September 20, 2010

transit sustainability guidelines

Transit Sustainability Guidelines Working Group
Tian Feng, Chair and Editor
tfeng@bart.gov

Standards Development Committee
American Public Transportation Association

introduction

Designing and operating sustainable transit requires a new way of thinking. For the transit industry to achieve true sustainability, it must take a holistic approach toward what a transit agency can and should contribute.

Improving transit systems' performance and integrating transit with community development is more vital to sustainability than simply reducing the environmental footprint of agency facilities. A transit system can consist of the greenest of earth-friendly, energy-efficient facilities and fleet, but it does little good if it is not used. An empty bus cannot be a sustainable bus. If transit doesn't succeed in integrating with and serving the community, it can be an environmental and economic burden and even a scar upon the landscape.

A holistic practice of transit sustainability leads to a healthier and happier lifestyle and a more livable community. While successfully reducing transportation's environmental footprint, transit agencies around the world have enhanced quality of life by making travel more enjoyable, affordable, and timely. We need to do everything in the realm of sustainability which is within the control or influence of transit agencies. This requires vision and, occasionally radical, innovation.

Sustainability practices by the transit industry should aim at having broader impact through the following:

1. Improving mobility via improved and enjoyable transit services
2. Reducing per capita automobile vehicle mile traveled
3. Reducing passenger transportation-generated CO^2 and other greenhouse gases
4. Creating livable communities through facilitating more environmental friendly forms of mobility such as walking, biking, and public transit. Increasing the number of routine destinations that are accessible safely and comfortably by walking, biking and public transit.

5. Reducing passenger transportation-caused ambient hazards such as noise, particulates in the air, vibration, physical threats, and mental stress to the public in general and particularly to pedestrians.

6. Reducing stress, loss of productivity, and traffic deaths and injuries and related health care costs caused by automobile travel.

The framework and guidelines introduced in this document are designed to lead to the realization of the above sustainability objectives.

document structure

The first four sections of this document are organized to reflect the sequence of creating, operating, and maintaining a transit system and each section recommends action items. Section 5 provides tools to guide implementation of the practices recommended in the first four sections, and section 6 points readers towards a more comprehensive resource.

Transit systems, no matter what the mode, have basic components which vary slightly between transit service providers, and consist of the following four elements:

1. **System Route and Transit Mode/Node**
   - Rail transit operates on track right-of-way (guideway) and fixed station site properties;
   - Bus transit uses shared or dedicated roadways and stops,
   - Ferry transit has routes across designated waterway and accesses terminal ports.

2. **Infrastructure and Facilities**
   - Rail transit's track and right of way requires civil/structural, power, and communication systems, as well as revenue and non-revenue facilities supporting transit operations;
   - Bus transit uses shared or dedicated roadways or guideways and has its own communication system, as well as revenue and non-revenue facilities supporting transit operations;
   - Ferry transit has its own and shared communication systems, and revenue and non-revenue facilities supporting transit operations;

3. **Rolling Stock and Fleet**
   - Rail transit has train (assembly of rail cars) for revenue service and significant amount of non-revenue rail and rubber-tire vehicles supporting maintenance and operations. Heavy rail also has locomotives;
   - Bus transit has buses as well as supporting vehicles;
   - Ferry transit has boats or vessels.

4. **Operations and Maintenance**
    - The unique operating attribute of a transit system is the combination of operating moving parts (fleet), stationary parts (infrastructure and facilities), and the interaction of the two. To effectively develop the practice of sustainability, transit agencies have unique challenges to integrate and optimize holistic operation and maintenance of fleet, infrastructure, and other facilities.

The first four sections each address five key Sustainability Attributes as defined below.

Smart Land Use & Livable Neighborhood: The impacts of transit agencies' planning, design, joint development, and operations policies and programs to local and regional land use, mobility, and place-making.

Materials, Construction/Operations Optimization: Material selection in design, construction, and fabrication of transit system and facilities elements. Also includes policies and programs that promote sustainable operations, as well as durable materials used in facilities construction and products used in operations, such as cleaning products and chemicals.

Energy & Resources Efficiency: Reduce waste in power, fuel, and water consumption. Includes opportunities for energy efficiency and renewable energy.

