STARS

Sustainable Transportation Analysis
& Rating System

Pilot Plan Application Manual

Version 1.0
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A framework for integrating sustainability into transportation plans

STARS-Plan is one of a family of STARS tools developed by the North American Sustainable Transportation Council (STC), a registered non-profit organization, and the Portland (OR) Bureau of Transportation. If you have questions about STARS, please contact Peter Hurley at 503.823.5007 and peter.t.hurley@portlandoregon.gov or Kelly Rodgers at 503.442.7165 and Kelly@transportationcouncil.org.

Acknowledgements

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Chapter 1: Introduction
STARS and Sustainable Transportation

Photo: Greg Raisman

Introduction

What is STARS?

STARS-Plan is part of an integrated family of STARS tools to advance sustainability in surface transportation. STARS (the Sustainable Transportation Analysis & Rating System) is an integrated planning framework for transportation plans, projects, and programs. Based on sustainability principles[1], STARS gives planners, citizens and decision-makers the ability to evaluate the full life cycle of transportation plans and projects, identifying innovative options and improving decision-making.

Since the use of transportation projects (e.g., the vehicles moving along it) often has more lasting consequences than the construction phase, the decision of what to build can be more important than how it is constructed. This "upstream" approach to transportation investments distinguishes STARS from other rating systems that are centered on the design and construction phases.

STARS requires users to set and achieve clearly stated goals and objectives, many of which are quantitative in nature. Rather than comply with a list of standards, STARS asks users to adopt goals and a small number of measurable objectives, and then evaluate strategies to achieve those goals and objectives. In cases where data is limited, STARS may provide a prescriptive list of actions that are known to achieve the objective at hand.

STARS promotes improved "access" rather than simply improved transportation mobility. That is, STARS encourages a mix of transportation and land use strategies to meet the needs of residents and businesses for access to people and places, goods, services, and information. This shift in focus enables users to conceive of solutions to transportation problems that might otherwise be overlooked with a traditional focus on moving vehicles.

State DOTs, regional agencies, cities, and counties are wrestling with how to improve access within seriously constrained budgets, while helping achieve economic, environmental and equity goals. They need practical tools to compare their transportation projects, programs, and plans using a national best practices standard, which STARS provides.

What is STARS-Plan?

STARS-Plan is one of a suite of tools in the STARS system designed to help transportation planners and decision-makers achieve triple bottom line sustainability outcomes through regional and local transportation plans. Currently, three STARS tools have been developed: STARS-Project for transportation projects, STARS-Plan for transportation plans, and the STARS Safety, Health, and Equity Tool (see Figure 1).

[1] STARS is informed by The Natural Step principles of sustainability

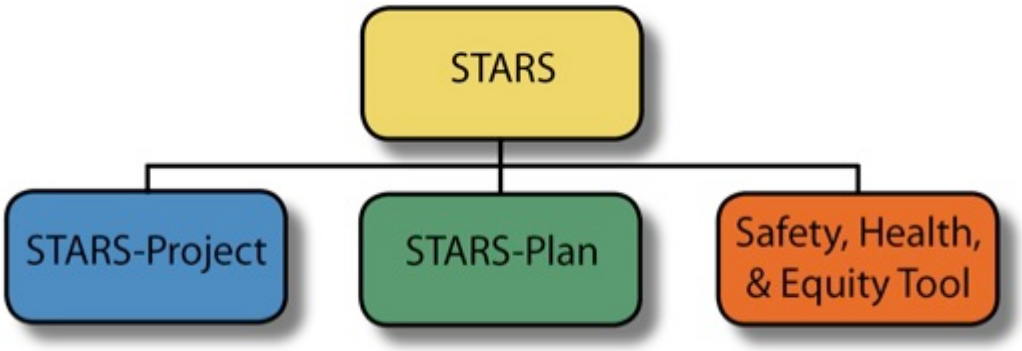

Figure 1: STARS products

STARS-Plan offers a clear and focused framework for communities to establish sustainable performance measures to forecast and verify the extent to which plans are meeting their goals and objectives. As a result, STARS-Plan helps streamline and simplify decisions about programs and projects, based on demonstrated outcomes over the short, medium, and long term.

STARS-Plan promotes programs and projects likely to achieve multiple goals. While STARS is organized into credit categories each with its own set of goals, objectives, and measures, such as Access and Mobility and Climate and Energy, strategies to improve one credit area (e.g. improving walkability for Access and Mobility) also produces benefits in another (e.g. reducing greenhouse gas emissions for Climate and Energy and increasing physical activity in Safety and Health). The STARS framework has been developed with an eye toward optimizing the areas of shared benefit. As a result, the performance measures selected are often crosscutting, serving multiple goals. As a result, STARS-Plan encourages using a few manageable, but powerful, measures for addressing sustainability in transportation plans (see "The Best and Worst" on page 8.)

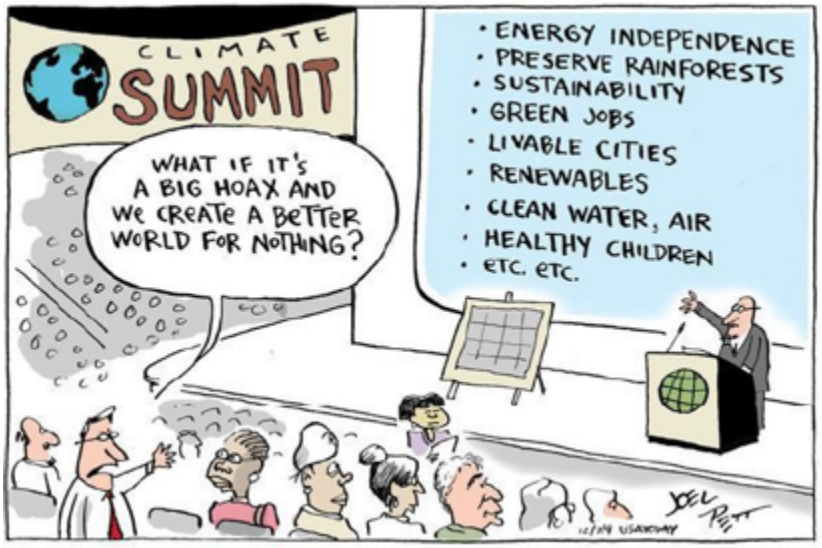

Figure 2: Multiple benefits

Source: Joel Pett

Background

STARS began in July 2008 when Portland Bureau of Transportation policy staff invited a dozen transportation and sustainability professionals to discuss how to shift transportation from moving vehicles to providing people with more and better choices, while reducing energy use and climate pollution in a financially constrained era. Many in the group were frustrated that transportation lagged the energy and building sectors in adopting sustainability and climate-friendly practices. The group drew inspiration from Leadership in Energy and Environmental Design (LEED™) and the Living Building Challenge,™ a product of the International

Living Building Institute, planning and certification systems that are transforming the building construction industry by rewarding projects for increasingly higher levels of performance.

In developing STARS, the group recognized that transportation is a means to an end, not an end in itself. People travel to access employment, education, goods, and services. People do not always need to travel to achieve these objectives. They may work at home or take classes or find information on the web. For example, there are multiple means to gain access to work: driving alone, carpooling, taking transit, bicycling, walking, working at home, and telecommuting. It was this realization that prompted STARS to focus on access, rather than only transportation mobility[2].

In 2010, the STC worked with the Santa Cruz County Regional Transportation Commission to develop the first twelve STARS-Project "core credits," including credits for Integrated Process, Access, Climate and Energy, and Cost Effectiveness Analysis. The STC contracted with five private sector firms to develop the core credits, and several volunteer technical advisors and peer reviewers helped refine the credits. The first version of the Project Application Manual was released in November 2010.

> "The more time I spend working, the more I want that work to make a difference. I made a promise to myself a few years back to make my plans and projects do more to help people and nature. STARS is a powerful guiding "North Star" helping me determine whether and how much I'm keeping that promise."
>
> *-Peter Hurley, Chair,*
> *North American Sustainable Transportation Council*

In 2011, with the support of the Santa Cruz Regional Transportation Commission, the STC pursued the development of a sustainability framework and credit rating system for transportation plans, called STARS-Plan. An Expert Advisory Panel, drawn from transportation practitioners from local, state, and federal levels of government, provided guidance for STARS-Plan. This Manual is the result of the first phase of STARS-Plan.

Where We Are and Where We Are Going

STARS-Plan is being developed in three phases (see Figure 3). This report is the result of the first phase, where a series of discussions with the Expert Advisory Panel helped inform the STARS-Plan framework. At this time, STARS-Plan consists of credit categories, goals, and objectives.

The second phase of STARS-Plan will establish the requirements and methods needed to meet the goals and objectives outlined in the credit framework. In addition to identifying strategies and methods, future iterations of STARS-Plan will likely require that users develop a low-capital/construction alternative that is more focused on operations. That is, one alternative will focus on transportation demand management, transportation system management, and transit operations improvements. These strategies are known to take effect quickly and are less expensive than many build scenarios.

The third phase involves training transportation planners to use STARS-Plan and developing a certification process to rate transportation plans using the STARS framework. This phase will include a training program for people to develop the capacity to certify plans.

[2] For further discussion on accessibility and merits of managing transportation to achieve multiple benefits, see Todd Litman's article *Are Vehicle Travel Reduction Targets Justified? Evaluating Mobility Management Policy Objectives Such As Targets To Reduce VMT And Increase Use Of Alternative Modes,* October, 2009. Victoria Transport Policy Institute

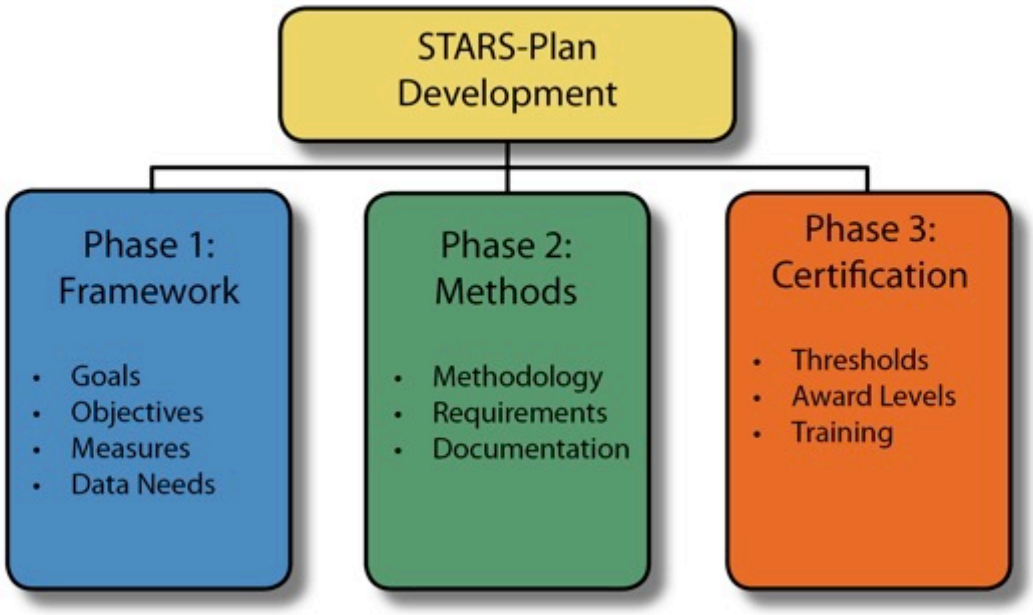

Figure 3: STARS-Plan Development

What is Sustainable Transportation?

How sustainability applies to transportation investments is not very well understood and infrequently attempted. The following definition from the Centre for Sustainable Transportation provides guidance for understanding sustainable transportation, and informs the STARS framework:

- Allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations.
- Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.
- Limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise.

