

**Incorporating Sustainability into TxDOT's Transportation Decision Making – Summary of
Work Performed, Methods Used, and Results Achieved**

Project 5-5541-01: Regional Workshops on Sustainability Enhancement Tool

Implementation of Project 0-5541: Developing Sustainable Transportation Performance
Measures for TxDOT's Strategic Plan

Report 5-5541-01-1

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**INCORPORATING SUSTAINABILITY INTO TXDOT'S TRANSPORTATION
DECISION MAKING – SUMMARY OF WORK PERFORMED,
METHODS USED, AND RESULTS ACHIEVED**

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CHAPTER 1: INTRODUCTION

This report summarizes the work performed in Fiscal Year (FY) 2009 and 2010 under TxDOT Implementation Project 5-5541-01 – “Regional Workshops on Sustainability Enhancement Tool.” TxDOT Research Project 0-5541, “Developing Sustainable Transportation Performance Measures for TxDOT’s Strategic Plan” was the basis for this implementation project. The research project findings are documented in a detailed technical report available at: <http://tti.tamu.edu/documents/0-5541-1.pdf>. Overall, the research dealt with developing performance measures for sustainability at the highway corridor level. The performance measures were aligned to TxDOT’s strategic plan, and methods for quantifying, normalizing, and combining the performance measures into a corridor-level sustainability index were also developed as part of the research.

As part of Project 0-5541, the performance measures and calculation methodologies were also coded into an MS Excel-based calculator (sustainability enhancement tool or SET) and an accompanying reference manual, which were submitted as products P1 and P2 under the original research project that terminated in FY2008.

This implementation project involved the development of workshop material aimed at disseminating research findings and training participants in hands-on use of the SET through a series of workshops in FYs 2009 and 2010. The specific project tasks were:

- Task 1 – Development of Draft Workshop Materials.
- Task 2 – Perform Workshop Walkthrough.
- Task 3 – Conduct Regional Workshops.
- Task 4 – Develop Final Workshop Materials.
- Task 5 – Update the Analysis Tool.
- Task 6 – Develop District-MPO-Local Agency Consortium Implementation Plan.
- Task 7 – Develop Plan to Integrate into TxDOT Practice.

The work done on these tasks are discussed in subsequent sections of this report. [Chapter 2](#) describes the development of workshop materials, [Chapter 3](#) summarizes the workshops conducted, [Chapter 4](#) discusses local agency implementation and plans to integrate into TxDOT practice, and [Chapter 5](#) provides the conclusion and future research.

CHAPTER 2: DEVELOPMENT OF WORKSHOP MATERIALS

Development of Draft Workshop Materials

The development of draft workshop materials was initiated using the work done in Project 0 5541 as a starting point. The available material included a detailed lesson plan for workshops (Appendix I of the main project report [0-5541-1]) and the spreadsheet-based calculator and reference manual (Product 0-5541-P1).

The workshops were titled “Incorporating Sustainability into TxDOT’s Transportation Decision Making,” to better reflect the content of the workshop, which also covered general aspects of sustainability, performance measures, and decision making, in addition to the use of the SET. The draft workshop materials developed by the research team included:

- PowerPoint presentation with instructor notes.
- Handouts and example exercises.
- Updated versions of the SET calculator and reference manual.

Other material, such as participant certificates, course evaluation forms, participant and instructor binders, CD labels, etc. were also prepared as part of the workshop materials.

Workshop Agenda and Lessons

The workshop was designed to contain six lessons over a one-day period, covering an introduction to sustainability and performance measurement, followed by an overview of the SET and hands-on application of the SET for corridor analyses. [Figure 1](#) shows the detailed workshop agenda. The six main lessons were:

1. Strategic Goals and Sustainability.
2. Performance Measures.
3. Introduction to the Sustainability Enhancement Tool (SET).
4. Data Requirements for SET Operation.
5. Example Corridor Application.
6. Interactive Exercise.