Quality of Ambient Environment & Health: Positive riding experience, system cleanliness, sense of safety and security ambience, place-making, as well as, easy access and navigation of the transit system.

Emissions & Pollution Control: Emissions and discharges related to fuel, chemical use, solid waste management, waste water, storm water, and other sources of pollution.

The matrix in Figure 1 conceptualizes scale of opportunities for implementing each of the five sustainability attributes in each of the four transit elements. The scale provides an indication that each of the transit elements has its unique potential to maximize opportunities and to achieve results in pursuing each of five sustainability attributes.

Figure 1: Overview of Transit Sustainability

		Sustainability Attributes				
	Implementation Opportunity	Smart Land Use & Livable Neighborhood	Materials & Construction/ Operations Optimization	Energy & Resource Efficiency	Quality of Ambient Environment & Health	Emissions & Pollution Control
Transit Elements	System Route, Transit Mode & Node	***	*	**	***	*
	Infrastructure & Facilities	**	***	**	***	**
	Rolling Stock & Fleet	**	***	**	***	**
	Operations & Maintenance	*	***	**	***	***

Implementation Opportunity:

* Less

** More

*** Most

system route, transit mode & node

The physical siting and the alignment of public transportation routes have a profound impact on urban growth patterns and sustainability potential, more so than any other aspect of transit design. The following guidelines address transportation planning as community building through attention to context.

There are many complex interfaces involved in transit system planning: transit users, transit operators, planning agencies, property owners, and numerous government agencies and community jurisdictions. A framework for the co-development of transit and land use planning will promote compact development patterns, encourage transportation choices, and optimize public interest and investment in the transit line. Furthermore, planning for access and connectivity among all transportation modes, including bicycling and walking, will promote transit as a viable alternative to automobile use.

There are also multiple public health considerations related to System Route, Transit Mode and Node. Safety and physical activity associated with accessing transit can enhance public health, both physical and mental.

These guidelines are aimed at optimizing urban vitality through integrating the transit design and land use planning processes. Transit-oriented development concepts and partnering with local agencies and governments are critical. This integrated, process-oriented approach also introduces performance measures for evaluation criteria established under the FTA “New Starts” program.

A. Smart Land Use & Livable Neighborhood

1.A.1 ☐ Partner with local and regional planning agencies to create transit supportive land use policies

1.A.1.1 Integrate transport and land-use decision-making in all project development

1.A.1.2 Participate in region-wide sustainability planning

1.A.1.3 Develop, in conjunction with the relevant Metropolitan Planning Organization (MPO) or other regional planning organization, an integrated transit/land use plan to reduce the acres of developed land per capita in each community and thereby reduce VMT.

1.A.1.4 During station location planning, assess the built form conditions including ownership and assembly patterns, future growth scenarios and physical impact of alignment on property development.

1.A.1.5 Coordinate with municipal planning staff to audit existing land use codes and develop station area plans to ensure compliance with the “5Ds;” Density, Design, Diversity, Distance to Transit, and Destination Connectivity.

1.A.1.6 Set measurable indicators within the catchment area to influence station performance such as mode split, density, and people per acre for commercial enterprise.

1.A.1.7 Adopt urban design standards for transit agency development that promote community identity. Standards should mitigate the effects of large scale infrastructure through implementation or encouragement of some or all of the following; development at a human scale; appropriate community amenities; distinctive identity features such as historic patterns and buildings; appropriate cultural context; and seamless connections to the surrounding neighborhoods.

1.A.1.8 Incorporate adaptive reuse of historic structures.

1.A.1.9 Carefully consider location of ancillary buildings such as substations, maintenance facilities, etc. in terms of both operational efficiency and urban context.

1.A.1.10 Internal transit agency land use policy should provide protocols for private sector engagement with strategies for partnerships, demonstration and/or catalyst projects to spur desired uses.

1.A.1.11 Mitigate the effects of large scale infrastructure by including incentives for development at a human scale; support of green building practice; provision of high quality and distinctive identity features and support for

seamless and integrated connections to the surrounding neighborhoods.

1.A.1.12 Identify short and long term impacts to adjacent land uses along alignment.