The Natural Step and the Triple Bottom Line

In developing the STARS framework, developers relied on the principles of The Natural Step to help define sustainability. Developed by Dr. Karl Henrik-Robert and vetted by an international community of scientists, The Natural Step identifies three basic conditions that must be met if we want to maintain the essential natural resources, structures and functions that sustain human society, and a fourth condition that recognizes the ability of human beings to meet their basic needs. The below are known as The Natural Step's Four System Conditions:

In a sustainable society, nature is not subject to systematically increasing:

- Concentrations of substances extracted from the earth's crust;
- Concentrations of substances produced by society;
- Degradation by physical means;
- And, in that society, people are not subject to conditions that systemically undermine their capacity to meet their needs

STARS recommends using The Natural Step (TNS) as a means to understand sustainability and as a framework for defining an end state, or ultimate, sustainable transportation system. Embedded in the sustainability definition above are concepts from The Natural Step. STARS uses a "backcasting" approach recommended by The Natural Step to identify which strategies help users meet their goals. Rather than relying exclusively on a forecasting method employed by many planning agencies, backcasting involves setting a vision and goals for the future, and then identifying the strategies and steps to take in order to reach those goals (see Figure 4: Backcasting). For each of the objectives, STARS asks users to establish targets through a backcasting process.

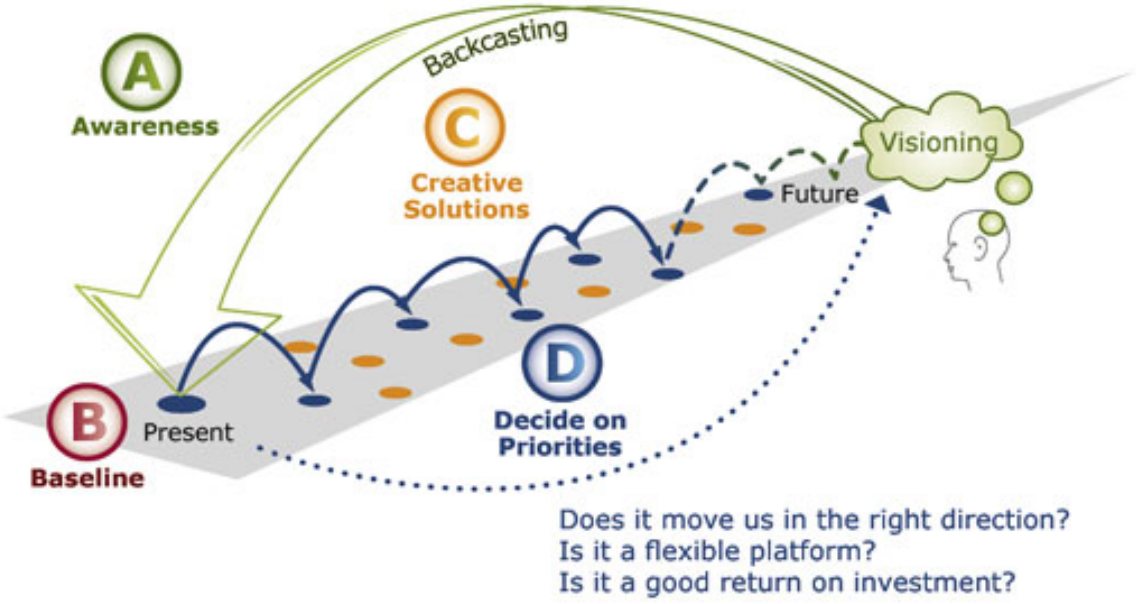

Figure 4: Backcasting

Source: The Natural Step, www.naturalstep.org/~natural/applying-abcd-method

While The Natural Step is valuable for understanding sustainability, STARS uses a Triple Bottom Line[3] framework to organize and implement sustainability into transportation plans and projects. The Triple Bottom Line organizes the benefits and impacts of decisions according to three categories: social equity, environmental quality, and economic prosperity (see Figure 5). Frequently, these categories are summarized as People, Planet, and Prosperity. As an implementing framework, STARS uses the Triple Bottom Line to identify goals, objectives, and performance measures for each credit category.

[3] The Triple Bottom Line was popularized by John Elkington in his book, *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*.

Why Use STARS-Plan's Triple Bottom Line Framework

STARS-Plan is a clear and focused sustainability framework designed for use in regional and local transportation plans. STARS-Plan uses the Triple Bottom Line to identify key goals and objectives that best achieve multiple bottom line outcomes (see Figure 6). Each STARS goal and objective notes how it affects the Triple Bottom Line in the spreadsheet in Appendix B.

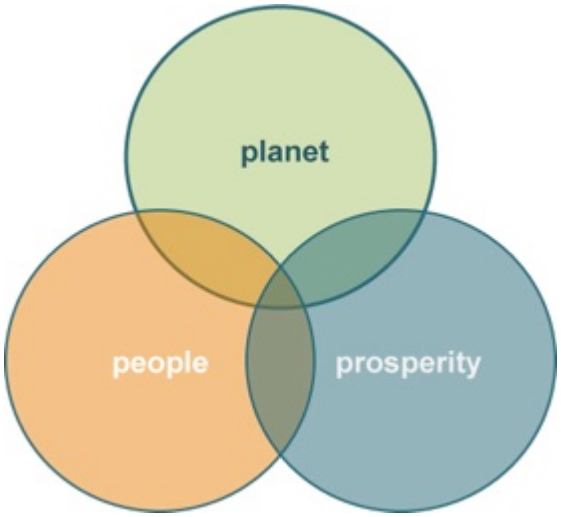

Figure 5: The Triple Bottom Line

The key is optimizing for all three dimensions of the Triple Bottom Line, and not "balancing" them. Often "balancing" sustainability discussions result in choosing several measures or strategies that benefit only one dimension of the Triple Bottom Line, with the idea that, in total, they address all three aspects. This approach results in trade-offs among the three dimensions, and does not recognize the interrelation of people, planet, and prosperity. STARS, on the other hand, recommends *3D Thinking*: what measures and strategies benefit all three dimensions of the Triple Bottom Line?

For example, STARS uses *vehicle miles reduced* as a key measure, because it relates to all three aspects of the Triple Bottom Line. For people, a reduction in vehicle miles traveled means that people are using other modes to meet their needs, and likely walking, bicycling, or taking transit. Choosing one of these modes is healthier and also reduces the amount of money people spend on vehicle expenses. Reducing vehicle miles traveled also benefits the environment: less driving means less greenhouse gas emissions and other pollutants are being generated (which also benefits people). Finally, in economic terms, a reduction in vehicle miles traveled translates to money otherwise spent on fuel is available to invest in the local economy. This amount of money can be substantial; economist Joe Cortright found that the "Green Dividend" of driving an average of four miles a day less in the Portland, Oregon metro area resulted in $2.6 billion dollar reinvestment on an annual basis.[4]

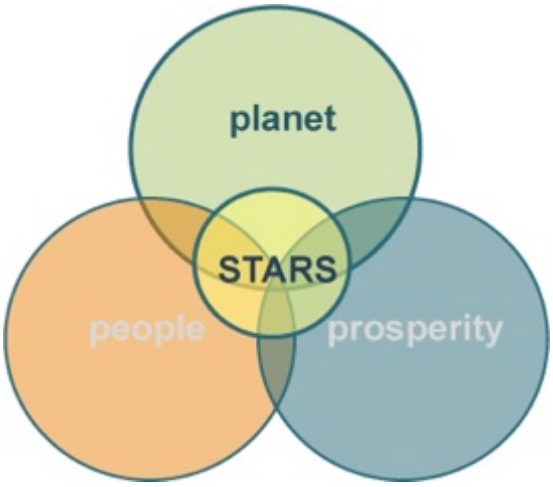

Figure 6: STARS and the Triple Bottom Line

How STARS-Plan is Structured

Credit Categories and Functions

The eight credit categories are: Integrated Process, Community Context, Access & Mobility, Safety & Health, Economic Benefit, Cost Effectiveness, Climate Pollution & Energy Use, and Ecological Function. STARS-Plan has one credit for each credit area rather than a suite of credits for each credit category (e.g. Access & Mobility has

[4] The Green Dividend report is available from the CEOs for Cities website: http://www.ceosforcities.org/work/portlands_green_dividend

only credit AM1 and Safety & Health has only credit SH1). To achieve a credit an applicant must take, or agree to, the goals or specific actions listed in the credit. There may be several goals under each credit.

Most of the credits are organized in a similar fashion: they have goals, objectives, and performance measures. For example, under the Access & Mobility credit, there are goals to *improve people's ability to meet most of their daily needs without having to drive* and *improve the convenience and quality of trips, especially walk, bicycle, and transit trips*. For each goal, STARS users must meet objectives that are generally quantified through performance measures (see Figure 7). See Appendix A for the entire STARS framework (credit categories, goals, objectives, and performance measures).

Figure 7: STARS Credit Structure

Integrated Process is a credit that explains how to lay the foundation for STARS; it is uniquely organized because it does not have a set of goals associated with it, but a list of required elements. Community Context is another credit category that is not organized like the remainder of the credits. Each community brings a different perspective and struggles with unique issues. As a result, STARS has created a category where the particular issues of the community may be addressed.

In some cases, agencies may not have a robust enough data set to evaluate the objectives. In these cases, surrogate measures are identified where data may be limited. The next phase of STARS-Plan will identify under what conditions these surrogate measures are accepted.

While STARS-Plan provides goals and objectives, specific guidance about *how* to set objectives will be developed in future iterations of STARS-Plan. However, one key element for setting objectives is to examine existing policy in the local area. For example, many states and local jurisdictions have established climate action plans, which may provide direction for setting targets.

"We have limited resources, so it was great to use STARS-Plan to avoid reinventing the wheel on many issues."

-Rob Inerfeld, City of Eugene, Oregon

Performance Measures

The STARS approach is largely based on performance measures; that is, it is outcome-oriented. STARS-Plan helps planners, community members and decision-makers prioritize projects and programs that best achieve community sustainability outcomes based on a small set of key performance measures. Performance measures can be generally categorized as leading (or output) or lagging (or outcome) measures. Leading measures are predictive in nature, and are often the result of model outputs. Lagging measures are the measure of the actual change or outcome.

The Best and the Worst

The measures STARS most highly recommends are those that address the three spheres of the Triple Bottom Line: people, planet, and prosperity. Four measures stand above the crowd as the most optimized. These optimized measures tend to show up in several places in STARS-Plan, as a testament to their importance. At the same time, we have identified three other common measures fail the test of clearly improving all three elements of the Triple Bottom Line, and tend to lead to unsustainable outcomes.

STARS recommends prioritizing the following four measures in transportation plans and projects:

1. **Reduce Vehicle Miles Traveled (VMT).** Reducing VMT frequently involves providing more and better transportation options and improving land use so that frequent origins and destinations are closer. Reducing VMT improves prosperity by reducing private vehicle use and therefore retaining in the local economy approximately 75% of money no longer spent on fuel and vehicle wear and tear. Reducing VMT improves prosperity by shifting trips that don't need to drive, preserving scarce roadway capacity for trips that do need to drive. Reducing VMT helps people by (usually) increasing walking, bicycle and transit use, all of which increase physical activity and therefore health. Reducing VMT often means reducing air pollution and its consequent health impacts. Reducing VMT improves environmental health by reducing greenhouse gas emissions.

2. **Prioritized Funding for Improvements to Areas That Have Reported Fatalities and Injuries.** Reducing fatalities and injuries clearly helps people. Reducing fatalities and injuries improves prosperity by reducing unanticipated congestion, which can wreak havoc on trip reliability for freight and other high value trips. Reducing unanticipated congestion also reduces braking, acceleration and idling, all of which reduce fuel consumption and therefore greenhouse gas emissions.

3. **Improve Travel Time Reliability.** Surveys reveal that, for high value trips (e.g. freight and commute), predictable/reliable travel times are often more valuable to users than improvements to average travel time. Improving travel time reliability helps prosperity by creating more reliable freight trips. Improving travel time reliability helps people by allowing them to avoid wasting time by leaving early in order to deal with unpredictable trip times.

