National Performance Measures: Initial target-setting

Performance Management
Connecticut Department of Transportation
## Timeline to May 20, 2018

<table>
<thead>
<tr>
<th>DATE</th>
<th>MILESTONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 16</td>
<td>Executive reviews recommended state performance targets</td>
</tr>
<tr>
<td>April 30</td>
<td>Initial TAMP (Transportation Asset Management Plan) due to FHWA</td>
</tr>
<tr>
<td>May 8</td>
<td>Meeting with MPOs to present proposed targets and coordinate to “maximum extent possible”</td>
</tr>
<tr>
<td>May 20</td>
<td>State DOT establishes performance targets</td>
</tr>
<tr>
<td>Oct 1</td>
<td>State DOT formally submits targets to FHWA</td>
</tr>
<tr>
<td>Nov 20</td>
<td>MPOs establish performance targets</td>
</tr>
</tbody>
</table>
Targets to be established

- Pavement condition (4)
- Bridge condition (2)
- System reliability (2)
- Freight movement (1)
- Air quality (1)
Target-setting considerations

- Target-setting methodology (maturity)
- Top risks in adopting the target
- Confidence in achieving target
Target-Setting Maturity Model

1. Aspirational
   Target based on desired outcome, little data used

2. Extrapolation
   Use historical time series and extend into future

3. Forecasting model
   Include explanatory variables/covariates in a model, forecast outcome

4. Systems approach
   Systems techniques (simulation, system dynamics) & cause-effect relationship
Risks

• Where are our headaches going to come from?
  • Insufficient investment → declining targets
  • Abstract target definitions
  • Perception (headlines)

• We should have a strategy to address the risks
  • Develop a communications strategy (telling our story first)
Confidence

• Are we confident we achieve the targets?

Confidence is higher with:

• More and better data
• Better understanding, more powerful models
• Control over outcomes
## Bridge Condition Measures

- % of NHS Bridges in “Good” and “Poor” condition
- **Max % poor: 10 (MAP-21)**

### Asset (unit of measure)

<table>
<thead>
<tr>
<th>NHS Bridge (deck area)</th>
<th>Current Condition (NBI submittal 3/2017)</th>
<th>2-year targets (2020)</th>
<th>4-year targets (2022)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good %</td>
<td>Poor %</td>
<td>Good %</td>
</tr>
<tr>
<td></td>
<td>18.1</td>
<td>15.0</td>
<td>22.1</td>
</tr>
</tbody>
</table>

### Maturity

<table>
<thead>
<tr>
<th>Forecasting/Systems</th>
<th>TOP RISK(S)</th>
<th>CONFIDENCE</th>
</tr>
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<tbody>
<tr>
<td>3.5</td>
<td>1. Budgetary uncertainty</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>2. Resource constraints</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Project delivery</td>
<td></td>
</tr>
</tbody>
</table>
Consequences of not making progress toward target: BRIDGE

• Loss of flexibility in programming funds
• Must document actions that will be taken to achieve targets in next period
## Pavement Condition Measures

- % of Interstate system in “Good” and “Poor” condition
  - MAX % Poor (Interstates): 5%
- % of National Highway System in “Good” and “Poor” condition

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<thead>
<tr>
<th>Asset (unit of measure)</th>
<th>Current Condition (HPMS submittal 6/2017)</th>
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<tbody>
<tr>
<td></td>
<td>Good %</td>
<td>Poor %</td>
<td>Good %</td>
</tr>
<tr>
<td>Interstate Pavement</td>
<td>66.2</td>
<td>2.2</td>
<td>65.5</td>
</tr>
<tr>
<td>(lane miles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Interstate NHS</td>
<td>37.9</td>
<td>8.6</td>
<td>36.0</td>
</tr>
<tr>
<td>Pavement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(lane miles)</td>
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<td>1. Budgetary uncertainty</td>
</tr>
<tr>
<td></td>
<td>2. State of Good Repair definition is not captured well</td>
</tr>
<tr>
<td></td>
<td>3. Declining targets need to be communicated properly</td>
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### Confidence