1.A.1.13 Use and adapt Brownfield sites, underutilized sites, and existing rail alignments.

1.A.1.14 Participate in station or transit node area land-use decisions by working with city/community planning, economic development, transportation officials, and relevant stakeholders. Engage in early dialogue in land use policy and planning to align interests, goals, and opportunities.

1.A.2 ☐ Promote partnerships for transit-oriented development

1.A.2.1 Work with jurisdictional partners to identify a set of transit nodes appropriate for focused capital and/or infrastructure improvements.

1.A.2.2 Prioritize station siting options that encourage development of residual lands and provide future flexibility.

1.A.2.3 Develop a framework to engage members of the local/or national development community to proactively steer future development towards station and transit node sites.

1.A.2.4 Demonstrate leadership by seeking regulatory assistance or providing financial assistance for initial transit oriented development projects to catalyze market growth.

1.A.2.5 Where opportunity for new community development exists, integrate appropriate mode of mobility with land use and community development.

1.A.3 ☐ Make livable neighborhoods a center piece of system planning

1.A.3.1 Prioritize alignment and/or station-siting options that will encourage appropriate future development, create place, and catalyze market growth in accordance with overall regional plan.

1.A.3.2 Promote infill development to encourage more compact and walkable urban environments.

1.A.3.3 Make transit stations and associated infrastructure as public destination points in their own right, by understanding user needs to ensure that transit architecture can act as catalyst for the surrounding environment.

1.A.3.4 Provide easy access from transit to dining, shopping, landmarks, special attractions, unique neighborhoods, and everyday services.

1.A.3.5 Use universal design and good wayfinding to make public transport easy to use for all users.

1.A.3.6 Design public spaces along the systems to encourage social interaction.

1.A.3.7 Fund transit projects to include improvements beyond the footprint or ROW of the transit agency to ensure pedestrian connections within local jurisdiction's ROW.

1.A.4 ☐ Integrate transit alignments and nodes into neighborhoods through the use of appropriate scale

1.A.4.1 The faster and greater the capacity of the transit system, the more it should be considered adjacent to, rather than at the center of pedestrian oriented space.

1.A.4.2 Ensure that transit is just one part of the overall public experience by using the scale of transit to fit the grain that exists or that is desired.

1.A.4.3 Lower capacity systems (such as street car and bus systems) may be integrated directly into dense, pedestrian oriented town centers making use of urban rights-of-way.

1.A.5 ☐ Plan for and encourage intermodal connections and transfers, including non-motorized access to transit modes

1.A.5.1 Plan for and optimize non-motorized access to transit nodes by integrating traffic, pedestrian, bicycling, and various forms of transit into a single comprehensive planning approach.

1.A.5.2 Analyze transportation coordination on a range of scales from neighborhood, corridor, and regional planning.

1.A.5.3 Develop performance-based transit node access strategies and design stations with special attention to a walkable urban design context.

1.A.5.4 Develop bike and pedestrian paths along transit alignments.

1.A.5.5 Establish a strong collaboration with the relevant MPO to exert influence on achieving more sustainable modal splits in eacharea of service

1.A.6 ☐ Optimize parking and reduce long term automobile dependence

1.A.6.1 Use market analysis and education to encourage creative parking strategies such as separating the

purchase of parking spaces from residential units near transit, shared parking between residential and commercial development, and reducing the need for overall vehicle ownership through agency support of car sharing organizations.

1.A.6.2 Where necessary, plan station and transit node areas to give private vehicles lower on-street priority than pedestrians in order to optimize transit and pedestrian flow, scale, and quality of experience.

1.A.6.3 Where parking is required to ensure ridership numbers are met, develop strategies to replace parking over a mandated time period with high density development, while ensuring original ridership numbers are maintained.

1.A.6.4 When parking is provided, consider building parking structures and developing remaining surplus land in higher intensity uses. Ensure that station and transit node parking includes alternatives such as vanpool, carpool, and compact spaces.

1.A.6.5 Understand and make use of best practices in Transportation Demand Management and pricing parking fees to make bus, bicycle, and pedestrian access to stations and transit nodes more attractive.

1.A.10 ☐ Engage stakeholders early on in the design and integration process

1.A.10.1 Establish a comprehensive stakeholder engagement process for all new projects.