4. **Improve Speed Consistency**. Improving speed consistency can help reduce fuel consumption. It is a measure based on speed, braking and acceleration. Improving speed consistency helps prosperity by retaining money in the local economy by reducing fuel consumption, as well as helping the planet by reducing greenhouse gas emissions.

We recommend avoiding using the following three measures in transportation plans and projects:

1. **Vehicle Level of Service (LOS).** A road receives a high LOS when there is little or no delay compared with posted speed, even during the heaviest use periods. A road with a high LOS often indicates that the road has excess capacity for much the day. Higher posted speeds also may not be the optimum speed for fuel efficiency, especially as more vehicles incorporate hybrid technology, which have lower fuel efficiency at common highway speeds. A high LOS can be an indicator of inefficient use of expensive roadway capacity and of inefficient posted speed.

2. **Volume-to-Capacity Ratio (V/C).** Closely related to vehicle LOS, and problematic for the same reasons. Vehicle LOS and V/C are primarily focused on a single mode, unlike the "Three Best" measures, all of which are multimodal. Even transit, which is a vehicle and counted in Vehicle LOS and V/C, is undervalued when a bus carrying 20 or 40 or 60 people is counted the same as a car with one person in it.

3. **Vehicle Delay/Hours of Congestion**. Vehicle delay suffers from the same problems as the previous two measures: focusing on vehicles rather than people and an over-reliance on posted speed, which may be unrealistic for congested urban areas during peak periods and is often not the optimum speed for fuel efficiency. Vehicle delay/hours of congestion frequently focuses on recurring congestion, which is more predictable and more avoidable for freight trips, than non-recurring congestion caused by crashes and other incidents, which is often a major cause of congestion and is more difficult to plan around.

Where in the Transportation Plan Process is STARS Used?

STARS-Plan should be used at the beginning of the planning process, as well as integrated throughout the planning process. Full integration is particularly important if the user wishes to be STARS-Plan certified. It is possible to use STARS-Plan as a guiding framework for aspects of the transportation plan. STARS-Plan allows for this modularity, although using individual components of STARS-Plan disqualifies the user from receiving certification.

Vision

Understanding the definition of sustainability presented in STARS-Plan, and required through the Integrated Process credit, is integral to crafting a vision that is grounded in sustainability.

Goals, Objectives, and Performance Measures

STARS-Plan recommends a backcasting process to identify which goals, objectives, and performance measures will best help the agency achieve the vision identified in the planning process.

Data and Modeling

STARS-Plan identifies specific data needs and model outputs used to assess the plan. A conversation about data and modeling is most beneficial at the outset of the planning process, in order to understand what data is available and what data or modeling limitations the agency has.

Evaluation

The objectives in the STARS-Plan are used to assess the performance of plan alternatives. STARS-Plan supporting strategies and measures help users explore how to best meet the goals and objectives.

Scale for STARS-Plan

STARS-Plan is intended to apply to local Transportation System (TSPs), Regional Transportation Plans (RTPs), and modal plans (e.g., a bicycle master plan). STARS-Plan is not intended to apply to state-level policy plans or programming decisions, such as State Transportation Improvement Plans (STIPs).

Timeframe for STARS-Plan

Transportation plans (RTPs and TSPs) generally have a 20 or 25-year time horizon. While this is an appropriate horizon for a transportation planning effort, many strategies can happen more quickly and have significant impacts. As such, STARS-Plan also recommends evaluation at the five to ten-year timeframe. Additionally, because many state and local governments have developed policies and goals for greenhouse gas reductions with a 2050 time horizon, STARS-Plan also recommends users to evaluate strategies out to 2050.

In summary, STARS-Plan recommends planning for two (required) and one (optional) "design years:"

- Short: Five to ten years from plan adoption
- Medium: 20 to 25 years from plan adoption
- Long: the year 2050

Note that STARS recognizes the difficulty in obtaining data for the year 2050. Agencies should obtain what data is available, and also look qualitatively at trends. STARS users should ask: "What will the community look like in 2050? What infrastructure and services will we need?"

Becoming a STARS 1.0 Certified Pilot Plan

STARS Plan 1.0 is designed to apply to transportation plans in the early stages of development and integrated throughout the process. As a planning tool, STARS is intended to inform how transportation plans are developed, before alternatives have been devised. That is, STARS asks users to build alternatives considering the goals and objectives through a backcasting process, and then again, to evaluate those alternatives based on the objectives and performance measures. The certification system and a training program will be developed in Phase 3 of STARS-Plan. In general, the following six steps outline the certification system as the STC intends to develop it.

1. Ask Questions

- Ask what problems you have for your transportation plan area. Problems with recurring congestion, insufficient multi-modal options, insufficient construction or operating funds and lack of public support are indicators of potential STARS candidate projects.
- Ask what goals you have for your transportation plan area. Improving the sustainability of the transportation system, providing people more and better travel options, integrating transportation and land use, identifying low cost improvement strategies and meeting energy and climate goals may all signify potential STARS candidate projects.
- Ask where in the process your plan is. As noted above, STARS is most effective the earlier it is applied in the plan development process, though plans later in the development process may still find STARS provides valuable decision-making information.

2. Contact the North American Sustainable Transportation Council (STC)

- Contact Peter Hurley to start the conversation. Peter is a Portland Bureau of Transportation Project Manager and Chair of the STC. He can be reached at 503.823.5007 or peter.t.hurley@portlandoregon.gov.

- After discussing the questions above, you'll talk with the STC about each of the credits in this manual, discussing how each might apply to your plan, and identifying which credits you may want to apply. The conversation will start to identify data issues, methodology questions, priority goals and objectives and priority credits.
- Decide whether the plan is likely to benefit from STARS and whether STARS is likely to benefit from the plan.

3. Agree on Responsibilities to Become a STARS 1.0 Candidate Pilot Plan

- The plan agency and the STC will sign an informal written agreement outlining which credits the plan intends to pursue, the responsibilities of each party and designating the plan a "STARS 1.0 Candidate Pilot Plan." This will usually involve a low-cost financial partnership between the organizations.

4. Apply the Credits

- Most plans will start with a STARS training for their project team (and, perhaps, decision-makers).
- All plans will offer educational materials and presentations on sustainability through a workshop or a series of integrated meetings, conducted by the STC, in collaboration with project team members, decision-makers and/or the Plan Stakeholder Committee.
- Submit a "pre-analysis proposal" to the STC, outlining what methods you intend to use for each credit you consider. This would allow the STC to work with you to address issues, before spending a significant amount of time and money on actions that the STC may consider insufficient.
- Integrate credits into your planning process. Credit application will occur primarily by the project team. The STC will be available to address interpretation questions.
- The project team will document issues and benefits that arise during credit application.

5. Documentation

- The project team will provide documentation to the STC how each credit was applied, which will be described in Phase 2 of STARS-Plan. The STARS development team found using "Basecamp" as a common website to post comments, questions and draft documents to be a valuable tool; the project may wish to use it or a comparable tool to communicate with the STARS team.
- The STC will collaborate with the agency on reviewing the documentation and how well the agency is meeting the goals and objectives. It is expected that this will be an iterative process.
- In order to be certified, the agency must adopt goals, objectives, performance measures and targets for the primary measures: *reduce VMT*, *improvements to number of areas that have reported fatalities and injuries*, *improve travel time reliability*, and *improve speed consistency*.

> "We want the STARS process to enrich our City's plan and I believe that if we each enhance our Transportation System Plans and the STARS process we will advance our profession and make our communities more livable, enjoyable and sustainable. I hope others join us and make this a living process."
>
> *-John Dorst, City of Gresham, Oregon*

6. Celebrate!

- At this point you should have a more sustainable plan with greater public support. Celebrate!

Glossary

Employment Centers: Are places of employment that include industrial and manufacturing, institutional (e.g., medical, educational), shopping centers, and other uses that may be appropriate to the community. STARS users may define the employment centers in their community.

Goals: Are general, directional (increase, decrease) statements that guide the plan, defined in accordance with sustainability principles. An example is Safety & Health Goal 2: *"Improve multimodal safety, especially for the most vulnerable users."*

Hydromodification: To alter the hydrology of a stream. Transportation, and urban development, can change the hydrology by increasing the amount of impervious surfaces which results in increased volumes of stormwater runoff and increased speed of stormwater runoff, as well as increasing levels of pollution (including increased temperature) in the stormwater. These actions impact streams and other bodies of water that receive the stormwater runoff.

Key Destinations: Include employment centers, places of worship, shopping destinations, educational facilities, social services, medical centers, and any other places of frequent visitation by populations in the community. STARS users able to define what places are key destinations, but should include consideration of all the above.

Methods: Are the evaluation methods used to assess how objectives and performance measures. They include information about data needs, model inputs and outputs, and other methods for evaluating the objectives.

Objectives: Are the means to achieving the goals. Objectives are quantified through performance measures (see below) and have a target amount of improvement and timeframe in which the objective will be achieved. An example is the Safety & Health objective for Goal 2 is *"Decrease fatalities and injuries for all travel modes."*

Pedestrian: While everyone is a pedestrian, not everyone walks. Walkable/rollable and accessible are used interchangeably as a reminder that a pedestrian network must accommodate all of its users including persons using mobility devices. Consider walking as shorthand for "walking/rolling."[5]

Performance Measures: Are the units of measure; also called measures of effectiveness. Some measures are leading; that is, they are predictive of outcomes (e.g., improved network connectivity is likely to increase active mode share). Others are lagging; that is, they measure outcomes directly (e.g., active mode share measures the result: how many people are walking, bicycling, or taking transit).

Primary Measures: Are the primary performance measures that achieve many objectives. These measures are the "heavy-lifters;" they represent the primary outcomes desired and often address multiple aspects of the Triple Bottom Line. They are: *reduce vehicle miles traveled*, *improvements to number of areas that have reported fatalities and injuries, improve travel time reliability*, and *improve speed consistency*.

Speed consistency: A measure of variation in fuel consumption between key origins and destinations based on speed, braking, and acceleration. Recommended by STC as one of the "Best" measures to show triple bottom line benefits. See pages 8 and 9 for "Best and Worst" measures.

[5] Willamette Pedestrian Coalition, 2011. Getting Around on Foot Action Plan.

Speed efficiency: Is the optimum speed profile that reduces vehicle acceleration and deceleration, which in turn improves fuel efficiency, reduces greenhouse gas (GHG) emissions, and has the added benefit of potentially reducing crashes.

STARS-Plan Design Years: In order to reflect performance in the short, medium and long-term, STARS recommends that projects use three design years: a year between 5-10 years from the start of plan implementation, a year between 20-25 years from the start of plan implementation, and 2050, the year commonly used for state and federal greenhouse gas reduction goals. Of these, a year between 5-10 and a year between 20-25 years are required. The year 2050 is optional.

Strategies: Are actions, programs, or other methods that help users achieve their goals and objectives. For example, in order to meet vehicle mile reduction targets, STARS users may explore using strategies of improved network connectivity or network completeness to aid in people's ability to walk more and drive less.

Targets: Are the quantified goals for performance measures, set by the STARS user and approved by the North American Sustainable Transportation Council (if pursuing certification). An example is the STARS performance measure: *Reduce vehicle miles traveled* and example targets could be reduction of 15% by 2022, 40% by 2032, and 80% by 2050.

Transportation-disadvantaged: Elderly, youth, people without cars, people experiencing poverty, people of color, people who experience language barriers, and people with disabilities often have constrained travel choices.

Vulnerable Users: Users who are injured or killed in greater proportion than the rest of the population. They may be vulnerable because of the mode they are using (e.g., bicycling) or because of their demographic characteristics (e.g. the elderly).

"STARS Plan has provided the RTC with a comprehensive view of what is involved in constructing and evaluating a sustainable transportation plan, and helped to communicate this information to the public and decision makers. Also, we expect the strong multimodal focus within the context of sustainable outcomes to advance the community conversation about transportation from a mode specific discussion to one focused on specific outcomes."