High
Consequences of not making progress toward target: PAVEMENT

• Loss of flexibility in programming funds
• Must document actions that will be taken to achieve targets in next period
System Reliability: “Level of Travel Time Reliability”

• “Normal” travel time: 50\textsuperscript{th} percentile
• Longest travel time: 100\textsuperscript{th} percentile
• 80\textsuperscript{th} percentile travel time: Worse (longer) than 80\% of travelers
• LOTTR: 80\textsuperscript{th} percentile / 50\textsuperscript{th} percentile
• Reliable LOTTR: 80\textsuperscript{th} / 50\textsuperscript{th} percentile travel time < 1.5
Travel Time: Percentiles

50th percentile = 16.7 minutes, “Normal”

80th percentile = 20.2 minutes – System Reliability

95th percentile = 23.3 minutes – Freight

100th percentile = longest travel time
1.18 TTI

Travel Time Index

I-95 SOUTHBOUND
OLD LYM - NEW LONDON
YEAR-ROUND RELIABILITY DATA
I-95 SOUTHBOUND
OLD LYME – NEW LONDON
AUGUST – SUNDAY PM
RELIABILITY DATA
## System Reliability Measures

- % person-miles of Interstate that are “reliable”
- % person-miles of non-Interstate NHS that are “reliable”

<table>
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<tr>
<th>System (unit of measure)</th>
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<th>2-year targets (2020)</th>
<th>4-year targets (2022)</th>
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</thead>
<tbody>
<tr>
<td>Interstate (person-miles)</td>
<td>78.3</td>
<td>75.2</td>
<td>72.1</td>
</tr>
<tr>
<td>Non-Interstate NHS (person-miles)</td>
<td>83.6</td>
<td>80.0</td>
<td>76.4</td>
</tr>
</tbody>
</table>

### Maturity/Top Risk(s) Confidence

<table>
<thead>
<tr>
<th>Maturity/Extrapolation</th>
<th>Top Risk(s)</th>
<th>Confidence</th>
</tr>
</thead>
</table>
| Aspirational/Extrapolation | 1. Reliability definition new, abstract, and may not capture individual user experience  
                            | 2. Outcomes subject to external factors  
                            | 3. Worsening reliability has to be communicated | Low         |
INTERSTATE System Reliability
(Percent person-miles traveled that are reliable)

2017, 78.3
NON-INTERSTATE NHS System Reliability
(Percent person-miles traveled that are reliable)

2017, 83.6

YEAR MEASURED (REPORTED FOLLOWING YEAR)

Percent Person-Miles (or VMT) Reliable

- INRIX (NPMRDS v2)
- HERE (NPMRDS v1)
- Conservative Proj
- Optimistic Proj
- Avg Chg Proj
- MMUT Proj
Consequences of not making progress toward target: SYSTEM RELIABILITY

• “State DOTs that fail to meet or make significant progress toward targets in a biennial performance reporting period will be required to document the actions they will undertake to achieve their targets in their next biennial performance report.”
### Freight Movement Measure

- Truck Travel Time Reliability (TTTR) index

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<tr>
<th>MATURITY</th>
<th>TOP RISK(S)</th>
<th>CONFIDENCE</th>
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</thead>
<tbody>
<tr>
<td>Aspirational/Extrapolation</td>
<td>1. Measure is very abstract and may not reflect individual experience&lt;br&gt;2. Outcomes subject to external factors&lt;br&gt;3. Declining reliability has to be explained and communicated</td>
<td>Low</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>System (unit of measure)</th>
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<th>2-year targets (2020)</th>
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<tbody>
<tr>
<td>Interstate (TTTR)</td>
<td>1.75</td>
<td>1.79</td>
<td>1.83</td>
</tr>
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</table>
Freight Movement

INTERSTATE Truck Travel Time Reliability index, TTTR - 95th/50th percentile, maximum over 5 time periods in a week.

YEAR MEASURED (REPORTED FOLLOWING YEAR)

2017, 1.75
Consequences of not making progress toward target: FREIGHT

• After a 2-year period, documentation of actions to achieve targets is required (as in system reliability).