1.A.10.2 Provide a framework for public input to address the urban design quality of the station/alignment and contribute to area place making.

1.A.10.3 Engage local groups including community development and housing advocacy groups to co-lead planning of station and transit node areas.

1.A.10.4 Ensure that stakeholder group is broad and inclusive – e.g. municipalities, disabled community, seniors, cyclists, pedestrians, cultural groups, business owners, public interest groups, etc.

1.A.10.5 Address infrastructure's impact on neighboring buildings early via community public outreach.

B. Energy & Resource Efficiency

These guidelines are aimed at leveraging alignment and route planning to minimize the overall energy consumption of the transit system.

1.B.1 ☐ Consider energy consumption in mode choice

1.B.1.1 Evaluate energy consumption in overall life cycle costs when selecting a transit mode for a planned alignment. Weigh initial capital cost against cost/energy use of ongoing operations over the planned service life of the system. Consider future trends in energy prices and types of fuel.

1.B.1.2 As a part of early project feasibility assessments, calculate efficiency of the proposed route in terms of speed and energy consumption.

1.B.2 ☐ Design alignment to optimize energy use

1.B.2.1 Identify opportunities to optimize energy use through fundamental decisions about routing, alignment, and track engineering.

1.B.2.2 Seek out and leverage the specific opportunities for energy optimization based on the climate/geographic condition of the transit system.

1.B.3 ☐ Develop partnerships for renewable energy

1.B.3.1 Partner with utility companies, State Dept. of Energy, 'Energy Trusts', and private energy providers in the transmission and distributed generation of electricity.

1.B.3.2 Consider if transit system's right-of-way has opportunities for alternative energy generation such as solar or wind.

1.B.3.3 Investigate other renewable energy sources including geothermal/ground source heating or cooling and cogeneration.

C. Quality of Ambient Environment & Health

These guidelines are aimed at improving overall public health through appropriate transit planning and advocacy.

1.C.1 ☐ Promote healthy modes of transportation

1.C.1.1 Design and locate stations/terminals/stops to promote environmentally friendly and health-promoting modes of transport, such as walking and bicycling.

1.C.1.2 Work with municipalities to provide pedestrian and bike friendly routes, including good visibility, separation

from high-speed vehicular traffic, separation from pollution sources (such as truck routes), and shade where appropriate. Connect pedestrian and bike paths and routes to transit stations or transit nodes.

D. Emissions & Pollution Control

These guidelines are aimed at controlling emissions and pollution generated by transit systems while improving their performance, and at reducing potential emissions and pollution by others through increasing ridership of efficient transit service.

1.D.1 ☐ Evaluate long-term impact of modal choices

1.D.2 ☐ Design to minimize noise and vibration

1.D.2.1 When possible, utilize grade separated solutions thereby maximizing speed, efficiency, and capacity of the transit system.

1.D.2.2 Grade separate transit alignments where feasible in order to reduce impacts of transit at pedestrian level. Grade separation will also permit the more efficient flow of transit, automobile, truck, and other transit and rail traffic, potentially reducing emissions due to unnecessary idling and more optimal travel speeds.

1.D.2.3 Where grade separation is not possible, choose routes to optimize both ridership and travel time. Shifting a route by a block or two may have a large effect on both.

1.D.2.4 Optimize frequency and location of bus stops to minimize impact of noise and emissions at street level.

1.D.2.5 Consider underground alignment as one means of helping control noise and vibration near sensitive land uses such as hospitals and residences.

2 infrastructure & facilities

This section includes guidelines for planning, design, and construction of all physical elements (excluding fleet). Stations, transit nodes, terminals, supporting facilities and systems, and corridors are addressed.

> "Green buildings make efficient and effective use of resources – energy, water, raw materials, and land – and provide a healthy environment for working, playing, learning and living. By applying green building practices to new construction and refurbishment of existing facilities, transit agencies can conserve resources through lower construction, operations, and maintenance expenditures."
>
> *-FTA*

FTA, in its Transit Green Building Action Plan, published in July of 2009, identifies several green building rating and analysis systems that provide trusted framework for planning and execution of sustainable rehabilitation and construction: USGBC LEED™, UK BREEAM, Green Building Initiative's Green Globes, US DOE and EPA's Energy Star, and ASHRAE. Integrated design of facilities and infrastructure shall follow the core concepts and principles as well as strategies outlined in the existing green building rating systems as applicable.