- Grace Blakeslee,
Santa Cruz Regional Transportation Commission, California

Chapter 2: The STARS Framework
Credit Categories, Goals, Objectives, and Measures

Photo: Michael @ NW Lens

Photo: Kelly Rodgers

Credit Category
Integrated Process

Integrated Process is a credit that establishes the foundation upon which the other credits are developed. Without undertaking the steps outlined in Integrated Process, STARS-Plan users will not be able to complete the remainder of the STARS credits.

Since Integrated Process is a procedural credit, it does not have a set of goals, objectives, and measures associated with it. Instead, Integrated Process requires users to undertake a series of actions.

Integrated Process	
Action	
IP Action 1 **Interdisciplinary Project Team**	Develop an interdisciplinary team; early engagement with full team
IP Action 2 **Acquire Baseline Data**	Collect data sources related to goals, objectives, and measures
IP Action 3 **Community Engagement**	Engage with community through committees, surveys, and other outreach efforts
IP Action 4 **Sustainability Education**	Educate project team and stakeholders about sustainability and equity
IP Action 5 **Backcast to Set Targets**	Use a backcasting process to establish targets for objectives

Table 1: Integrated Process Summary

Integrated Process Action 1: Interdisciplinary Project Team

Sustainability issues are more likely to be integrated effectively into a plan when members of the project team have expertise in the various issue areas. Users must assemble an interdisciplinary team so that a diversity of issues are addressed, and early in the project. STARS recommends an integrated kick-off meeting will all team members present.

Methods and Data

In addition to the typical project team members, consider including members with expertise in:

- Ecology
- Landscape architecture
- Public health
- Public involvement with transportation-disadvantaged populations
- Bicycle and pedestrian safety

Integrated Process Action 2: Acquire Baseline Data

STARS users must ensure they have the data needed to evaluate the projected performance of plan alternatives. Data availability and quality varies tremendously between agencies. STARS-Plan recognizes this by requiring the use of the best available data. Given the significant impact of the recent economic downturn on travel behavior, data should be fresh (since 2008) or adjusted to reflect current travel volumes and patterns. The following describe the data needs for the credits. Further information about data is described under the relevant credits.

User survey

Understanding the way people use, and want to use, the transportation system, is critical to developing a responsive plan. At the outset of the planning effort, STARS-Plan requires a substantive effort toward a statistically significant survey of system users. A similar survey should be used in the medium- and long-term STARS-Plan Design Years to ascertain how users perceive progress toward plan goals. For details about what should be included in the user survey, see IP Action 2, Community Engagement, below.

Transportation-disadvantaged populations

Because a substantial proportion of the population do not have regular, affordable access to a private vehicle, it is important to have basic information on the needs of transportation-disadvantaged people when deciding how to best distribute the benefits and burdens of transportation projects and programs. STARS-Plan requires identifying who is choice constrained, where they travel to and from and what their priorities are (see "User Survey," above). STARS-Plan requires that responses from transportation-disadvantaged people are equal to or greater than their proportion of the plan area population.

> For the purposes of STARS, "'Equity' means all people have full and equal access to opportunities that enable them to attain their full potential."[1]

When planning for future STARS design years, consider the population trends for transportation-disadvantaged groups, which may be different than those of the general population.

Transportation-disadvantaged populations include:

- People who do not own a car
- People of color
- People experiencing poverty

- People with disabilities
- People experiencing language barriers
- Elderly
- Youth

Mode share
Mode share is the percentage of trips taken by each mode, based on a geographic area (e.g. Transportation Analysis Zone).

Vehicle miles traveled
Vehicle Miles Traveled (VMT) is a key measure of economic, environmental and community health. VMT is a fundamental indicator of the effectiveness of transportation and land use policies and practices. Collect data by the smallest available geographic area.

Multimodal travel time
STARS-Plan recommends acquiring mean travel time data for all modes (walk, bicycle, transit, freight, carpool/vanpool, drive alone), between key origins and key destinations.

Travel time reliability
Travel time reliability is a basic consideration when people choose whether and how to travel. STARS-Plan recommends acquiring data for all modes (walk, bicycle, transit, freight, carpool/vanpool, drive alone), between key origins and key destinations. Reliability measures the variability of trip times, including the impact of non-recurring congestion resulting from crashes and weather.

Speed consistency and speed efficiency
Speed consistency measures the variability of trip speeds: reducing braking and acceleration can improve safety and reduce fuel consumption. Speed efficiency is the optimum speed profile that reduces braking and acceleration, which reduces fuel consumption and greenhouse gas (GHG) emissions, and has the added benefit of potentially reducing crashes and improving travel time reliability.

Fatalities and injuries
Establish fatality and injuries rates and locations, by mode.

Criteria pollutants
Collect data for criteria pollutants.

Public, private, and social costs and benefits
The STARS Cost Effectiveness credit requires an evaluation of public, private, and social costs and benefits of the life cycle of the plan. Benefits and costs of plan alternatives will be acquired in subsequent credits.

Pavement index, routine maintenance costs, deferred costs (streets); asset age, service call schedule (transit)
These data areas are required for the Cost Effectiveness credit.

Sensitive lands
STARS-Plan recommends identifying local, state, and federally defined sensitive areas.

Stormwater volumes, flow, and water quality
STARS recommends that users collect baseline information about stormwater volumes, flow, and water quality.

Tree canopy
STARS-Plan recommends that users calculate tree canopy coverage in the rights-of-way

Integrated Process Action 3: Community Engagement

Another part of Integrated Process is ensuring that a diverse group of stakeholders provide input into the goals and objectives for the plan and provide comments on the alternatives. These objectives can be accomplished through a variety of outreach and engagement strategies. The particular strategy will depend on the needs of the community.

Methods and Data
Because different groups have different transportation needs, it is important to have basic information on transportation-disadvantage people when deciding how best reduce disparities in the transportation system. STARS requires identifying who is transportation-disadvantaged, where they travel to and from and what their priorities are (see "User Survey" below).

Below are two ways that STARS recommends engaging with the community, although the particular outreach strategy will depend on the needs of the community:

Community Stakeholder Committee
STARS-Plan recommends forming a diverse, interdisciplinary and ongoing Plan Stakeholder Committee (PSC). This stakeholder group should include, among others, technical staff, local interest groups, user groups, representatives from each transportation-disadvantaged group and neighborhood representatives. Elected officials are encouraged to serve as ex-officio members of the PSC to hear from, and interact with, other members. Ideally, the PSC should to be engaged in all stages of the plan, including providing recommendations at key decision points. However, the particular form of engagement may differ depending on the needs of the community.

Surveys
STARS-Plan recommends conducting ongoing outreach through mailed and digital surveys to gain community feedback, first near the planning process begins, secondly during plan alternative development, and finally at the analysis and selection stages. If the outreach performed is extensive, this may substitute for having a Plan Stakeholder Committee. STARS users may consider interviews with certain community members, particularly those who do not typically join committees. Representatives from transportation-disadvantaged communities may especially benefit from one-on-one conversations.

Surveys should include the information below.

The User Survey should address:

Respondent information

- Where does respondent live?
- What are respondent's demographic characteristics, including age, race and ethnicity, gender, physical ability, languages spoken, income, educational attainment, and household characteristics?

Access Needs

- Where are respondent's trip origins and key or frequent destinations, both current and desired?
    - For work? For basic daily needs?
    - What destinations are inaccessible?
- What are respondent's modes of travel, both current and desired?
    - How long does it take?
    - Is it reliable?
    - How much does it cost?
    - What route does respondent travel?
    - How would respondent prefer to travel, ideally?

Barriers to Access

- What barriers and opportunities to access (physical, financial, safety, time, reliability, lack of information, etc.) does the respondent experience?
- What are respondent's perceptions of safety, by mode, by time of day, by and location?

Equity

- How have transportation investments positively or negatively impacted the respondent or respondent's community, or have investments had no impact? Are there accumulated impacts?

Suggestions and Feedback

- What goals and priorities does the respondent want the plan to achieve in terms of access to destinations and services, types of modes for traveling, economic benefits, and the environmental improvements?
- What suggestions does the respondent have for projects and programs to be considered?

Outreach Methods

- What are the best options for the respondent to continue to participate in developing the project?

Integrated Process Action 4: Sustainability Education

A key part of Integrated Process is ensuring that a diverse group of stakeholders have the opportunity to learn about sustainability and how it applies to transportation.

> "Sustainability is a community value in Eugene, as is resiliency against changes in climate and higher fuel prices. It is important, then, that our new transportation plan be truly effective in these endeavors. STARS-Plan provides a well-reasoned framework for this purpose."
>
> *-Kurt Yeiter, City of Eugene, Oregon*

Educate the project team, stakeholders, and perhaps the wider community on sustainability and how sustainability applies to transportation plans. This important step helps get people "on the same page" regarding the vision and outcomes for the plan. STARS-Plan recommends that a core group of the Plan Stakeholder Committee (see below), project staff, and decision-makers participate in a sustainability workshop to learn how sustainability principles can be applied to transportation plans, and the basic elements of STARS-Plan. Plan staff may also want to incorporate sustainability education into materials provided to the general public.

Methods and Data

Integrating sustainability and equity into the plan process may be accomplished through a workshop at the outset of the process (recommended) or as a series of dedicated meetings throughout the process. The STC will provide materials to be used for the workshop.

Integrated Process Action 5: Backcast to Set Targets

Backcasting is a powerful tool to establish goals, objectives, and measures. Recommended by The Natural Step, backcasting is used by STARS-Plan to answer the question "What outcomes do we want from our transportation system in future years?" STARS-Plan requires the project management team and/or the Plan Stakeholder Committee to use backcasting to establish at least one goal and measureable objective for the primary performance measures: *reduce VMT*, *improvements to number of areas that have reported fatalities and injuries*, *improve travel time reliability*, and *improve speed consistency*.

Methods and Data

First, establish which credits, goals, and objectives to pursue. Then, determine what baseline data is available and collect missing data, if necessary. Establish targets for each of the STARS design years, using existing policy guidance if available.

Case Study: Transportation System Plan for Eugene, Oregon

The City of Eugene is studying its current transportation system and how it could change to better meet the long-term needs of Eugene's residents, businesses, and visitors. The result of this study will be a Transportation System Plan that will include all transportation modes, including freight, pedestrian and bicyclists, personal vehicles, transit, rail networks, airport, and pipelines. The Transportation System Plan will then be included in the city's comprehensive plan (Envision Eugene) as the section dedicated to transportation issues. The plan will look at ways to maintain the extensive infrastructure invested extensive in their street and sidewalk/shared path networks and continue to improve the efficiency of their street network.

Early in the planning process, The City of Eugene recruited a diverse stakeholder group, the Transportation Community Resource Group (TCRG), to review, evaluate, discuss and comment on project information throughout the project. The TCRG will develop recommendations for the project management team and, ultimately, City Council consideration.

Photo: CH2MHill

The City of Eugene hosted two sustainability workshops that were consistent with the STARS-Plan Integrated Process Action 2. The first workshop with city staff and other agency partners; the second workshop included participants from the TCRG. In both cases, participants discussed sustainability frameworks that applied to transportation projects, learned how the Triple Bottom Line influenced STARS, and provided feedback on appropriate goals and objectives for the plan.

Photo: Ryan Snyder

Credit Category
Access & Mobility

STARS is designed to support the creation and use of a balanced and efficient transportation system. This means that, over time, roughly the same number of trips would be taken by each of the major modes (walking, bicycling, bus and rail transit, carpool and vanpool, and driving alone).

Because, in most parts of North America, driving alone dominates the other modes and leads to an unbalanced transportation system, the STARS Access & Mobility goals are designed to reward improvements to, and use of, non-drive alone modes equal to or greater than improvements to driving alone. In most cases numerous capital and programmatic improvements over many years will be required to achieve a balanced transportation system.

