Planning for Climate Change: Mitigation and Adaptation

Cheryl Laskowski, Ph.D.

August 21, 2013
Complimentary Responses to Climate Change

Definitions

> **Mitigation**: Reduce GHG emissions, increase GHG sinks.

> **Adaptation**: Reduce impacts from climate change
Complimentary Responses to Climate Change

**Definitions**

> **Mitigation**: Reduce GHG emissions, increase GHG sinks.

> **Adaptation**: Reduce impacts from climate change
Greenhouse Gas Emissions
Greenhouse Gas Emissions: Inventory

- Facilities - Electricity 11%
- Facilities - Natural Gas 1%
- Refrigerants 2%
- Transport - Rail Electricity 20%
- Transport - Purchased 2%
- Transport - Non-Revenue 3%
- Transport - CNG 54%
- Transport - Gasoline Bus 2%
- Transport - Vanpool 3%

Inventory Benefits

> Understanding where your emissions come from
> Identifying areas to reduce emissions
Greenhouse Gas Emissions: Inventory

Inventory Benefits

> Monitor performance over time

<table>
<thead>
<tr>
<th>Year</th>
<th>Metric Tons CO2e</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>500,000</td>
</tr>
<tr>
<td>2008</td>
<td>450,000</td>
</tr>
<tr>
<td>2009</td>
<td>400,000</td>
</tr>
<tr>
<td>2010</td>
<td>350,000</td>
</tr>
<tr>
<td>2011</td>
<td>300,000</td>
</tr>
<tr>
<td>2012</td>
<td>250,000</td>
</tr>
</tbody>
</table>
Greenhouse Gas Emissions: Inventory

Percentage of Total Greenhouse Gas Emissions by Source

Inventory Benefits

> Monitor indicators over time

Bus Purchased
Heavy Rail
Light Rail
Bus Operated by Metro
Greenhouse Gas Emissions: How-To

> Emissions = Activity Data \times Emission Factor

> Activity Data can be affected by technology changes, usage patterns

> Emission Factors are generally affected by others

> CO_2 \text{ emissions} = \text{kWh per year} \times \text{CO}_2 \text{ per kWh}

> Convert bus fleet to CNG, Establish conservation policy measures

> Utility provider’s production portfolio

Understanding & Managing your Activity Data is Key!

> Coordination among departments

> Standardizing collection

> Institutionalizing the process

> Provides insight beyond GHG emissions
Evaluate activity over time, not just GHG emissions

Historic Waste Production

- **Total Solid Waste**
- **Solid Waste Trash**
- **Solid Waste Recycled**

Yearly data from 2008 to 2012.
Greenhouse Gas Emissions: Activity Data

Understand activity data by facility

Facility Electricity Use by Major Facilities in 2012

Kilowatt Hours in Millions

Division 11  Division 66  Division 34  Division 6  Division 4  Division 60  Division 9  Division 3  Division 21  Division 1  Division 8  Division 10  Division 2  Division 7  Division 22  Division 18  Division 15  Division 30  Division 99 - Gateway  Division 20
Greenhouse Gas Displacement
Accounting for the Benefits

Transportation Sector

Transit

Transportation Sector

Transit

APTA, 2011
Accounting for the Benefits

Emissions generated by Transit

Metro 2012 Net Greenhouse Gas Emissions

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantity of Emissions Displaced (MT CO2e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Emissions Displaced from Mode Shift</td>
<td>(491,291)</td>
</tr>
<tr>
<td>Emissions from Metro Operations</td>
<td>484,983</td>
</tr>
<tr>
<td>Net Emissions from Metro Operations</td>
<td>(6,308)</td>
</tr>
</tbody>
</table>

Emissions displaced by Transit

- Mode Shift
  - Avoided car trips
- Congestion Relief
- Land-Use Multiplier
Other Transportation Agencies with Similar Efforts

New York (MTA)

> Annual sustainability report since 2008
> LED Lighting and CFL upgrades for bridges, tunnels, train signaling lights
> Renewable energy (rooftop PV panels and fuel cells)
> Use recycled water for car wash
> Innovative and artistic raised-grate street sculptures to prevent subway flooding

Chicago (CTA)