A. Smart Land Use & Livable Neighborhoods

2.A.1 ☐ Integrate transit facilities with neighborhood design along system route

2.A.1.1 Design transit stations and facilities in aesthetic, historic and functional accord with the surrounding community. Conduct, where applicable, community charrette to engage the neighborhood.

2.A.1.2 Provide safe patron seating areas, weather protection, information, route maps and directional signage to

promote connectivity between transit modes and transit operators.

2.A.1.3 Provide bike racks and bike lockers.

2.A.1.4 Provide for bike repair and rental businesses.

2.A.1.5 Design trackways as greenways to improve environment, and reduce noise and heat island effects.

B. Materials & Construction / Operations Optimization

These guidelines are aimed at improving the sustainability of material elements unique to transit infrastructure and facilities. Materials traditionally considered environmentally preferable are not always best for transit systems. However, green building rating systems reference numerous sources for material selection that achieve both environmental and performance objectives.

2.B.1 ☐ Design for service life, quality, durability and flexibility

2.B.1.1 Select materials with environmentally and economically superior service lives when designing core infrastructure (75 years for LRT and 100 years for HRT).

2.B.1.2 Aim to avoid materials with suspected negative environmental health effects likely to be regulated within their service life (i.e. “low VOC” by USGBC definition).

2.B.1.3 Design for flexibility, including system expansion, increases in ridership, and alternative uses of supporting facilities.

2.B.1.4 Ensure that materials used in the construction of transit structures are scaled and detailed appropriately for urban communities, e.g. detailed for weather resistance, provide visual interest at pedestrian level, permit passage of light.

2.B.2 ☐ Design for material applicability and low maintenance

2.B.2.1 Ensure quality of experience for the transit user by investing in the correct materials to suit the transit mode application.

2.B.2.2 Choose materials that are easily maintainable but high quality for customers for transit stations, transit nodes, terminals, stops, and supporting facilities. Ensure that materials used in the construction of transit structures are long lasting and easily maintained to maintain functionality and the visual quality of the urban environment.

2.B.2.3 Aim to avoid materials with complicated repair, removal and disposal requirements for health and safety, air quality, and waste management.

2.B.3 ☐ Select materials with low embodied energy (i.e. local, recycled, recyclable)

2.B.3.1 Incorporate recycled materials into transit projects when transit-specific requirements are met – longevity, durability, low-maintenance, etc. Favor post-consumer recycled content.

2.B.3.2 Favor materials that can be further reused within transportation system or recycled at the end of their useful life within transportation system.

2.B.3.3 Favor materials which require minimal energy to produce high performance.

2.B.3.4 Favor materials that do not involve excessive transportation at any stage of their lifecycle (i.e. “local” materials by USGBC definition).

2.B.3.5 Favor rapidly renewable materials components (i.e. “rapidly renewable” materials by USGBC definition).

2.B.3.6 Engage in local material exchange program (such as WasteMatch)

2.B.4 ☐ Incorporate innovative sustainable construction practices

2.B.4.1 Refer to applicable green building rating system strategies and documentation for sustainable construction methodologies.

2.B.4.2 Develop a checklist of construction practices that are environmentally friendly, and can be utilized during various project phases.

2.B.4.3 Maximize use of existing infrastructure and facilities and/or components.

2.B.4.4 Seek local feedback from construction organizations and local construction firms.

2.B.4.5 Incorporate prefabricated components, both unique to transit and generally available.,

2.B.4.6 Get more information on local regulations to clarify opportunities for innovative construction practices.

2.B.4.7 When excavating, explore opportunities to utilize excavated materials on-site instead of hauling away.

C. Energy & Resource Efficiency

These guidelines are aimed at improving the energy efficiency of infrastructure and facilities that are unique to transit. Where appropriate, the guidelines address specific modes, including bus and rail.