1. Increase people's ability to meet most of their daily needs without having to drive	
Objective	Measure
To improve safe, attractive, and affordable access to work, school, goods, and other key destinations by walking, bicycling, and transit	% of population within a x-minute walk, bike, or transit trip of key destinations VMT
2. Improve the convenience and quality of walk, bicycle, transit, car/vanpool, and freight trips	
Objective	Measure
A. To improve travel time reliability and speed consistency between key origins and destinations for transit, car/vanpool trips, and freight trips	Travel time reliability
	Speed consistency
B. To improve travel time and/or reliability for pedestrian and bicycle trips between key origins and destinations	Travel time
	Travel time reliability
C. To improve the quality of walk, bicycle, car/vanpool, and transit trips	MMLOS grade
	Address user survey

Table 2: Access & Mobility Credit Summary

Access & Mobility Goal 1

Increase people's ability to meet most of their daily needs without having to drive	
Objective	**Measure**
To improve safe, attractive, and affordable access to key destinations by walking, bicycling, and transit	% of population within a x-minute walk, bike, or transit trip of key destinations
	VMT

***Surrogate Measure**: If VMT is not available, mode share and route directness could substitute.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Objective		
% of population within a x-minute walk, bike, or transit trip of key destinations	5- 10	
	20 - 25	
	Year 2050	
VMT	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Photo: Dan Burden

Discussion
The first measure, *% of population within a x-minute walk, bike, or transit trip of key destinations*, reflects how well the community meets the concept of the "20-minute neighborhood," a term used by Portland's Bureau of Planning and Sustainability[6] and also discussed at the City of Eugene. The 20-minute neighborhood is a neighborhood where residents are able to meet their daily needs within a 20-minute walk of their home.

[6] Portland Bureau of Planning and Sustainability's 20-minute neighborhood map

Twenty minutes was picked as a reasonable distance that people would be willing to travel, and approximates a ½ mile walking distance. Creating a 20-minute (more or less) neighborhood requires mixed-use development such that residences live near the services they need and a well-connected transportation network. STARS users may choose a different timeframe, such as a five-minute or 30-minute neighborhood, and may also choose what percentage of the population lives within this neighborhood boundary. In both cases, users must justify their decisions using the Triple Bottom Line criteria.

The second measure, reducing vehicle miles traveled, is one of the most important goals for a community to achieve. Reducing VMT can produce numerous economic, environmental and social benefits, including:

- Keeping money in the local economy by reducing fuel expenditures for system users as they need to drive less;
- Improving health by increasing physical activity through more walk, bike and transit trips;
- Reducing climate pollution and improving air quality;
- Supporting a better mix of nearby jobs, housing, schools, parks and shopping.

VMT measures a reduction in driving, and embedded in it are several factors: it means people are using a different mode/taking fewer driving trips, are not taking the trip, and that they are taking shorter trips (presumably largely because of the proximity of attractive destinations). Restated as measures, it represents a shift in *mode share* and improved *route directness*, and *improved proximity* to destinations. (Embedded in mode share is the quality of the network – a result of improved network quality is an increase of mode share). It could be one of those factors, or a combination of all three. A problem with VMT is that if it is a reflection of only one of those factors, it may not necessarily represent improved access. VMT also has a number of assumptions built into it, from a modeling perspective.

> "The STARS framework will provide the strategic tools to rethink how we design, build and operate transportation projects. The challenges inherent in addressing climate change, improving access and economic goals are huge, but if we succeed – the rewards are even greater."
>
> *-George Dondero*
> *Santa Cruz County Regional Transportation Commission*

If VMT data are not available, agencies can use mode share plus route directness. Active mode share is a lagging indicator that measures an outcome; that is, the actual number of people walking, bicycling, and taking transit (versus a measurement of the conditions that encourage walking). Mode share can be difficult to model.

Route directness measures a trip as the crow flies versus the actual route available to reach the destination. This measure accounts not only for network connectivity, but also connectivity as it relates to destinations.

Access & Mobility Goal 2

Improve the convenience and quality of walk, bicycle, transit, and car/vanpool trips	
Objective	Measure
A. To improve travel time reliability and speed consistency between key origins and destinations for transit, car/vanpool trips, and freight trips	Travel time reliability
	Speed consistency
B. To improve travel time and/or reliability for pedestrian and bicycle trips between key origins and destinations	Travel time
	Travel time reliability
C. To improve the quality of walk, bicycle, car/vanpool, and transit trips	MMLOS grade
	Address user survey

***Surrogate Measure**: For objective A, if data does not exist for reliability, measures for incidents or non-recurring congestion (clearance time, incident response time) may substitute. If speed consistency data are not available, person-hours of delay may substitute.*

Caltrans' Performance Measures for Rural Transportation Systems indicate that most agencies will have a Travel Demand Model that will account for travel times, speeds, and delay. Note that this will be further developed in Phase 2 of STARS-Plan.

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Objective A		
Travel time reliability	5- 10	
	20 - 25	
	Year 2050	
Speed consistency	5- 10	
	20 - 25	
	Year 2050	
Objective B		
Travel time	5- 10	
	20 - 25	
	Year 2050	
Travel time reliability	5- 10	
	20 - 25	
	Year 2050	
Objective C		
Multimodal Level-of-Service (MMLOS)	5- 10	
	20 - 25	
	Year 2050	
Address user survey	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
Travel time and travel time reliability are two measures that reflect improved convenience of trips. From the Caltrans' *Smart Mobility* report, multimodal travel reliability is described as "predictability of travel time for users of all modes, allowing for routine differences based on time and day." Speed consistency is the consistent speed of the trip (fewer starts and stops).

Photo: Charlie Zegeer

Regarding reliability and speed consistency (objectives A and B), objectives and forecasts should recognize and evaluate that non-recurring congestion often creates as much or more delay than recurring congestion and can often be reduced more quickly and more cost effectively than recurring congestion, significantly improving trip reliability and speed consistency. For more information, see Chapter 3: Strategies and Resources (TBD).

Network Quality
A number of factors can influence the quality of the network, including the presence of sidewalks, street trees, benches, and lighting (objective C). The 2010 Highway Capacity Manual has updated level-of-service inputs for multiple modes (see Table 3 below). While these multimodal level-of-service (MMLOS) factors are improved over past years, they do not fully encompass the factors that produce a sense of comfort and safety for pedestrians and bicyclists. Other methods may substitute.

Bicycle Level of Service	Pedestrian Level of Service
ADT – Traffic volume	ADT – Traffic volume
Directional, Peak-to-Daily, and Peak Hour Factors	Directional, Peak-to-Daily, and Peak Hour Factors
Number of through lanes	Number of through lanes
Speed limit	Traffic speed
Percentage of traffic that is heavy vehicles	Buffer width
Surface conditioning rating	Sidewalk width
Width of outside lane	Width of outside lane
On-street parking permitted, percentage occupied	On-street parking permitted, percentage occupied
Pavement width to the right of the outside lane stripe	Pavement width to the right of the outside lane stripe
Parking width (to right of bike lane)	Existence and spacing of street trees

Table 3: Multimodal LOS factors

Note that MMLOS includes speed for both bicycle and pedestrian inputs. Speed is a critical issue for a sense of comfort, but also for safety, which is addressed in the Safety & Health credit below.

Another way to approach improving the quality of the transportation network is to ask the users where they feel improvements are needed. Integrated Process requires a user survey, where users describe what access barriers they face, where they feel unsafe, or make suggestions for improvements. STARS users must document how they have addressed concerns in the survey.

Photo: Kelly Rodgers

Credit Category
Safety & Health

In the U.S. in 2009, nearly 34,000 people were killed and over 2.2 million people were injured as a result of traffic crashes. Of those killed, over 4,000 were walking and 630 were riding a bicycle. Of those injured, 59,000 were walking and 51,000 were riding a bicycle.[7] Traffic crash injuries can result in severe and/or permanent health damage, affecting quality of life and at a great cost to individuals and societies; the cost of crashes in the U.S. is about $164 billion per year.[8]

The transportation system affects health every day. A transportation system that supports active transportation modes, such as walking, biking, and taking public transportation, provides many health benefits for individuals and for communities. Auto-oriented transportation systems are associated with low physical activity rates; physical inactivity costs the U.S. up to $76 billion a year.[9] In contrast, increasing rates of walking, biking, and public transportation use result in lower rates of chronic disease (including cancer, diabetes, stroke, and heart disease) and mortality.[10] In addition, as bicycle and pedestrian trips increase, bicyclists and pedestrians are less likely to be involved in collisions with motor vehicles.[11]

Nationwide, the costs of health impacts from transportation-related air pollutants "is between $40 billion and $64 billion a year."[12] The transportation system also impacts health through exposure to noise and stress, changes in accessibility of food, jobs, school, and other key destinations, and changes in the portion of household budgets spent on transportation and housing.

[7] National Highway Traffic Safety Administration statistics, 2010.
[8] American Public Health Association. (2009). *At the Intersection of Public Health and Transportation*. Washington, DC: American Public Health Association.
[9] American Public Health Association. (2009). *At the Intersection of Public Health and Transportation*. Washington, DC: American Public Health Association.
[10] Lee, V., Mikkelsen, L., Srikantharajah, J., Cohen, L. (2008). *Strategies for Enhancing the Built Environment to Support Health Eating and Active Living*. Oakland, CA: Prevention Institute.
[11] Jacobsen, P.L. (2003). Safety in numbers: More walkers and bicyclists, safer walking and bicycling. *Injury Prevention,* 9, 205--209.
[12] American Public Health Association. (2009). *At the Intersection of Public Health and Transportation*. Washington, DC: American Public Health Association.

1. Improve multimodal safety, especially for the most vulnerable users	
Objective	Measure
To decrease fatalities and injuries for all travel modes. Pedestrian and bicyclists fatalities and injuries will not be higher than their proportion of trips.	Prioritized funding for improvements to areas that have reported fatalities and injuries
2. Improve healthy by increasing physical activity by people using the transportation system	
Objective	Measure
To increase the percentage of walk, bicycle, and transit trips	Mode share
3. Improve air quality	
Objective	Measure
To decrease the quantities of harmful airborne pollutants	Criteria pollutants

Table 4: Safety & Health Credit Summary

Safety & Health Goal 1

Improve multimodal safety, especially for the most vulnerable users	
Objective	Measure
To decrease fatalities and injuries for all travel modes. Pedestrian and bicyclists fatalities and injuries will not be higher than their proportion of trips.	Prioritized funding to areas that have reported fatalities and injuries

***Surrogate Measure**: In the event that fatality and injury data are not available, crash rate data may substitute.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Improvements to number of areas that have reported fatalities and injuries	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Photo: Dan Burden

Discussion
Travel demand models cannot readily predict fatalities and injuries; they are derived from modeling crashes. As such, the STARS measure requires users to make improvements to areas where fatalities and injuries have been reported. Users will determine what type of safety improvements should be made, with community input.

One concern about using this measure is that pedestrian and bicycle injuries are often under-reported, leading to an inaccurate picture of actual safety conditions. Crash data is more readily available, although tends to favor reporting of automobile collisions rather than pedestrian and bicycle crashes. We encourage jurisdictions to increase reporting of bike and pedestrian crashes and injuries.

Speed

Another key issue to improve safety is speed suitability; that is, that streets are designed and speeds are set to maximize multimodal safety and are consistent with the surrounding neighborhood character. In fact, speed is a significant enough factor in safety and perceived safety that STARS users may wish to set an additional goal and objective for reducing vehicle speeds on certain multimodal facilities.

Two considerations for speed suitability are designing streets to their posted speed and setting a design speed that is consistent with neighborhood character – both of which should maximize multimodal safety. They are but address slightly different concerns and are measured differently. The first is making sure that streets are not overbuilt: an example is a street that is designed to handle traffic flow of 55 mph but the posted speed is 35 mph. In this situation, it is likely that speeding will be a problem. See

Figure 8 for an illustration.