• The next freight performance report becomes more prescriptive:

  (i) An identification of significant freight system trends, needs, and issues within the State.

  (ii) A description of the freight policies and strategies that will guide the freight-related transportation investments of the State.

  (iii) An inventory of truck freight bottlenecks within the State and a description of the ways in which the State DOT is allocating funding under title 23 U.S.C. to improve those bottlenecks.

  (A) The inventory of truck freight bottlenecks shall include the route and milepost location for each identified bottleneck, roadway section inventory data reported in HPMS, Average Annual Daily Traffic (AADT), Average Annual Daily Truck Traffic (AADTT), Travel-time data and measure of delay, such as travel time reliability, or Average Truck Speeds, capacity feature causing the bottleneck or any other constraints applicable to trucks, such as geometric constrains, weight limits or steep grades.

  (B) For those facilities that are State-owned or operated, the description of the ways in which the State DOT is improving those bottlenecks shall include an identification of methods to address each bottleneck and improvement efforts planned or programmed through the State Freight Plan or MPO freight plans; the Statewide Transportation Improvement Program and Transportation Improvement Program; regional or corridor level efforts; other related planning efforts; and operational and capital activities.

  (iv) A description of the actions the State DOT will undertake to achieve the target established for the Freight Reliability measure in § 490.607.

  (3) The State DOT should, within 6 months of the significant progress determination, amend its Biennial Performance Report to document the information specified in this paragraph to ensure actions are being taken to achieve targets.
Air quality measure: State Total Emissions Reduction

- Emissions reduction is *cumulative*
  - Achieved reductions continue to impact actual emissions as long as improvement project is in place

- MAP-21 measure captures *rate of change* in emissions reduction
  - “First derivative” → more difficult to visualize
    - “Slowing growth in emissions reduction” is expressed as a *negative* rate of change
  - Benefits are counted only on the year funds are first obligated
Air quality measure: State Total Emissions Reduction

- **Emissions (kg)**
  - If we reduce emissions in a project, there is always a lower quantity of pollutants in the air because the project was built

- **Emissions reduction (kg/day)**
  - Each day that the project is in place, emissions are lower by a number of kilograms of pollutants

- **Rate of change of emissions reduction (kg/day/time)**
  - This is the CMAQ measure: A positive number means we are reducing pollutants faster than in a previous period
### Emissions reduction analogy

<table>
<thead>
<tr>
<th>EMISSIONS</th>
<th>A CAR STARTING FROM ZERO TO 75 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMISSIONS:</strong> When an emissions reduction project is built, emissions (kilograms) of pollutants are reduced as the project is in place. &lt;br&gt;( \text{kg}_2 &lt; \text{kg}_1 )</td>
<td><strong>DISTANCE:</strong> When the car starts and moves forward, we are always ahead of where we started &lt;br&gt;( x_2 &gt; x_1 )</td>
</tr>
<tr>
<td><strong>EMISSIONS REDUCTION:</strong> Each day the project is in place, ( x ) kilograms / day of pollutants continue to be reduced &lt;br&gt;( \text{kg/day}_2 &lt; \text{kg/day}_1 )</td>
<td><strong>SPEED:</strong> Increases from zero until car achieves cruising speed of 75 MPH &lt;br&gt;We continue position gains; speed plateaus at 75 MPH</td>
</tr>
<tr>
<td><strong>RATE OF CHANGE IN EMISSIONS REDUCTION:</strong> Are we increasing the rate of reduction in emissions (kg/day) over time? Do we continue to build projects?</td>
<td><strong>RATE OF CHANGE IN SPEED:</strong> Acceleration increases from zero and then decreases to zero when the car maintains cruising speed of 75 MPH</td>
</tr>
</tbody>
</table>
Zero to 75 MPH in a quick car: DISTANCE

DISTANCE: ALWAYS AHEAD OF WHERE WE STARTED
Zero to 75 MPH in a quick car: **SPEED**

**SPEED:**

INCREASES TO 75 MPH
0 to 75 MPH: RATE OF CHANGE IN SPEED (ACCELERATION)