To lower energy consumption and carbon footprint of infrastructure and facilities, the following groups of methods should be explored for applicability and feasibility at the design phase of all new construction and rehabilitation projects: energy harvesting, energy conservation and recovery, energy efficiency, and on-site generation (to avoid transmission losses and/or provide renewable energy). Water efficiency measures found in Section 2E also contribute to energy and resource efficiency. Green building rating systems can provide good framework for achieving and measuring of energy efficiency endeavors.

2.C.1 ☐ Energy Harvesting

- **2.C.1.1** Plan facilities to reduce energy consumption during the design phase, as the size and placement of station facilities also affects energy consumption.
- **2.C.1.2** Consider alignment design with humped track at stations to aid acceleration and deceleration.
- **2.C.1.3** Orient and design above-ground facilities to take advantage of prevailing winds and maximize use of natural ventilation to replace or augment mechanical ventilation.
- **2.C.1.4** Orient and design aboveground facilities to maximize use of natural lighting to replace or augment electrical lighting with help of photo-sensors. Consider use of tubular daylighting delivery into underground spaces.
- **2.C.1.5** Consider incorporation of solar thermal systems to replace or augment fuel-based space and water heating.
- **2.C.1.6** Consider incorporation of passive solar systems to replace or augment fuel-based space heating (i.e. SolarWall technology).
- **2.C.1.7** Consider incorporation of ground-source heat pump systems to replace or augment fuel-based space heating and cooling.

2.C.2 ☐ Energy Conservation and Recovery

- **2.C.2.1** Use Heat Recovery Units (aka Energy Recovery Ventilators) to provide heating and cooling.
- **2.C.2.2** Design fenestration and shading to avoid unwanted solar gain (i.e. use low-e glass, external light shelves).
- **2.C.2.3** Design facilities with increased wall and roof insulation, including vegetative roof.

2.C.2.4 Use motion sensors to minimize idle lighting.

2.C.2.5 Use air-quality sensors and variable-frequency ventilators to adjust air-exchange.

2.C.2.6 Use rapid roll-up doors to minimize losses of conditioned air in maintenance and repair facilities.

2.C.2.7 Consider process heat recovery for domestic hot water.

2.C.2.8 Incorporate for light and temperature controls at facilities' offices.

2.C.2.9 Minimize right-of-way electrical transmission losses through optimized substation spacing.

2.C.2.10 Minimize right-of-way transmission losses through use of a better conductive material for contact rail or catenaries (i.e. aluminum/aluminum composite third rail).

2.C.2.11 Employ regenerative braking systems on the trains to capture energy from braking vehicles and feed it back into the power distribution system for use by adjacent trains. Alternatively, regenerated power can be stored in wayside storage systems.

2.C.3 ☐ Energy Efficiency

2.C.3.1 Use premium efficiency motors and other equipment.

2.C.3.2 Design for efficient lighting (lumens per watt) as well as task lighting.

2.C.3.3 Consider use of small-scale photovoltaic systems (with/without inverter) for signage, emergency phones, canopy lighting, closed circuit systems, microwave transmitters, and other applications to power small load equipment.

2.C.3.4 Incorporate meters for electrical power in new construction and have intelligent control systems to permit measurement of electricity consumed and promote conservation efforts.

2.C.3.5 Install permanent carbon dioxide monitoring systems that provide feedback on space ventilation performance in a form that affords operational adjustments and energy savings.

2.C.4 ☐ On-Site Generation

2.C.4.1 Consider integration of photovoltaic system to provide electrical power for all or some loads.

2.C.4.2 Consider integration of wind turbines to provide electrical power for all or some loads.

2.C.4.3 Consider integration of co-generation equipment to provide electrical power and heat for all or some demand.

2.C.4.4 Consider integration of fuel cell to provide electrical power for all or some loads as well as some heat for domestic uses.

2.C.5 ☐ Consider innovative approaches to energy usage

2.C.5.1 Utilize electric vehicle connections at stations. Charge cars during off-peak hours.

2.C.5.2 Develop contracts to promote improved energy consumption through cost sharing of demonstrated improvements through innovation.

2.C.6 ☐ Partner with local power utility

2.C.6.1 Ensure early dialogue with local utility when exploring new approaches to energy efficiency, production, and purchasing. Review scope of work with the utility and potential impacts including challenges and benefits. Establish a general understanding of the extent of utility impact. Get support from the utility.