Fatalities and injuries clearly impact the "people" part of the triple bottom line. A recent study has demonstrated that fatalities and injuries have an economic impact as well:

"Multiplying the total numbers of reported fatalities and injuries by the estimated costs of a fatality and an injury, the total crash costs in the urbanized (area) … is $299.5 billion. That figure is over three times the cost of congestion for the same year ($97.7 billion) reported in the Texas Transportation Institute's (TTI) annual *Urban Mobility Report*."

- Crashes vs. Congestion: What's the Cost to Society?[12]

The second issue, setting a design speed consistent with neighborhood character, is deciding if the design speed is appropriate for the land uses, goals for and character of the area. Is it appropriate to have a street designed for 35 mph when the surrounding land use includes residential development and schools and there is a goal of increasing walking and bicycling?

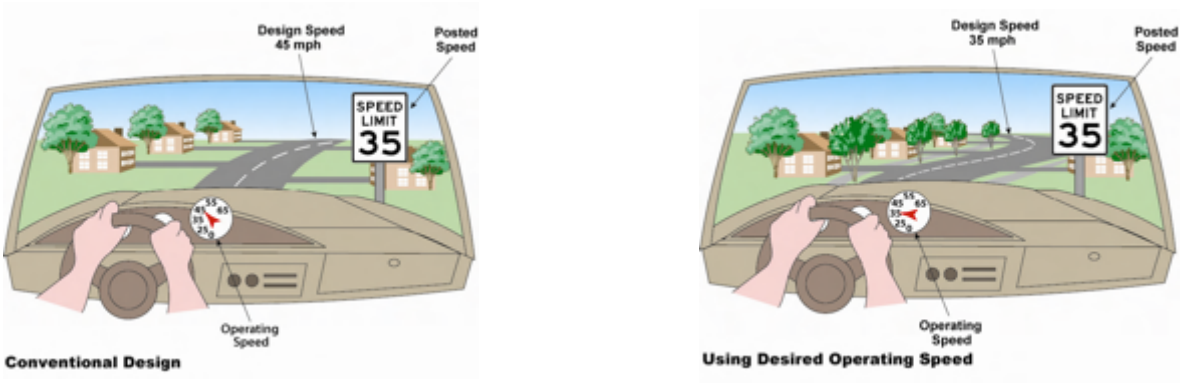

Figure 8: Posted speed, design speed, and operating speed

Source: The Smart Transportation Guidebook

[13] Cambridge Systematics (2011) for AAA. *Crashes vs. Congestion: What's the Cost to Society?*

On this second issue, Caltrans' *Smart Mobility* report challenges the use of "design speed:"

> Smart Mobility strongly suggests altering the conventional use of "design speed" as a means of determining acceptable design features for highways and conventional roadways. Design speed is normally determined almost entirely based on facility type, with deviations permitted only in response to the most extreme alignment constraints. A concept more in keeping with Smart Mobility principles is "speed suitability", which involves:
>
> - Determining a context-sensitive target speed for a new facility or a redesign, taking into consideration the adjoining activities, land use and place type and the multi-modal users of the facility, and
> - Designing the facility to enforce the target speed through physical design features and speed management techniques such as signal coordination.

Most agencies will at least have data on posted speed and average speed, using Caltrans' *Performance Measures for Rural Transportation Systems* guidebook as an indication of data availability.

Safety & Health Goal 2

Improve health by increasing physical activity by people using the transportation system	
Objective	Measure
To increase the percentage of walk, bicycle, and transit trips	Mode share

***Surrogate Measure**: VMT could be used as a surrogate measure if mode share data is not available.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Mode share	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
Active mode share is a lagging indicator that measures an outcome; that is, the actual number of people walking, bicycling, and taking transit (versus a measurement of the conditions that encourage walking). Mode share can be difficult to model. Vehicle miles traveled (VMT) is a similar measure, demonstrating a change from driving to taking other modes (or the trip not taken).

Photo: Dan Burden

Safety & Health Goal 3

Improve air quality	
Objective	Measure
To decrease the quantities of harmful airborne pollutants	Criteria pollutants

***Surrogate Measure**: If criteria pollutant data are not available, vehicle miles traveled and speed consistency (vehicle flow) could substitute since they are contributing factors to air quality conditions.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Criteria pollutants	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
This measure is adapted from the *Smart Mobility* report.

Photo: Dan Burden

Credit Category
Equity

Historically, some transportation investments have unfairly negatively impacted some groups, particularly low-income and minority populations, such as the construction and expansion of freeways through low-income and minority neighborhoods. At the same time, the benefits of transportation investments have not been fairly distributed among all populations, with the majority of transportation funding benefiting those who can afford to purchase and operate private vehicles. Generally, transportation projects have focused on improving travel time and safety for motorists with little regard to other users, although 9% of American households do not have access to a vehicle.[14] People experiencing poverty or language barriers, people of color, older adults, youth, and people with disabilities tend to experience a disproportionately small share of benefits from transportation investments. These groups are overrepresented in households without access to a vehicle. Other elements of the transportation system, such as lack of ADA compliance or safe street crossings also create extra barriers that may prevent these groups from experiencing the full benefit of transportation investments.

For the purposes of this credit, "'Equity' means all people have full and equal access to opportunities that enable them to attain their full potential."[15]

This credit ensures that transportation plans are designed to reduce disparities for transportation-disadvantaged populations and do not negatively impact those populations disproportionately. The objectives include an evaluation of Access & Mobility, Safety & Health, and Economic Benefit across population groups.

[14] 2010 American Community Survey 1 year estimates.
[15] King County, Washington. Ordinance 2010-0509.

1. Reduce disparities in healthy, safe access to key destinations for transportation-disadvantaged populations	
Objective	Measure
Demonstrate that planned investments reduce disparities in access, safety, health, and economic benefit between transportation-disadvantaged and non-transportation-disadvantaged populations	Percentage of plan spending on projects and programs in areas of key origins and destinations for transportation-disadvantaged populations
2. Demonstrate that planned investments do not disproportionately impact transportation-disadvantaged populations	
Objective	Measure
Demonstrate that transportation investments do not disproportionately impact transportation-disadvantaged populations from the construction or operation of the project	Transportation-related criteria pollutants
	Travel time reliability
	Traffic noise exposure

Table 5: Equity Credit Summary

Equity Goal 1

Reduce disparities in healthy, safe access to key destinations for transportation-disadvantaged populations	
Objective	**Measure**
Demonstrate that planned investments reduce disparities in access, safety, health, and economic benefit between transportation-disadvantaged and non-transportation-disadvantaged populations	Percentage of plan spending of projects and programs in areas of key origins and destinations for transportation-disadvantaged populations

***Surrogate Measure**: None.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Locations of projects and programs in areas of key origins and destinations for transportation-disadvantaged populations.	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
For Plan, users must demonstrate that the project list reduces disparity. (In STARS-Project, the objective is to ensure equitable benefits of access, safety, health, and economic benefit of the project). Demonstrating a reduction in disparity is by shown by selecting projects and programs in areas where transportation-disadvantaged populations live, work, shop, and other areas (i.e., key origins and destinations).

Photo: Trailnet

Equity Goal 2

Demonstrate that planned investments do not disproportionately impact transportation-disadvantaged populations	
Objective	Measure
Demonstrate that transportation investments do not disproportionately impact transportation-disadvantaged populations from the construction or operation of the project	Transportation-related criteria pollutants
	Travel time reliability
	Traffic noise exposure

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Transportation-related criteria pollutants	5- 10	
	20 - 25	
	Year 2050	
Travel time reliability	5- 10	
	20 - 25	
	Year 2050	
Traffic noise exposure	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
As required under the Integrated Process credit, STARS users will need to identify transportation-disadvantaged populations in the plan so they can identity how transportation investments affect them.

Travel time reliability should be calculated for multiple modes, and especially for transportation-disadvantaged populations.

Note that one area of impact that has historically been borne upon transportation-disadvantaged populations is poor air quality resulting from the operations of transportation systems. This issue is addressed under Safety & Health Goal 3.

Photo: Kelly Rodgers

Credit Category
Economic Benefit

1. Re-invest in the local economy	
Objective	Measure
To reduce expenses from fuel consumption and related vehicle use	VMT/ dollars
	Speed consistency
2. Improve economic access	
Objective	Measure
To provide practical and convenient access to employment centers by multiple modes	% of population within a 30-minute trip, by mode
3. Improve travel time reliability and speed consistency for high-value trips	
Objective	Measure
To improve travel time reliability and speed consistency for freight between representative origins and destinations	Travel time reliability
	Speed consistency

Table 6: Economic Benefit Credit Summary

Economic Benefit Goal 1

Re-invest in the local economy	
Objective	Measure
To reduce expenses from fuel consumption and related vehicle use	VMT/ dollars
	Speed consistency

***Surrogate Measure**: If speed consistency data are not available, person-hours of delay may substitute.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
VMT	5- 10	
	20 - 25	
	Year 2050	
Speed consistency	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.


Photo: Dan Burden

Discussion
Local economies benefit from less driving as money that would have been spent on fuel is available for other investment in the local economy. In addition, there is a financial benefit to the individual, who has more money to spend (or save) by not spending it on fuel and other vehicle-related expenses. Reducing fuel consumption is a result of reduced vehicle miles traveled and increased speed consistency (optimized vehicle flow).

Reducing vehicle miles traveled is one of the most important goals for a community to achieve. Reducing VMT can produce numerous economic, environmental and social benefits, including:

- Keeping money in the local economy by reducing fuel expenditures for system users as they need to drive less;
- Improving health by increasing physical activity through more walk, bike and transit trips;
- Reducing climate pollution and improving air quality;
- Supporting a better mix of nearby jobs, housing, schools, parks and shopping (sometimes described as "20 minute neighborhoods").

A vehicle miles reduction will translate to dollars re-invested in the local community (the "Green Dividend"). When Phase 2 of STARS-Plan is developed, the methodology for the green dividend will be applied so that STARS users can provide a VMT reduction measure and associated dollar amount.[16]

[16] The Green Dividend report is available from the CEOs for Cities website: http://www.ceosforcities.org/work/portlands_green_dividend

Economic Benefit Goal 2

Improve economic access	
Objective	Measure
To provide practical and convenient access to employment centers by multiple modes	% of population within a 30-minute trip, by mode

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
% of population within a 30-minute trip, by mode	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
This goal addresses how accessible employment centers are to the workforce by different modes of transportation.

Economic Benefit Goal 3

Improve travel time reliability and speed consistency for high-value trips	
Objective	Measure
To improve travel time reliability and speed consistency for freight between representative origins and destinations	Travel time reliability
	Speed consistency

Surrogate Measure: *If data does not exist for reliability, measures for incidents or non-recurring congestion (clearance time, incident response time) may substitute. If speed consistency data are not available, person-hours of delay may substitute.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Travel time reliability	5- 10	
	20 - 25	
	Year 2050	
Speed consistency	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Caltrans' *Performance Measures for Rural Transportation Systems* indicate that most agencies will have a Travel Demand Model that will account for travel times, speeds, and delay. Note that methods will be further developed in Phase 2 of STARS-Plan.

Discussion
From the *Smart Mobility* report, multimodal travel reliability is described as "predictability of travel time for users of all modes, allowing for routine differences based on time and day." Speed consistency is the consistent speed of the trip (fewer starts and stops). This objective includes reliability and consistency for freight.

Photo: Kelly Rodgers

Credit Category
Cost Effectiveness

STARS objectives reflect the overarching perspective that providing people attractive, affordable and more efficient travel by modes (e.g., transit, bicycle, walking) as options to driving alone is desired. These objectives can potentially be achieved in various ways, some of which would be more efficient than others. Thus, the purpose of this cost-effectiveness analysis credit is to encourage applicants to achieve the requirements of the credits *cost effectively* (i.e., so that the cost per unit of benefit for the proposed transportation investment is low relative to that cost for alternative transportation investments). Since the desired performance outputs of a transportation investment are measured as part of other credits, the technical focus of this credit is on *cost*: how it is defined, measured, and incorporated into a cost-effectiveness analysis credit.