ACCELERATION = 0 AFTER 75 MPH IS REACHED
Zero to 75 MPH in a quick car

DISTANCE: ALWAYS AHEAD OF WHERE WE STARTED

SPEED: INCREASES TO 75 MPH

ACCELERATION = 0 AFTER 75 MPH IS REACHED
Zero to 75 MPH in a quick car

Distance from standing start, feet

Time t, seconds

Speed = mph; acceleration = ft/sec²

Position (ft)  Speed (mph)  Acceleration (ft/sec²)
Zero to 75 MPH in a quick car

CMAQ Air quality measure is like measuring acceleration (rate of change in speed)

CONSTANT SPEED - zero acceleration
Cumulative Emissions Reductions from CMAQ-funded projects

- Reductions increase
- Rate of change slows down
**VOC – Rate of Change in Emissions Reduction due to CMAQ obligations for continuing projects**

- Additional emissions reduction not counted in the MAP-21 rule

- CTfastrak operating obligations (2015)

- Additional reductions from 2nd & 3rd years of CTfastrak that federal guidelines do not allow to be included.

Annual VOC reductions due to projects obligated in given year.
**NOx** – Rate of Change in Emissions Reduction due to CMAQ obligations for **continuing** projects

- Additional emissions reduction not counted in the MAP-21 rule

- **CTfastrak operating obligations (2015)**

- **Annual NOx reductions due to projects obligated in given year.**

- Additional reductions from 2\(^{nd}\) & 3\(^{rd}\) years of CTfastrak that federal guidelines do not allow to be included.
PM2.5 – Negligible rate of change in emissions reductions

Additional emissions reduction not counted in the MAP-21 rule

Annual reductions due to projects obligated in a given year.

CTFastrak construction obligations (2011)
Air quality measure challenges

• Qualitative benefits not captured in measure
• Funding (obligation) variability
• Impact of mega-projects on measure
Are benefits counted?

CMAQ Program Investment

- Year 2 & 3 operating funds to new transit projects (NOT counted in measure)
- QUALITATIVE BENEFITS (NOT counted in measure)
- QUANTITATIVE BENEFITS (counted in measure)

QUALITATIVE BENEFITS (NOT counted in measure)
Variability in yearly obligations

CMAQ Obligations by year

$60 M
$50 M
$40 M
$30 M
$20 M
$10 M

Mega-projects

CMAQ Obligations by project type

- Travel Demand Management
- Transit Improvements
- Transit - Fastrak
- Ride Sharing
- Public Education & Outreach Activities
- Congestion Reduction and Traffic Flow Improvements
- Bicycle and Pedestrian Facilities and Programs
- Alternative Fuels and Vehicles
- STP/CMAQ

Transit - Fastrak
Megaprojects

PM2.5 Reduction by Project type
(Impact of CT Fastrak investment)

- Alternative Fuels and Vehicles
- Bicycle and Pedestrian Facilities and Programs
- Congestion Reduction and Traffic Flow Improvements
- Public Education & Outreach Activities
- Ride Sharing
- STP/CMAQ
- Transit - Fastrak
- All other Transit Improvements
- Travel Demand Management

Year

Reduction (kg/day)
VOC - 2-year cumulative and 4-year cumulative targets for Total Emissions Reduction Measure

VOC 4-year target
VOC 2-year target
VOC Projected 1-year

CTFastrak operations

2-year target, 2019, 19.320
4-year target, 2021, 30.140
**NOx - 2-year cumulative & 4-year cumulative targets for total emissions reduction measure**

- **2-year target, 2019:** 67.690 kg/day
- **4-year target, 2021:** 102.370 kg/day

Graph showing emissions reduction over years with lines for 1-year actual & projected, 2-year cumulative, and 4-year cumulative. Key points for CT Fastrak operations are highlighted with labels for 2-year target, 2019, 67.690 kg/day, and 4-year target, 2021, 102.370 kg/day.
PM2.5 - 2-year cumulative & 4-year cumulative targets for total emissions reduction measure

- **PM2.5 4-year target**: 2021, 2.674 kg/day
- **PM2.5 2-year target**: 2019, 1.632 kg/day