Incorporating Sustainability into TxDOT's Transportation Decision-Making – Interactive Workshop

AGENDA FOR WORKSHOPS

Lesson	Title	Min.	Start	End
	Workshop Introduction	15	9:00 AM	9:15 AM
1	Strategic Goals and Sustainability	30	9:15 AM	9:45 AM
2	Performance Measures	45	9:45 AM	10:15 AM
	BREAK	15	10:15 AM	10:30 AM
3	Introduction to Sustainability Enhancement Tool	45	10:30 AM	11:00 AM
4	Data Requirements for SET Operation	45	11:00 AM	11:30 AM
	LUNCH	30	11:30 AM	12:30 PM
4	Example Corridor Application	45	12:30 PM	1:15 PM
5	Interactive Exercise	75	1:15 PM	2:30 PM
	BREAK	15	2:30 PM	2:45 PM
	Final Comments and Evaluation	15	2:45 PM	3:00 PM

Figure 1. Workshop Agenda.

Updated Performance Measures for the SET

Most of the performance measures remained unchanged from those developed in Project 0-5541. However, two of the air quality-related performance measures (one relating to pollutant emissions and another relating to non-attainment status) were combined into a single revised measure (termed as the “air quality index”). This was done on the basis of discussions with TxDOT staff. Additionally, an update of TxDOT’s Strategic Plan resulted in a slight modification in the wording of one goal (“enhance the value of transportation assets” was changed to “preserve the value of transportation assets”), which was also reflected in the revised set of goals, objectives and performance measures. [Table 1](#) shows the final set of measures used in the SET. [Appendix A](#) describes the new air quality index measure in detail. Documentation of all other measures is available in the 0-5541 research report. The SET calculator and reference manual were updated to reflect the latest performance measures.

Table 1. Goals, Objectives, and Measures Used in the SET.

TxDOT Goal	Sustainability-Related Objective	Performance Measure
Reduce congestion	Improve mobility on highways	Travel time index
	Improve reliability of highway travel	Buffer index
Enhance safety	Reduce crash rates and crash risk	Annual severe crashes per mile
	Improve traffic incident detection and response	Percentage lane-miles under traffic monitoring/surveillance
Expand economic opportunity	Optimize land-use mix for development potential	Land-use balance
	Improve road-based freight movement	Truck throughput efficiency
Preserve the value of transportation assets	Maintain existing highway system quality	Average pavement condition score
	Reduce cost and impact of highway capacity expansion	Capacity addition within available right of way
	Leverage non-traditional funding sources for highways	Cost recovery from alternative sources
	Increase use of alternatives to single-occupant automobile travel	Proportion of non-single-occupant travel
Improve air quality	Reduce adverse human health impacts and comply with ambient air quality standards	Air Quality Index
	Reduce greenhouse gas emissions	Daily CO ₂ emissions

Finalized Workshop Materials and Analysis Tool

Tasks 4 and 5 of this project involved the development of finalized workshop materials and an updated analysis tool. The draft workshop materials developed as described previously (including the revised SET, user manual, examples, and PowerPoint slides) were updated concurrently as workshops progressed, based on feedback from workshop participants and

observations made by TTI researchers while conducting the workshops. The finalized workshop materials and analysis tool was submitted to TxDOT as Product 5-5541-01-P1 in August 2010. The workshop material is also provided in a CD accompanying this report. These materials included:

- Instructor Notebook with PowerPoint slides and teaching notes.
- Participant Workbook containing an agenda, “Meet the Instructor” page, and printed slides of the presentation.
- CD with the SET, reference manual, and example corridor problem filled in.
- Handouts, exercise materials, and visual aids, including:
 - Characteristics of a good performance measure.
 - Performance measures and description.
 - Data sources.
 - Small corridor example.
 - Example application for US-281.
 - Interactive exercise.
 - Answer key for interactive exercise.
 - Workshop evaluation form.
 - Data element entry form.
 - Participant certificates.

CHAPTER 3: SUMMARY OF WORKSHOPS CONDUCTED

This section summarizes Tasks 2 and 3, covering the workshop walkthrough and regional workshops. Using the draft workshop materials developed at the beginning of the project, a workshop walkthrough (i.e., a pilot workshop) was conducted in College Station, Texas, on April 24, 2009, with selected TxDOT and TTI staff. Following this, six regional workshops were conducted across various TxDOT district locations in FYs 2009 and 2010. [Table 2](#) lists the workshop dates, locations, and number of attendees.