> Green Initiatives
> Converted entire bus fleet ultra-low sulfur diesel in March 2003
> Buses delivered since 2007 have clean-diesel engines and particulate filters that meet EPA emissions standards
> CTA currently operates 250 hybrid buses, 15% total bus fleet
> In 2011, CTA received a $2.2 million federal grant to purchase two all-electric buses
Climate Change Adaptation
Steps in assessing long-term climate impacts

Identify Potential Impacts
- Extreme Heat
- Flooding
- Drought
- Wildfires
- High Winds
- Sea Level Rise

Assess Risk
- Likelihood
- Consequence

Identify Critical Assets
- Ridership
- Connectivity

Act
- Plan
- Implement
Identify Potential Risks

# Days >95°F per year

- 111 - 120
- 91 - 100
- 81 - 90
- 51 - 60
- 41 - 50
- 31 - 40
- 21 - 30
- 11 - 20
- 2 - 10

[Map showing the number of days with temperatures above 95°F per year in different regions of Los Angeles County.]

Source: Los Angeles County, CA-METANET, Los Angeles Metropolitan Transportation Authority
Identify Potential Risks

# Days >95°F per year

- 111 - 120
- 91 - 100
- 81 - 90
- 51 - 60
- 41 - 50
- 31 - 40
- 21 - 30
- 11 - 20
- 2 - 10
Identify Potential Risks

# Days >95°F per year

- 111 - 120
- 91 - 100
- 81 - 90
- 51 - 60
- 41 - 50
- 31 - 40
- 21 - 30
- 11 - 20
- 2 - 10

Map showing areas with different numbers of extreme heat days per year.
Identify critical assets
Assess risk

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Insignificant 1</th>
<th>Minor 2</th>
<th>Moderate 3</th>
<th>Major 4</th>
<th>Extreme 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain (5)</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
<td>Very High</td>
</tr>
<tr>
<td>Likely (4)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>Possible (3)</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Unlikely (2)</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Rare (1)</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>
## Assess risk

### Extreme Heat (Days >95°F)

<table>
<thead>
<tr>
<th>Key</th>
<th>Asset and Risk</th>
<th>Description of Risk/Comments</th>
<th>Likelihood L (1-5)</th>
<th>Consequence C (1-5)</th>
<th>Rating L+C (2-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overheating of communications or signaling system, causing stoppage, delay, or bus bridge</td>
<td><em>Ex. Inland locations only</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Rail buckling causing service delays for the rail and potentially delays in bus lines if bus bridges are necessary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Grid power consumption exceeds peak; the electrical system to stations fails. Loss of communication systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Grid power consumption exceeds capacity causing loss of traction power and necessitating major rerouting of rail services using buses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Softened asphalt on bus routes, causing rerouting and service delays</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Heat stress of maintenance workers or delay in construction/maintenance activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Grid power consumption exceeds peak capacity, loss of air conditioning, heat stress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Passenger heat stress due to ambient and radiant temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Reduce life expectancy of tires, rails</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset and Risk</td>
<td>Description of Risk/Comments</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Rating</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Overheating of communications or signalling system, causing stoppage, delay, or bus bridge</td>
<td><em>Expected to impact inland above ground locations. The loss of service impacting an entire line</em></td>
<td>Possible (3)</td>
<td>Moderate (3)</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>
Resources

Guidance Documents

APTA: Quantifying Greenhouse Gas Emissions from Transit
APTA: Guidelines for Climate Action Planning
APTA: Quantifying and Reporting Transit Sustainability Metrics
TRB: Emissions Savings from Transit
California Climate Change Adaptation Policy Guide
ICLEI: US Community Protocol for Greenhouse Gas Emissions Inventories

Climate Science + Adaptation

Cal-Adapt.org
NOAA Sea Level Rise Viewer
California Climate Change Adaptation Strategy for Energy & Transportation

Transportation Reports

Metro Climate Action and Adaptation Plan
FTA Flooded Bus Barns and Buckled Rails
US DOT Climate Adaptation Plan
Adaptation Cost Benefit Analysis Overview
Adapting to Rising Tides: San Francisco
Planning for Climate Change: Mitigation and Adaptation

Cheryl Laskowski, Ph.D.

Cheryl.Laskowski@aecom.com