td>
</tr>
<tr>
<td>HOV Vehicle Trips</td>
<td>1,618,118</td>
<td>2,495,860</td>
</tr>
<tr>
<td>Total Daily Vehicle Trips</td>
<td>10,861,933</td>
<td>17,630,998</td>
</tr>
</tbody>
</table>
## TIME OF DAY VEHICLE TRIP TABLES

<table>
<thead>
<tr>
<th>Time</th>
<th>Truck Vehicle Trips</th>
<th>SOV Vehicle Trips</th>
<th>HOV Vehicle Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>441,335</td>
<td>713,524</td>
</tr>
<tr>
<td>AM</td>
<td>1,666,374</td>
<td>2,725,832</td>
<td>242,891</td>
</tr>
<tr>
<td></td>
<td>2,350,600</td>
<td>3,814,347</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>673,011</td>
<td>1,088,369</td>
<td>541,564</td>
</tr>
<tr>
<td></td>
<td>2,237,793</td>
<td>3,673,823</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,452,368</td>
<td>5,604,885</td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td>249,231</td>
<td>402,959</td>
<td>666,732</td>
</tr>
<tr>
<td></td>
<td>3,002,758</td>
<td>4,915,170</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,918,721</td>
<td>6,338,917</td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td>88,584</td>
<td>143,245</td>
<td>165,961</td>
</tr>
<tr>
<td></td>
<td>879,626</td>
<td>1,464,552</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,134,171</td>
<td>1,863,903</td>
<td></td>
</tr>
</tbody>
</table>
### VEHICLE MILES TRAVELED

<table>
<thead>
<tr>
<th>Time</th>
<th>AM VMT</th>
<th>MD VMT</th>
<th>PM VMT</th>
<th>NT VMT</th>
<th>TOTAL DAILY VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29,231,507</td>
<td>34,755,605</td>
<td>40,286,588</td>
<td>13,398,933</td>
<td>117,672,632</td>
</tr>
<tr>
<td></td>
<td>46,269,810</td>
<td>56,293,733</td>
<td>64,089,408</td>
<td>21,578,644</td>
<td>188,231,596</td>
</tr>
</tbody>
</table>

44% of VMT on freeway  
39% of VMT on arterial  
17% of VMT on local/collector

While freeways have more VMT than arterials in 2000, they have only 60% of the hourly capacity of the arterials. However per-lane freeway capacity is 4 to 5 times as great as arterials.

### VEHICLE HOURS TRAVELED

<table>
<thead>
<tr>
<th>Time</th>
<th>AM VHT</th>
<th>MD VHT</th>
<th>PM VHT</th>
<th>NT VHT</th>
<th>TOTAL DAILY VHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>834,692</td>
<td>1,011,084</td>
<td>1,196,474</td>
<td>375,714</td>
<td>3,417,963</td>
</tr>
<tr>
<td></td>
<td>1,360,637</td>
<td>1,682,856</td>
<td>1,964,960</td>
<td>599,284</td>
<td>5,607,736</td>
</tr>
</tbody>
</table>
### CONGESTED VEHICLE HOURS TRAVELED

<table>
<thead>
<tr>
<th>Time</th>
<th>AM Congested VHT</th>
<th>MD Congested VHT</th>
<th>PM Congested VHT</th>
<th>NT Congested VHT</th>
<th>Total Daily Congested VHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>985,136</td>
<td>1,202,100</td>
<td>1,397,435</td>
<td>449,635</td>
<td>4,034,306</td>
</tr>
<tr>
<td></td>
<td>1,801,623</td>
<td>2,242,139</td>
<td>2,557,559</td>
<td>823,561</td>
<td>7,424,882</td>
</tr>
</tbody>
</table>

### AVERAGE HIGHWAY SPEEDS

<table>
<thead>
<tr>
<th>Speed Type</th>
<th>Daily Free-Flow Average Speed</th>
<th>Daily Congested Average Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Free-Flow Average Speed</td>
<td>34.4</td>
<td>33.6</td>
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<tr>
<td>Daily Congested Average Speed</td>
<td>29.2</td>
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### VEHICLE MILES TRAVELED SUMMARY

<table>
<thead>
<tr>
<th>Mileage Type</th>
<th>VMT per Capita</th>
<th>VMT per Household</th>
<th>VMT per Job</th>
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<tbody>
<tr>
<td>VMT per Capita</td>
<td>32.4</td>
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<tr>
<td>VMT per Household</td>
<td>86.8</td>
<td>81.0</td>
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<tr>
<td>VMT per Job</td>
<td>56.9</td>
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### VEHICLE HOURS TRAVELED SUMMARY

<table>
<thead>
<tr>
<th>Hour Type</th>
<th>VHT per Capita</th>
<th>VHT per Household</th>
<th>VHT per Job</th>
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<tbody>
<tr>
<td>VHT per Capita</td>
<td>1.1</td>
<td>1.3</td>
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<tr>
<td>VHT per Household</td>
<td>3.0</td>
<td>3.2</td>
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</tr>
<tr>
<td>VHT per Job</td>
<td>2.0</td>
<td>2.2</td>
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</tr>
</tbody>
</table>
A Few Recommended Performance Measures for 2030 Plan Analysis

Source: Tim Lomax, TTI, Texas A&M University

“It’s more than just Volume/Capacity Ratios”

- Individual Delay per Person
- Individual Travel Time per Person (“Planning Time”)
- Individual Cost Per Person
- Congestion Index from Texas Transportation Institute
- Total Travel Time
- Total Delay Hours
- Total Cost of Travel & Delay
ARC utilizes a traditional link-based procedure to estimate mobile source emissions.