Table 2. Workshop Details.

Date	Location	Number of Attendees*
April 24, 2009 (Pilot)	College Station	6
June 3, 2009	San Antonio	8
June 10, 2009	Fort Worth	6
August 20, 2009	El Paso	13
August 25, 2009	Austin	8
May 7, 2010	Houston	8
May 25, 2010	El Paso	18

**Note: Number of attendees refers to participants only, and does not include workshop instructors*

Workshop Evaluations and Participant Feedback

At each workshop, participants were asked to fill in a workshop evaluation form (shown in [Appendix B](#)), to provide ratings for the workshops as well as additional specific comments. Many of the participant comments were used to update and finalize workshop material in Tasks 4 and 5. The ratings of the workshop aspects that were on a 5-point scale are averaged over 67 respondents and presented in [Table 3](#). As seen in [Table 3](#), the attendees rated all aspects of the workshop very highly.

Table 3. Ratings from Workshop Evaluations.

Parameter	Number of Responses by Rating Category (1- Poor, 5- Excellent)					Average Rating (on 5)*
	1	2	3	4	5	
1. Delivery			2	22	43	4.6
2. Organization				16	51	4.8
3. Subject Knowledge				9	58	4.9
4. Usefulness of Workshop			4	24	39	4.5
5. Understanding Sustainability			6	22	39	4.5
6. Understanding Performance Measures			3	29	35	4.5
7. Use of SET		1	2	28	36	4.5

* Average over total of 67 respondents

Selected Participant Comments on the Importance of the Workshop

The evaluation forms also contained comments from participants; a selected set of these comments are presented below:

- “The SET is adaptable and flexible and can be used in any area. The instructors were very patient and helpful. They made themselves available and accessible during the exercise.”
- “Excellent overview of performance measures and how results can be combined across different dimensions/priorities to obtain an overall picture of sustainable impacts.”
- “I haven’t worked in this area of evaluation before, so I gained much knowledge regarding sustainability tools.”
- “... (the importance of) the need to think futuristically about projects.”
- “The exercise was very helpful to understand the delivery due to hands-on learning opportunities.”
- “Great tool to check our TxDOT goals.”

CHAPTER 4: POTENTIAL FOR IMPLEMENTATION

The future implementation potential of this research project was explored under Task 6 (District MPO-Local Agency Consortium Implementation Plan) and Task 7 (Plan to Integrate into TxDOT Practice). The main findings and observations based on these tasks are summarized below:

- In terms of district-MPO-local agency coordination, the El Paso area was identified as a potential location for such pilot implementation. The workshop held in El Paso in 2009 was very well attended and was unable to accommodate all interested participants. A follow-up workshop was held in 2010. Both workshops were filled to capacity and had participants from TxDOT, El Paso MPO, and the City of El Paso.
- On basis of training received at the workshop, the El Paso MPO used the calculator tool to perform analyses for use as supplementary documentation for their TIGER grant funding applications.
- The City of El Paso expressed interest in using a similar tool/approach for Bus Rapid Transit (BRT) corridors, with a set of modified performance measures based on the city's goals and performance measures that better reflect transit needs. The TTI research team has developed a proposal for the consideration of the Center for Intelligent International Transportation Research (CIITR). The City of El Paso also provided a letter of support for this proposal, and the project was selected for funding under the CIITR's research program for the 2011 Fiscal Year.
- A national-level project under the National Cooperative Highway Research Program (NCHRP) – Project 08-74 Sustainability Performance Measures for State DOTs and Other Transportation Agencies was an outflow of the TxDOT 0-5541 research project (based on a project statement that originated in Texas). The TTI-led research team was awarded this project through a competitive selection process, and research on this project is currently under way. The findings from this research, which draws upon the expertise of a wide variety of research experts and panel members, will be very useful in terms of informing future implementation for TxDOT on a DOT-wide basis.
- The current SET is focused on planning-level corridor analyses. There is potential to expand the SET to cover programming and project development, design, construction, maintenance, and operations. There is also potential to broaden the SET tool beyond corridor-level analyses and to incorporate it into the NEPA process.
- The coordination of the SET with federal livability initiatives is also a possibility for future implementation.
- Another direction for implementation within TxDOT is to explore the possibility for sustainability rating systems that can be applied on a statewide basis.