2.C.6.2 Leverage utility's expertise in energy production to produce and/or purchase renewable energy

2.C.6.3 Leverage transit agency's long-term facility ownership.

2.C.6.4 Utilize energy efficiency and renewable energy pilot projects to study effectiveness of possible improvements. Select projects that fit transit capital goals, funding, and budgets.

D. Quality of Ambient Environment & Health

These guidelines are aimed at creating a positive and healthy ambient environment within transit facilities and along transit corridors in order to attract and maintain riders. Ambient environment is considered in three tiers:

- Comfort,
- Health, and
- Safety.

2.D.1 ☐ Enhance security and safety (friendly, safe, and secure for all demographics)

2.D.1.1 Implement Crime Prevention through Environmental Design (CPTED, pronounced sep-ted): a low-tech strategy that encourages people on the street and in neighborhoods to look out for each other. The following

three principles are aimed at reducing fear and incidence of crime and maintaining quality of life:

2.D.1.2 Natural Surveillance: Create an environment that encourages people to observe the spaces around them. Maximize visibility and views of streets and neighborhoods.

2.D.1.3 Natural Access Control: Use strategic placement of entrances, exits, fencing, lighting, and landscaping to control or limit access. Limit access and increase natural surveillance to either keep criminal intruders out or make them more easily marked as intruders.

2.D.1.4 Natural Territorial Reinforcement: Design environment to clearly delineate private space, to create a sense of ownership among neighborhood residents. Design and siting of buildings, fencing, pavement, signs, lighting, and landscape elements can express ownership while defining public, semi-public, and private spaces.

2.D.1.5 Use visible crime prevention elements, such as posting information on security cameras and providing ample and accessible phones.

2.D.1.6 Partner with community to achieve safe walking/biking routes to transit. Achieve high quality streetscapes with wide walk-ways that encourage community use (walking, biking, wheelchair, etc.).

2.D.1.7 Incorporate safe bicycle storage.

2.D.1.8 Develop security plans for transit systems. Integrate design, technology, and operations into security plans early in the planning and budgeting stages.

2.D.1.9 Particularly in regard to anti-terrorist measures, employ transparent security, invisible to the public eye, to further enhance the sense of openness within transit public spaces. (Also, refer to 2.D.1.12 herein.) However, there are locations and times when public officials require a show of security and force, based on potential threats, activities, tips, and public events. Transit systems planning should allow for the flexibility to increase or reduce security levels and activities.

2.D.1.10 Provide good even lighting throughout publicly accessible spaces which serves as a deterrent to crime. In addition during an emergency, the public should be able to readily identify exits in order to exit from stations and buildings quickly and directly to the outside.

2.D.1.11 Clear mark emergency signage. The numbers, locations and widths of the exits should be planned to allow peak loads of people to exit in a short time.

2.D.1.12 Mitigate the impact of vehicular threats and help protect people and facilities from potential damage in a blast through providing such measures as setbacks from the street and bollards, planters, barriers, benches, and other street furniture engineered to resist vehicles. .

2.D.1.13 Acoustics should allow travelers to hear public address announcements on the platforms and help control excess noise and vibration.

2.D.2 ☐ Provide inviting space

2.D.2.1 Public spaces should be clean, free of litter, unpleasant odors, and graffiti.

2.D.2.2 Lighting levels and fixtures should be functional and aesthetic, to provide good visibility and additional security. Consideration should be given to daylighting regularly occupied spaces. Reference 3.4 guideline 4.

2.D.2.3 Public amenities can include shops, telephones, benches, and safe, clean toilet facilities.

2.D.2.4 Use landscaping and hardscaping to make spaces pleasant.

2.D.2.5 Overhead aerial structures, vents, tunnels, and other elements should be designed collaboratively between architects and engineers to blend aesthetics with essential technical criteria.

2.D.2.6 Design spaces and provide openings to visually connect the indoor environment with outdoor spaces.

2.D.2.7 Integrate art within and around public transportation facilities to compliment the design of stations and transit infrastructure.