**CTFastrak construction**
- 2010

**CTFastrak operations**
- 2011

**Projected 1-year & projected 2-year cumulative**

- 2021, 2.674 kg/day
- 2019, 1.632 kg/day
## Air Quality Measure

- **Total Emissions Reduction**
- **From projects entered into the CMAQ Public Access system in previous year**

<table>
<thead>
<tr>
<th>Emissions Component</th>
<th>Current Measurements (CMAQ Public Access as of 2017)</th>
<th>2-year targets (2020)</th>
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<tr>
<td></td>
<td>2-year cumulative kg/day</td>
<td>4-year cumulative kg/day</td>
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<tr>
<td>VOC</td>
<td>10.820</td>
<td>263.890</td>
<td>19.320</td>
</tr>
<tr>
<td>NOx</td>
<td>34.680</td>
<td>462.490</td>
<td>67.690</td>
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<tr>
<td>PM2.5</td>
<td>1.040</td>
<td>12.950</td>
<td>1.632</td>
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### Maturity & Risk

**Extrapolation**

- **Level 2**
- **TOP RISK(S)**
  1. Qualitative benefits are not captured in measure
  2. Given program priorities, quantifiable benefits may appear low with respect to other agencies

**CONFIDENCE**

Moderate
Air Quality Measure

- Total Emissions Reduction
- From projects entered into the CMAQ Public Access system in previous year

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MATURITY
Extrapolation
Level 2

TOP RISK(S)
1. Qualitative benefits are not captured in measure
2. Given program priorities, quantifiable benefits may appear low with respect to other agencies

CONFIDENCE
Moderate
Consequences of not making progress toward target: AIR QUALITY

- Document the actions state will undertake to achieve its targets in their next biennial performance report.
System Reliability Findings

Statewide Level of Travel Time Reliability
Based on Vehicle-Miles Traveled
System Reliability Findings

Level of Travel Time Reliability (Interstate System)
Based on Vehicle-Miles Traveled

- Not in MPO
- Southeastern Connecticut COG
- South Western MPO
- South Central Regional COG
- Naugatuck Valley Council of Governments
- Lower Connecticut River Valley MPO
- Housatonic Valley MPO
- Greater Bridgeport / Valley MPO
- Capital Region COG

Vehicle Miles Traveled / Day

- Interstate Non-Reliable
- Interstate Reliable

[Diagram showing travel time reliability levels for different regions]
System Reliability Findings

System Performance Measure (% Reliable), Interstate System Based on Vehicle-Miles Traveled

- Not in MPO
- Southeastern Connecticut COG
- South Western MPO
- South Central Regional COG
- Naugatuck Valley Council of Governments
- Lower Connecticut River Valley MPO
- Housatonic Valley MPO
- Greater Bridgeport / Valley MPO
- Capital Region COG

Likely lowest MPO Interstate reliability in US
System Reliability Findings

Level of Travel Time Reliability (Non-Interstate NHS)
Based on Vehicle-Miles Traveled

- Not in MPO
- Southeastern Connecticut COG
- South Western MPO
- South Central Regional COG
- Naugatuck Valley Council of Governments
- Lower Connecticut River Valley MPO
- Housatonic Valley MPO
- Greater Bridgeport / Valley MPO
- Capital Region COG

Vehicle Miles Traveled / Day

- Non-Int. NHS Non-Reliable
- Non-Int. NHS Reliable
System Reliability Findings

System Performance Measure (% Reliable), Non-Int. NHS
Based on Vehicle-Miles Traveled

- Not in MPO
- Southeastern Connecticut COG
- South Western MPO
- South Central Regional COG
- Naugatuck Valley Council of Governments
- Lower Connecticut River Valley MPO
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- Greater Bridgeport / Valley MPO
- Capital Region COG

% VMT
- Non-Int. NHS Non-Reliable
- Non-Int. NHS Reliable
Freight Findings

Truck Travel Time Reliability
Weekday { 6-10AM, 10AM-4PM, 4-8PM }
Weekend { 6AM-8PM, 8PM-6AM }

Highest 95/50 percentile Travel Time Ratio of 5 time periods