- This research was based on TxDOT's 2007–2011 strategic plan. TxDOT recently revised its strategic plan (for 2011–2015), which includes a changed set of goals. There is potential for modifying the existing SET and performance measures to better align with TxDOT's new strategic plan goals, in order to pursue wider implementation within TxDOT.
- Overall, broad applicability and buy-in at TxDOT can be pursued through a focused program of lectures, marketing and outreach material, and meeting with key staff and elected officials.

CHAPTER 5: CONCLUSIONS AND FUTURE RESEARCH

This project (Regional Workshops on the Sustainability Enhancement Tool) was the implementation of TxDOT Project 0-5541 “Developing Sustainable Transportation Performance Measures for TxDOT’s Strategic Plan.” As part of this project, researchers modified the performance measures originally developed as part of the research project and updated the SET calculator and reference manual to reflect these changes. Draft workshop instructional materials were developed, and a pilot workshop was held in April 2009, in College Station, Texas. Following this, regional workshops were held at the following TxDOT districts: San Antonio, Fort Worth, El Paso, Austin, and Houston. Workshop attendees were mostly TxDOT staff, but also included staff from other states, from cities, MPOs, and private consultants. The workshops received very positive feedback from attendees. Feedback and comments from the workshops were incorporated into finalized workshop material and the SET and reference manual, which were submitted to TxDOT in August 2010 (Product 5-5541-01-P1).

Researchers also explored possibilities of applying this research in a coordinated manner for local agencies and TxDOT, as in the case of the City of El Paso, where a project proposal is under consideration for BRT applications, and the El Paso MPO, which used the SET for performing analyses for funding applications.

The scope for broadening the research for further applicability within TxDOT, was also discussed. Specific areas of future research identified included:

- Update the performance measures to align with TxDOT’s new strategic plan.
- Expand the SET to cover programming and project development, design, construction, maintenance, and operations.
- Broaden the SET tool beyond corridor-level analyses.
- Modify the performance measures and SET to address federal regulations and guidance such as NEPA and livability initiatives.
- Develop sustainability rating systems that can be applied on a statewide basis.
- Incorporate findings from national-level research projects such as NCHRP 08-74.

Overall, it was found that the SET and workshops provide transportation practitioners with a good understanding of sustainability, performance measurement, and decision making as it can be applied to the transportation sector, specifically highway corridors. Other potential uses can be drawn from these basics, and depend on the proposed audience and the nature of projects and case studies under evaluation. Adjustments to performance measures and goals based on the scope/analysis level can also help further the usefulness of this project’s findings.

APPENDIX A – REVISED AIR QUALITY PERFORMANCE MEASURE

- [Figure A1](#) (on the next page) shows the calculation of the revised air quality measure in diagrammatic form.
- The measure has three components: ozone, carbon monoxide (CO), and particulate matter (PM), each of which is assigned Importance Factors (adding to 1).
- The default importance factors for each component are adjusted upward/downward depending on the nonattainment status of the region (increased importance is given to components that the area is in nonattainment for)
- The emissions for the following pollutants are estimated: volatile organic compounds (VOC), oxides of nitrogen (NO_x), CO, and PM; The VOC and NO_x are combined and expressed as NO_x equivalents and considered together for the ozone component. These individual emissions are each compared to predefined best and worst-case values, and expressed on a 0–1 scale using linear interpolation.
- The individual component scores are then combined together on the basis of the importance factors to obtain the Air Quality Index value on a 0–1 scale.

