The Mobility Energy Productivity (MEP) Metric

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**Motivation**

- What is mobility?
- How do you quantify mobility?
- How does mobility affect society?
- Existing transportation performance metrics are not relevant or meaningful for the 21st century.
- Mobility: The quality of a network or system to connect people to goods, services, and employment.

The Energy Efficient Mobility Systems (EEMS) Program will identify and develop technologies and innovations that encourage maximum mobility, minimum energy consumption, and maximum cost effectiveness.

**Properties of the MEP Metric**

- Reflects efficiency of accessing a network of goods, services, and employment
- Can be applied to any road, rail, air, river, or rail transport network, etc.
- Determined by:
  - Travel time and travel time reliability to destinations
  - Energy and monetary cost of travel
  - Quality attributes (e.g., scenic, historic, city, or employer)

**Basic Data Elements of the MEP Metric**

- **Basic Data**
  - Travel Time and Isochrone
  - Energy Efficiency Measures
  - Land Use Data
  - Travel Demand Data
  - Third-party isochrone application programming interfaces (e.g., HERE)

**Basic Elements of the MEP Metric**

- Identify the number of opportunities that people can reach within a certain travel-time threshold via different modes.
- The opportunities measure is further determined by the frequency of trip purpose and population or employment density-weighted summation.

The MEP metric is calculated by weighting the cumulative opportunities using a negative exponential function applied on the modal weighting factor.

**MODEL WEIGHTS FOR ENERGY AND OPERATING COSTS**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Energy Intensity (kWh/passenger-mile)</th>
<th>Capital and Operational Cost (dollar/passenger-mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paratransit</td>
<td>4.13</td>
<td>2.25</td>
</tr>
<tr>
<td>TNC</td>
<td>1.8</td>
<td>1.54</td>
</tr>
<tr>
<td>Driving</td>
<td>0.90</td>
<td>0.48</td>
</tr>
</tbody>
</table>

**Geographic Area for Analysis**

The Mobility Energy Productivity (MEP) metric is calculated for the 50 largest metropolitan areas in the United States. It is designed to be easy to scale and can be applied to a home, district, city, or employer.

**Illustrative Scenario Analysis**

- **Baseline**
  - Population-Density-Weighted Mobility Productivity: 162
  - Population-Density-Weighted Travel-time Deterrence: 90 minutes in baseline, decreased by 70% (10 minutes in scenario)

**Next Steps**

- Calculate MEP for the 50 largest metropolitan areas in the United States
- Integrate with regional travel demand models to assess alternative future scenarios
- Travel Survey
  - Obtain relevant data from publicly available sources such as the National Household Travel Survey (NHTS)
  - Incorporate mode-activity realism into the computation of the metric (to address certainty and demographic trends)

**Vehicle Automation**

Future technologies will result in multiple changes to the MEP metric (some changes increase MEP and some reduce MEP), but also impacts of adoption rates, induced (or reduced) congestion, and other transportation changes. Coupling the MEP calculations with agent-based travel microsimulation models might require different contexts for different technologies and settings.

**NEXUS**

- **NEXUS**
  - Future technologies will unite energy-related impacts into the consideration of the metrics. (e.g., automated vehicles, smart grid, etc.)
  - Some changes increase MEP and some reduce MEP.

**MEP by Mode – Columbus**

![MEP by Mode – Columbus](image1)

**MEP by Activity – Columbus**

![MEP by Activity – Columbus](image2)

**MEP by Various Cities**

![MEP by Various Cities](image3)