Automated Mobility District (AMD)

**Automated mobility districts** (AMD) is introduced as a term to describe a campus-size implementation of automated vehicle technology to realize the benefits of fully-automated vehicle mobility service.

- Fully automated and driverless vehicles.
- Service is confined to a geographic boundary
- Mobility within the district is restricted to or dominated by automated vehicles.

On a captive guideway | On existing road network
Morgantown PRT ~ 1978

Rubber Wheeled ‘AV’
Dedicated guideway/roadway
Electric Propulsion
~16 passenger vehicles
Operational for >20 years
Currently
http://transportation.wvu.edu/prt
Objective

Estimate the fuel and GHG emissions impacts in an AMD serviced by an automated-vehicle based transit system.

- **Mobility Analysis (Previous work)**
  - Quantify mobility changes with an AMD system.

- **Fuel and GHG emission Analysis (This work)**
  - Quantify fuel and GHG emission changes.

Motivation

- **Initial implementation of Automated Vehicles foreseen as AMDs**
  - PaloAlto – Austin – Pittsburg – Babcock Ranch

- **Confined geographic areas simplify refueling infrastructure (ex. EV, Hydrogen)**
Case Study: A campus based AMD

Kansas State University Campus
(Manhattan, Kansas)
• Area: 664 acres
• Population: ~25,000

Considering to use a Personal Rapid Transit (PRT) System to provide mobility on campus.
## Mobility Analysis (Previous Work)

<table>
<thead>
<tr>
<th></th>
<th>Base Scenario</th>
<th>Service Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No PRT</td>
<td>6 Min.</td>
</tr>
<tr>
<td>Driving Personal Veh.</td>
<td>40,131</td>
<td>38,352</td>
</tr>
<tr>
<td>Walking</td>
<td>20,216</td>
<td>18,814</td>
</tr>
<tr>
<td>Riding the PRT</td>
<td>0</td>
<td>3,604</td>
</tr>
<tr>
<td>Total</td>
<td>60,347</td>
<td>60,770</td>
</tr>
<tr>
<td>Driving Personal Veh.</td>
<td>2,014</td>
<td>1,927</td>
</tr>
<tr>
<td>Walking</td>
<td>5,037</td>
<td>4,688</td>
</tr>
<tr>
<td>In the Parking Lot</td>
<td>1,877</td>
<td>1,686</td>
</tr>
<tr>
<td>Riding the PRT</td>
<td>0</td>
<td>458.2</td>
</tr>
<tr>
<td>Total</td>
<td>8,928</td>
<td>8,759.2</td>
</tr>
</tbody>
</table>

- Used the 4-steps travel demand modeling approach
- Analyzed mobility metrics (PMT/PHT) with and without PRT system
## Mobility Analysis (Previous Work)

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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No PRT</td>
<td>6 Min.</td>
<td>3 Min.</td>
<td>2 Min.</td>
</tr>
<tr>
<td>Driving Personal Veh.</td>
<td>-</td>
<td>-1,779</td>
<td>-3,510</td>
<td>-4,324</td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>-</td>
<td>-1,402</td>
<td>-3,446</td>
<td>-4,535</td>
<td></td>
</tr>
<tr>
<td>Riding the PRT</td>
<td>-</td>
<td>3,604</td>
<td>8,169</td>
<td>10,279</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>423</td>
<td>1,213</td>
<td>1,420</td>
<td></td>
</tr>
</tbody>
</table>

|                      |               | Driving Personal Veh. | - | -87 | -172 | -209 |
|                      |               | Walking             | - | -349 | -851 | -1,114 |
|                      |               | In the Parking Lot  | - | -191 | -345 | -380 |
|                      |               | Riding the PRT      | - | 458  | 843  | 1,035 |
| Total                |               | -168.8             | -525.4 | -668 |

- System must be responsive to draw ridership.
- Any system will induce PMT (Personal Miles Traveled).
- Can the system provide increased mobility with less fuel & GHG emission?
Mobility Analysis – take aways

Last mile solution for a campus (parking to buildings)
• AV wait time needs to be less than 3 minutes to have significant impact
• 10 AMD miles displaced ~ 4.5 ped & 4.5 vehicle miles
• 4 AMD hours displaced ~3 ped & 1 vehicle hour
• Total system VMT increased 2-3%
• Total system PHT decreased ~1% (people will travel further to go faster)
• Total system energy (even with conservative assumptions) decreased
Fuel and GHG Emission Analysis

Fuel and GHG by Driving
- PMT->VMT of driving on road and parking.
- VMT% by veh. age and type
- Fuel Economy

Fuel and GHG by PRT
- PMT->VMT of PRT (assuming different occupancy rate)
- Fuel Economy (by assuming operating at Steady-State & ~30 mph)

Total fuel and GHG
- Different service freq.
- Different occupancy
Comparison of normalized GHG emission under different service frequency (assuming Occupancy = 2)

-3.5% -5.0% -5.2%

- GHG from Operating PRT
- GHG from Pass. Veh. On Parking Lot
- GHG from Pass. Veh. On Road Network
Results (2)

Comparison of normalized GHG emission under diff. service frequency (assuming Freq = 3 min)

-3.5% -4.6% -5.1%

System induces more travel, but at less energy

System reduces energy/GHG emission between 3.5% to 8.2%.

Amount of reduction dependent on:

- Fleet characteristics of AMD
- Amount of ride sharing
- Service Frequency
Next Steps

Relevance to modern AV initiatives

• Parking and pedestrian congestion (along with vehicle congestion) must be modeled
• Nearly all AV mobility concepts are EV powered
• Exclusive roadway vs shared needs to be assessed

Opportunities moving forward

• Model proposed districts for mobility & energy (Mid-town Detroit, Pena Station Next)
• Collect data and validate model with early AMD deployments (Babcock Ranch)
• Vehicle accessibility policy