Fundamental to the STARS philosophy and objectives is the belief that people making transportation investment decisions (1) should understand that current methods for evaluating and selecting transportation projects and program sometimes fail to consider well or entirely some important impacts of those projects, both positive ones (benefits) and negative ones (costs), and (2) should make better attempts to identify, measure, and consider those impacts.

It should be noted that getting the best regional transportation system of facilities and programs is *not a cost-minimization problem*; it is an optimization problem that requires balancing user benefits against user costs. In making choices about behavior, and about the purchase and consumption of goods and services, people are rarely trying to minimize cost—they are trying to optimize value (the best mix of benefit and cost).

1. Optimize benefits over the life-cycle of the project	
Objective	Measure
To optimize benefits relative to public, private, and social costs over the plan's time horizon	Compare benefits (e.g., reduced VMT, improve speed consistency) to costs
2. To prioritize the enhancement and maintenance of the existing system over system expansion	
Objective	Measure
A. Street network: 1. To maintain pavement condition on roadways to 75%	Pavement condition
2. Demonstrate cost of routine maintenance to useful life vs. cost of deferred maintenance	Routine costs Deferred maintenance costs

B. Transit: 1. To maintain average asset age no more than 50% of the useful life	Average asset age
2. To maintain average distance between service calls of 8,000 miles	Service calls

Table 7: Cost Effectiveness Credit Summary

Cost Effectiveness Goal 1

1. Optimize benefits over the life-cycle of the project	
Objective	Measure
To optimize benefits relative to public, private, and social costs over the plan's time horizon	Compare benefits (e.g., reduced VMT, improve speed consistency) to costs

Surrogate measure: *Agencies should collect as much of the data listed below as possible.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
This goal is adapted from STARS-Project's Cost Effectiveness Evaluation. In Phase 2 of STARS-Plan, the methodology will be adapted to transportation plans. For reference, the STARS-Project Cost Effectiveness Evaluation includes the following in its requirements:

1. Create the cost denominator for measures of cost effectiveness. For STARS the cost denominator has three components: (1) monetary life-cycle costs for the public sector (planning, design, construction, operation, maintenance, preservation, decommissioning), (2) out-of-pocket private costs for use of the facility (primarily vehicle, fuel, maintenance, and insurance for cars, trucks, and bikes, and fares for transit), and (3) the estimated monetized cost of changes in carbon dioxide (CO_2).

2. Import the Access and Carbon numerators from work done on the STARS credits. The guidance for the Access & Mobility, Safety & Health, and Climate Pollution & Energy Use credits describe how to create the performance measures for these topics that can serve as the numerators of the cost-effectiveness measures.

3. Create the cost-effectiveness measures. Use the data from steps 1 and 2.

Cost Effectiveness Goal 2

To prioritize the enhancement and maintenance of the existing system over system expansion	
Objective	Measure
A. Street network: 1. To maintain pavement condition on roadways to 75%	Pavement condition
2. Demonstrate cost of routine maintenance to useful life vs. cost of deferred maintenance	Routine costs Deferred maintenance costs
B. Transit: 1. To maintain average asset age no more than 50% of the useful life	Average asset age
2. To maintain average distance between service calls of 8,000 miles	Service calls

***Surrogate Measure**: Caltrans' Performance Measures for Rural Transportation Systems guidebook indicates that a pavement management system or pavement condition index is data most agencies will have. SCCRTC indicates that they have the following relevant data: Maintenance Backlog and Pavement Management Index.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Pavement condition (streets)	5- 10	
	20 - 25	
	Year 2050	
Routine costs vs. deferred maintenance costs (streets)	5- 10	
	20 - 25	
	Year 2050	
Average asset age (transit)	5- 10	
	20 - 25	
	Year 2050	
Service calls (transit)	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
This goal should address the on-going need to keep the existing system in good condition. Maintenance backlogs and pavement management address existing system condition.

These objectives are adapted from San Francisco's *Performance Assessment Report*. This report, which assesses progress made on their Transportation System Plan, and describes the methodology and data for their asset management measures, and how those measures relate to funding decisions (see page 40 of the document).

Photo: Laura Sandt

Credit Category
Climate & Energy

The STARS-Plan goals and objectives focus on three areas to reduce climate pollution and energy use. They are described in the table below. All of these objectives are important. Although vehicles are becoming more fuel efficient, the *Growing Cooler* report published in 2007 suggests that the benefits of these technological improvements are likely to be offset by growing VMT.[17] Implementing strategies to reduce trip length and the need to rely on vehicles for transport for many trips will be a crucial factor in reducing GHG emissions related to transportation.

Reduce greenhouse gas emissions and fossil fuel consumption	
Objective	Measure
A. To reduce fuel consumption	VMT
B. To improve speed consistency between origins and destinations, by multiple modes	Speed consistency
C. To reduce fossil fuel use for operations	Fuel consumption

Table 8: Climate & Energy Credit Summary

[17] "Growing Cooler: The Evidence of Urban Development and Climate Change," Reid Ewing, et al, 2007.

Climate & Energy Goal

Reduce greenhouse gas emissions and fossil fuel consumption	
Objective	Measure
A. To reduce fuel consumption	VMT
B. To improve speed consistency between origins and destinations, by multiple modes	Speed consistency
C. To reduce fossil fuel use for operations	Fuel consumption

Surrogate Measure: *If speed consistency data are not available, person-hours of delay may substitute.*

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
VMT	5- 10	
	20 - 25	
	Year 2050	
Speed consistency	5- 10	
	20 - 25	
	Year 2050	
Fuel consumption	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
VMT and speed consistency are cross-cutting measures. In addition to Climate & Energy, they also relate to Access & Mobility and Economic Benefit. Objective (C) is intended as a measure for operations, encouraging energy conservation or renewable energy strategies.

Speed consistency is also important. Improving speed consistency (traffic flow) can reduce vehicle acceleration and deceleration, which in turn improves fuel efficiency, reduces greenhouse gas (GHG) emissions, and has the added benefit of potentially reducing crashes.
While improving overall traffic flow and vehicle operations may reduce GHG emissions and generally improve safety, the "speed profile," or variety of operating speeds at different locations in the corridor, or under different traffic conditions, can also increase or decrease GHG emissions and fossil fuel consumption. The optimal speed profile for reducing braking and acceleration and improving fuel efficiency is called *speed efficiency*.

Improving speed consistency can also be a double-edged sword, by inducing more and longer trips. Thus, design considerations include:

- Reduce stop and go traffic to improve network flow and maintain consistent speeds that optimize overall vehicle fuel economy. Traffic calming measures (i.e. roundabouts, signal prioritization, etc.) that reduce stop and go traffic on local road networks can increase fuel economy, as might "Active Traffic Management" systems which modify traffic operations to maintain flow, while maintaining consistent speeds on highways can also achieve optimal fuel economy and lower levels of CO2 emissions per mile;[18]
- Build improvements that encourage use of alternative modes by improving travel speed consistency for carpools, transit, and non-vehicular modes. Historically, when transit travel times for a given trip origin and destination are 10 minutes or 25 percent or more above driving alone, (all other factors being equal), transit mode shares tend to be low;
- Reducing the impact of crashes and other non-recurring congestion;
- Improve travel predictability without inducing additional or longer drive-alone vehicle trips.

Finally, STARS-Plan asks users to consider reducing a project's long-term energy consumption by incorporating on-site renewable energy strategies or strategies that improve energy efficiency (objective C). These strategies can help achieve the overall greenhouse gas (GHG) reduction goal of the plan.

[18] U.S. Department of Transportation. Transportation's Role in Reducing U.S. Greenhouse Gas Emissions. 2010. http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf. Accessed June 17, 2010.

Photo: City of Portland

Credit Category

Ecological Function

1. Improve or avoid habitat	
Objective	Measure
A. To avoid or minimize impacts to local, state, or federally defined sensitive areas	Amount and quality of area
B. To improve habitat in and adjacent to the right-of-way	Amount and quality of habitat
B. To increase the tree canopy in rights-of-way	Tree canopy
2. Improve water quality and stream flows	
Objective	Measure
To manage and treat stormwater volumes and flow on-site through LID practices	Post-development conditions relative to pre-development conditions

Table 9: Ecological Function Credit Summary

Ecological Function Goal 1

1. Improve or avoid habitat	
Objective	Measure
A. To avoid or minimize impacts to local, state, or federally defined natural areas	Amount and quality of area
B. To improve habitat in and adjacent to the right-of-way	Amount and quality of habitat
C. To increase the tree canopy in rights-of-way	Tree canopy

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Amount and quality of area	5- 10	
	20 - 25	
	Year 2050	
Amount and quality of habitat	5- 10	
	20 - 25	
	Year 2050	
Tree canopy	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.


Photo: Kelly Rodgers

Discussion
This goal suggests that STARS users prioritize transportation investments that produce ecological function benefits, including habitat restoration. Strategies to achieve this include pursuing joint projects with other agencies, such as other departments responsible for watershed health, stormwater management, and habitat restoration.

Objective A asks STARS users to avoid sensitive areas, as defined by local, state, and federal agencies.

Objective B asks STARS users to look for opportunities to improve habitat in the right-of-way (e.g., "green streets") or adjacent to the right-of-way. An example of the latter is a transportation agency building a bicycle

trail adjacent to a stream and coordinating with the watershed/habitat/park agency to perform restoration work.

Increasing the tree canopy, Objective C, has a number of co-benefits besides improving habitat, particularly for birds, in the right-of-way. Increasing the tree canopy reduces the urban heat island effect – where urban areas have higher temperatures due to the amount of dark surfaces. Additionally, trees help intercept rainwater and mitigate stormwater runoff. Street trees also improve the character of the pedestrian environment, helping to create a buffer from traffic on roadways and even more simply, providing cover for pedestrians. Street trees have also been known to improve property values.

Ecological Function Goal 2

Improve water quality and stream flows	
Objective	Measure
To manage and treat stormwater volumes and flow on-site through LID practices	Post-development conditions relative to pre-development conditions

Requirements and Documentation
To be determined. STARS asks users to set targets for each of the design years.

Measure	Design Year	Target
Post-development conditions relative to pre-development conditions	5- 10	
	20 - 25	
	Year 2050	

Methods and Data
To be determined. STARS-Plan recommends using backcasting to establish quantitative and/or qualitative measures that reflect community values on the performance of the transportation system in future years.

Evaluation methods will describe how to evaluate the performance of the plan in meeting the objective. For example, a travel reliability methodology would include specifying which inputs and outputs are required from the travel demand model.

Discussion
STARS users should examine how stormwater requirements are changing. The EPA and the states are evolving the municipal separate stormwater system (MS4) national pollutant discharge elimination system (NPDES) permit process through new rule making and changes to permits issued by states to municipalities. In the past, one of the focus areas of the NPDES MS4 permits was on requiring stormwater *quality* treatment for areas of *new* development. Stormwater *quantity* (flow control) was typically managed by municipalities to reduce flooding by focusing on matching post-development peak flows with pre-development peak flows.

Hydromodification is to alter the hydrology of streams. Transportation systems can change the hydrology of streams by increasing the amount of impervious surfaces, which results in increased volumes of stormwater runoff and increased speed of stormwater runoff (as well as creating increased levels of pollution, including higher temperatures).

The direction of the new NPDES MS4 permits includes requiring treatment for stormwater *quality and quantity* for both *new and redevelopment*, and *retrofits* for *existing* development. The management of stormwater *quantity* goes beyond flood control to also include reducing hydromodification in streams (erosion due to high flows). To reduce hydromodification, stormwater quantity management will shift from focusing on peak flow matching to attempting to match a full hydrograph pre- and post- development (matching both the volume and timing of release of water for a full storm or series of storms). The management of stormwater *quantity* is also seen as a way to reduce overall pollutant loads in stormwater by reducing the total amount of stormwater that is released to streams.