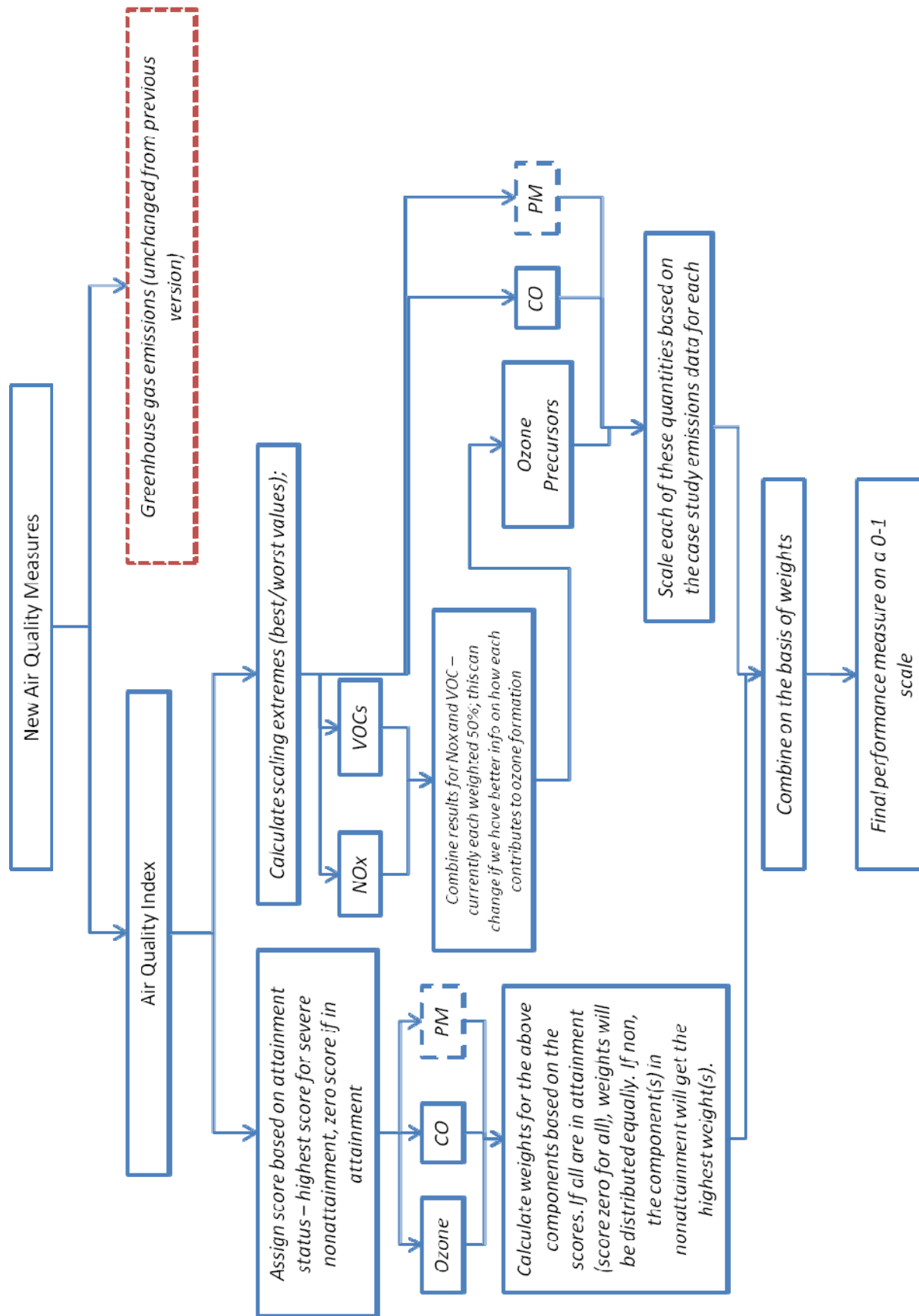


Figure A1. Diagrammatic Representation of the Revised Air Quality Performance Measure.

APPENDIX B – WORKSHOP EVALUATION FORM
Incorporating Sustainability into TxDOT’s Transportation Decision-Making

Workshop Evaluation Form

Please rate the overall quality of instruction:

	Poor				Excellent
Delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subject	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please rate the following:

	Poor				Excellent
Usefulness of this workshop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The workshop’s contribution to your understanding of :

Sustainability and transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Performance measures and their application for decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Use of the SET	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Please tell us the most important point(s) made in this presentation.

How could this workshop be improved?

Any other questions/comments?

Thanks for your feedback!

Name (optional): _____

Agency (optional): _____