- Satisfies federal transportation conformity regulations that direct regional emissions analyses
  
  *Transportation Conformity Rule - Section 93.122(b)*

- Consistent with methodology used to develop emissions inventories needed to establish MVEB as part of the SIP
Interface with Travel Demand Model

To calculate emissions, need link-based travel attributes from the travel demand model.

Two primary variables affecting mobile source emission estimates:

- VMT
- Speed

Emissions model “reads” loaded networks for each time-of-day period and post-processes speeds and VMT for emissions modeling purposes.
EPA guidance requires HPMS based forecasts of VMT for emission analyses.

- Average daily, summer-adjusted HPMS VMT estimates for year 2000 compared to average daily travel model VMT for same year, at functional class level

- Adjustment factors applied at link level using HPMS functional class code
<table>
<thead>
<tr>
<th>HPMS Functional Class (Code)</th>
<th>2000 HPMS VMT Summer-Adjusted Average Daily VMT</th>
<th>2000 Travel Demand Model VMT Average Daily VMT</th>
<th>HPMS Adjustment Factors</th>
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</thead>
<tbody>
<tr>
<td>Rural Interstate (1)</td>
<td>5,840,728</td>
<td>8,488,287</td>
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<tr>
<td>Rural Principal Arterial (2)</td>
<td>3,569,720</td>
<td>3,090,694</td>
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<tr>
<td>Rural Minor Arterial (6)</td>
<td>3,811,482</td>
<td>3,168,965</td>
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<tr>
<td>Rural Major Collector (7)</td>
<td>3,708,389</td>
<td>3,452,056</td>
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<tr>
<td>Rural Minor Collector (8)</td>
<td>1,249,317</td>
<td>1,091,894</td>
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<tr>
<td>Rural Local (9)</td>
<td>3,490,796</td>
<td>12,864,647</td>
<td>0.27</td>
</tr>
<tr>
<td>Urban Interstate (11)</td>
<td>37,694,171</td>
<td>34,376,364</td>
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<tr>
<td>Urban Other Freeway (12)</td>
<td>6,478,628</td>
<td>2,348,406</td>
<td>2.76</td>
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<tr>
<td>Urban Principal Arterial (14)</td>
<td>10,350,324</td>
<td>15,653,577</td>
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<tr>
<td>Urban Minor Arterial (16)</td>
<td>21,924,642</td>
<td>18,473,757</td>
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<tr>
<td>Urbanized Collector (17)</td>
<td>7,617,087</td>
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<tr>
<td>Urbanized Local (19)</td>
<td>15,412,042</td>
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<tr>
<td><strong>Total VMT</strong></td>
<td><strong>121,147,325</strong></td>
<td><strong>117,182,322</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>
Emission Factors

Most important change with update to MOBILE6.2 is implementation of emission factors by roadway type (drive cycle).

- Arterials/Collectors
- Freeways/Interstates
- Ramps
- Local Roads

Only emissions for arterials/collectors and freeways/interstates are speed sensitive.

Emission factors produced for 2.5 mph, then 3 mph to 65 mph, inclusive, in one mph increments.
Emissions Modeling Process Summary

Loaded Networks for Each Time Period

- Final assigned VMT and VHT from a capacity-restrained assignment procedure

HPMS Adjustment Factors

Emission Factors

HPMS “Equivalencies”

TP+ Emissions Model

- Post-process link congested flow speed
- Post-process link VMT
- Calculate link emissions
- Summarize link-level emissions over entire network for four time periods
## Multi-Year Program - Activity/Tour-Based Model

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<table>
<thead>
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<table>
<thead>
<tr>
<th></th>
<th>Integration /Cross-Validation with Trip-Base Models</th>
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</table>
Next Steps…

- Conversion to Cube’s Application Manager, Scenario Manager / Flowchart Approach
- Refine EJ Performance Measures
- Refine Evening / Night TOD Model
- Summarize Model Output by Activity Centers & Town Centers (LCI sites)
- Review the Externals Model
Next Steps (Continued)

• Refine Transit Coding / Modeling & Commuter Rail with “Externals” Input
• Continue Tour-Based & Activity-Based Model Development
• Refine Sketch Modeling Methods
• Perform Commercial Vehicle / Truck Survey and Use Transearch Reebie Data
• Freight Model Development
ANOTHER NEW HIGHWAY?!

THE MODEL MADE ME DO IT.
Guy Rousseau
Modeling Manager

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grousseau@atlantaregional.com

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