Amount of impervious surfaces was considered as a potential measure, since increased impervious areas are a source of increased stormwater volumes, flow, and pollutant loading. However, there may be cases where a

new street (and impervious surfaces) may improve connectivity, leading to more walk, bicycle, and transit trips – a desired STARS outcome. Other measures considered include *width of street* for similar reasons; a narrower street generates less runoff and often has other co-benefits of reducing speed and improving safety. However, the determinants of street width are numerous, making it a challenging measure to use for stormwater purposes.

Case Study: Neighborhood Greenways, Portland, Oregon

In 2007, the City of Portland adopted a Green Street policy to require and incorporate green street facilities in public and private development, recognizing the multiple policy objectives that green streets achieve, including:

- Handle stormwater on site through use of vegetated facilities;
- Provide water quality and flow control benefits and replenishes groundwater (if an infiltration facility);
- Create attractive streetscapes that enhance neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods;
- Meet broader community goals by providing pedestrian and bicycle safety; and
- Serve as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, main streets, and wildlife habitats.

This green street policy was integrated into the City's Transportation System Plan, as well as other planning documents governing infrastructure development. As a result, when the Portland Bureau of Transportation retrofits streetscapes for pedestrian crossings or traffic diversions, they are also required to manage stormwater, where feasible, to protect the downstream water bodies and pipe infrastructure.

Photo: City of Portland

The green street policy was taken a step further with Neighborhood Greenways. The Portland Bicycle Plan 2030 calls for the Portland Bureau of Transportation to partner with the stormwater agency, the Bureau of Environmental Services, to construct sustainable stormwater facilities along routes where there is a demonstrated need for stormwater retrofits. On other projects, the Bureau of Transportation coordinates with a non-profit organization, Friends of Trees, to promote tree planting along neighborhood greenways.

For more information:
Neighborhood Greenways
Portland Bicycle Plan 2030

Photo: Dan Burden

Credit Category
Community Context

Every community has issues unique to it. The Community Context credit is an open credit for STARS users to include additional goals and objectives that relate to the specific issues of the area. Community Context goals and objectives should demonstrate benefit to all three elements of the triple bottom line.

Goal	
Objective	Measure
TBD by STARS users	
TBD by STARS users	

Table 10: Community Context Credit Summary

Chapter 3: Strategies and Resources

Photo: Xue Liu

Note: STARS-Plan strategies and resources will be developed under Phase 2 of STARS-Plan.

Appendix A. STARS-Plan Framework (Credits, Goals, Objectives, and Measures)

Credit Category	Goal	Objectives	Measures
Access & Mobility	Improve people's ability to meet most of their daily needs without having to drive	To improve safe, attractive, and affordable access to work, school, goods, and other key destinations by walking, bicycling, and transit	% of population within a 30-minute walk, bike, or transit trip of key destinations **VMT**
	Improve the convenience and quality of trips, especially for walk, bike, transit, car/vanpool, and freight	To improve travel time and/or travel time reliability for pedestrian and bicycle trips between key origins and destinations To improve travel time reliability and speed consistency for transit, car/vanpool, and freight trips between key origins and destinations To improve the quality of walk, bicycle, car/vanpool, and transit trips	**Travel time reliability** **Speed consistency** Travel time MMLOS grade Address user survey
Safety & Health	Improve multimodal safety, especially for the most vulnerable users	To decrease fatalities and injuries for all travel modes. Pedestrian and bicyclist fatalities and injuries will not be higher than their proportion of total trips	**Prioritized funding for improvements to areas that have reported fatalities and injuries**
	Improve health by increasing physical activity by people using the transportation system	To increase the percentage of walk, bicycle, and transit trips	Mode share
	Improve air quality	To decrease the quantities of harmful airborne pollutants	Criteria pollutants

Credit Category	Goal	Objectives	Measures
Equity	Reduce disparities in healthy, safe access to key destinations for transportation-disadvantaged populations	To demonstrate that planned investments reduce or eliminate disparities in Access & Mobility, Economic Benefit, Safety & Health between transportation-disadvantaged and non transportation-disadvantaged populations	Percentage of plan spending on projects and programs in areas of key origins and destinations for transportation-disadvantaged populations
	Demonstrate that planned investments do not disproportionately impact transportation-disadvantaged populations	To demonstrate that transportation-disadvantaged communities do not experience disproportionate impacts from transportation construction or operations	Transportation-related criteria pollutants **Travel time reliability** Traffic noise exposure
Economic Benefit	Re-invest in the local economy	To re-invest in the local economy through reducing expenditures on fuel and related vehicle use	**VMT** / dollars **Speed consistency**
	Improve economic access	To increase practical and convenient access to employment centers by multiple modes	% of population within a 30-minute trip by mode
	Improve travel time reliability and speed consistency for high-value trips	To improve travel time reliability and speed consistency for freight between representative origins and destinations.	**Travel time reliability** **Speed consistency**
Cost Effectiveness	Optimize benefits over the life-cycle of the project	To optimize benefits relative to public, private and social costs over the plan's time horizon.	Compare benefits (e.g. reduced VMT, improved travel time reliability) to costs

Bold measures are primary measures

Credit Category	Goal	Objectives	Measures
	To prioritize the enhancement and maintenance of the existing system over system expansion.	To maintain pavement condition on roadways to 75% and demonstrate the cost of routine maintenance vs. deferred maintenance (street network) To maintain average asset age no more than 50% of the useful life and to maintain service calls to an average of 8,000 miles (transit)	Pavement condition Routine maintenance costs Deferred maintenance costs Average asset age Service calls
Climate and Energy	Reduce greenhouse gas emissions and fossil fuel consumption	To reduce fuel consumption To improve speed consistency between origins and destinations, by multiple modes To reduce fossil fuel use for operations	**VMT** **Speed consistency** Fuel consumption
Ecological Function	Avoid or improve habitat	To avoid or minimize impacts to local, state, and federally defined sensitive areas To improve habitat in or adjacent to the right-of-way To increase the percentage of tree canopy in rights-of-way	Amount and quality of area Amount and quality of habitat Tree canopy
	Improve water quality and stream flows	To manage and treat stormwater volumes and flow on-site through LID practices	Post-development conditions relative to pre-development conditions
Community Context	TBD by local agency and community		

Bold measures are primary measures

Appendix B. STARS-Plan Objectives and the Triple Bottom Line

Credit Category	Objectives	Measures	People	Prosperity	Planet
Access & Mobility	To improve safe, attractive, and affordable access to work, school, goods, and other key destinations by walking, bicycling, and transit	% of population within a 30-minute walk, bike, or transit trip of key destinations	**X**	**X**	**X**
		VMT	**X**	**X**	**X**
	To improve travel time and/or travel time reliability for pedestrian and bicycle trips between key origins and destinations To improve travel time reliability and speed consistency for transit, car/vanpool, and freight trips between key origins and destinations To improve the quality of walk, bicycle, car/vanpool, and transit trips	**Travel time reliability**	**X**		
		Speed consistency	**X**	**X**	**X**
		Travel time	**X**	**X**	**X**
		MMLOS grade	**X**		
		Address user survey	**X**		
Safety & Health	To decrease fatalities and injuries for all travel modes. Pedestrian and bicyclist fatalities and injuries will not be higher than their proportion of total trips	**Prioritized funding for improvements to areas that have reported fatalities and injuries**	**X**	**X**	**X**
	To increase the percentage of pedestrian, bicycle, and transit trips	Mode share	**X**	**X**	**X**
	To improve air quality	Criteria pollutants	**X**	**X**	**X**

Bold measures are primary measures

Credit Category	Objectives	Measures	People	Prosperity	Planet
Equity	Demonstrate that planned investments reduce or eliminate disparities in Access & Mobility, Economic Benefit, Safety & Health between transportation-disadvantaged and non transportation-disadvantaged populations	Percentage of plan spending on projects and programs in areas of key origins and destinations for transportation-disadvantaged populations	**X**		
	Demonstrate that transportation-disadvantaged communities do not experience disproportionate impacts from transportation construction or operations, taking into account accumulated impacts	Transoprtation-related criteria pollutants	**X**		**X**
		Travel time reliability	**X**		
		Traffic noise exposure	**X**		
Economic Benefit	To re-invest in the local economy through reducing expenditures on fuel and related vehicle use	**VMT** / dollars	**X**	**X**	**X**
		Speed consistency	**X**	**X**	**X**
	To increase practical and convenient access to employment centers by multiple modes	% of population within a 30-minute trip to employment centers, by mode	**X**	**X**	
	To improve travel time reliability and speed consistency for freight between representative origins and destinations.	**Travel time reliability**	**X**	**X**	**X**
		Speed consistency	**X**	**X**	**X**
Cost Effectiveness	To optimize benefits relative to public, private and social costs over the plan's time horizon.	Compare benefits (e.g. reduced VMT, improved travel time reliability) to costs	**X**	**X**	**X**

Bold measures are primary measures

Credit Category	Objectives	Measures	People	Prosperity	Planet
	To maintain pavement condition on roadways to 75% and demonstrate the cost of routine maintenance vs. deferred maintenance (street network)	Pavement condition		**X**	**X**
		Routine maintenance costs		**X**	**X**
	To maintain average asset age no more than 50% of the useful life and to maintain service calls to an average of 8,000 miles (transit)	Deferred maintenance costs		**X**	**X**
		Average asset age		**X**	**X**
		Service calls		**X**	**X**
Climate and Energy	To reduce fuel consumption	**VMT**	**X**	**X**	**X**
	To improve speed consistency between origins and destinations, by multiple modes	**Speed consistency**	**X**	**X**	**X**
	To reduce fossil fuel use for operations	Fuel consumption	**X**	**X**	**X**
Ecological Function	To avoid or minimize impacts to local, state, and federally defined sensitive areas	Amount and quality of area			**X**
	To improve habitat in or adjacent to the right-of-way	Amount and quality of habitat			**X**
	To increase the percentage of tree canopy in rights-of-way.	Tree canopy	**X**	**X**	**X**
	To manage and treat stormwater volumes and flow on-site through LID practices	Post-development conditions relative to pre-development conditions			**X**

Bold measures are primary measures

Appendix C. STARS-Plan Primary Measures

Measure	Objectives	Goal	Credit Category
VMT	To improve safe, attractive, and affordable access to work, school, goods, and other key destinations by walking, bicycling, and transit Re-invest in the local economy through reducing expenditures on fuel and related vehicle use To reduce fuel consumption	Improve people's ability to meet most of their daily needs without having to drive Re-invest in the local economy Reduce climate pollution and energy use	Access & Mobility Economic Benefit Climate Pollution & Energy Use
Travel time reliability	To improve travel time and/or travel time reliability for pedestrian and bicycle trips between key origins and destinations To improve travel time reliability and consistency for transit, car/vanpool, and freight trips between key origins and destinations To improve travel time reliability and consistency for freight between representative origins and destinations	Improve the convenience and quality of trips, especially for walk, bike, transit, car/vanpool, and freight trips Improve travel time reliability and consistency for high-value trips	Access & Mobility Economic Benefit

Bold measures are primary measures

Measure	Objectives	Goal	Credit Category
Speed consistency	To improve travel time reliability and consistency for transit, car/vanpool, and freight trips between key origins and destinations	Improve the convenience and quality of trips, especially for walk, bike, transit, car/vanpool, and freight trips	Access & Mobility
	To improve travel time reliability and consistency for freight between representative origins and destinations	Improve travel time reliability and consistency for high-value trips	Economic Benefit
	Re-invest in the local economy through reducing expenditures on fuel and related vehicle use	Re-invest in the local economy	Economic Benefit
	To improve speed consistency between origins and destinations, by multiple modes	Reduce greenhouse gas emissions and fossil fuel consumption	Climate Pollution & Energy Use
Prioritized funding for improvements to areas that have reported fatalities and injuries	To decrease fatalities and injuries for all travel modes. Pedestrian and bicyclist fatalities and injuries will not be higher than their proportion of total trips	Improve multimodal safety, especially for the most vulnerable users	Safety & Health

Bold measures are primary measures