2.D.2.8 Further enhance the experience of the public ridership with the integration of entertainment at appropriate spaces. Acoustics and pedestrian flows must be considered. Create possibilities for local entertainers to enhance the experience of their neighbors while providing opportunity for visibility.

2.D.2.9 Leverage opportunities to aesthetically enhance necessary and functional architectural and structural spaces and elements; consider color, texture, and rhythm of elements.

2.D.2.10 Reflect the history and cultural diversity of station and transit node locations, thus linking the transit system to communities.

2.D.2.11 Consider integrating literature into the transit experience. Integrate renowned or obscure poetry at waiting areas or on trains enhancing the rider's experience.

2.D.3 ☐ Provide comfortable experience

2.D.3.1 Maintain thermal comfort. Provide wind breaks, where needed.

2.D.3.2 Design stations/transit nodes/stops/terminals to protect riders from weather conditions (wind, rain, snow, sun, and extreme heat and cold).

2.D.3.3 Provide high-quality amenities at all transit stations and stops (such as sidewalks, seating and lighting) through adequate design, including design for safety and security.

2.D.3.4 Ensure that all facilities are well designed and well-maintained to promote cleanliness and comfort.

2.D.3.5 Provide high-quality customer information, both electronically (including next-bus or next-train information) and (at facilities) through staff and stationary signage, to ensure that riders know of transit services, general information, and rapid and accurate information on service disruptions.

2.D.4.8 Implement single card fares, where practical.

2.D.4 ☐ Implement high quality wayfinding systems (where and when)

2.D.4.1 Identify stations/hubs with signage such that the public (pedestrians, bicyclists, private automobile users, and transit riders) recognizes its location. Use operator logo and particular colors to identify various transit services or routes.

2.D.4.2 Within station/transit node/hub provide wayfinding signage consisting of directional signage and maps to train platforms, bus stops, shuttle stops, ferry docks, taxi stands, bicycle routes, and pedestrian routes.

2.D.4.3 Identify specific platforms and stops with operator logos and route designations (colors, numbers, and letters) and destination names.

2.D.4.4 Within station/transit node/hub include wayfinding signage and maps directing customers out to nearby streets, attractions, and landmarks.

2.D.4.5 Provide real-time transit information letting customers know exactly when to expect their next bus or train. This should be provided with real time electronic displays outside of and throughout station/transit node/hub and on the internet.

2.D.4.6 Provide regional transit information by phone, internet, and via take-away brochures and maps.

2.D.4.7 Clearly communicate fares and schedules.

2.D.4.8 Make wayfinding simple and intuitive – easy to understand, regardless of the user's experience,

knowledge, language skills, abilities or disabilities, or current concentration level.

2.D.4.9 Provide information on local points of interest, restaurants, and shops. Consider marketing cultural events, sporting activities, and local attractions through visual elements within and around transit systems. Posters, signage and electronic billboards can provide opportunities for informing riders about local activities.

2.D.4.10 Efficiently design transit facilities so that communication, ticketing, signage, etc, are centrally located to reduce maintenance required to support these various elements.

2.D.4.11 Information should be presented in a consistent manner among transit systems to aid customers' understanding.

E. Emissions & Pollution Control

These guidelines are aimed at proactively reducing the potential contribution of transit systems infrastructure and facilities to air and water pollution beyond current regulatory requirements. Methods to reduce air emissions, wastewater discharges, hazardous waste, and pollution in general are presented. The guidelines also discuss greenhouse gas emissions, water conservation, and waste minimization.

2.E.1 ☐ Mitigate contaminated areas and brownfields

2.E.1.1 Favor construction of new facilities and infrastructure on a previously developed land, including land contaminated with hazardous waste or pollution thus providing an opportunity to restore degraded urban land while promoting infill and reducing sprawl.

2.E.2 ☐ Control hazardous materials, water effluent and air pollution

2.E.2.1 Eliminate existing and reduce the use of new known and suspected hazardous materials in transit stations, transit nodes, terminals, stops, and supporting facilities (see 2B).

2.E.2.2 Design facilities to minimize mold and mildew growth through material selection, insulation design, as well as, indoor environmental quality control (ventilation, temperature, humidity).

2.E.2.3 Clean tunnels for improved air quality (AQ).

2.E.2.4 Take steps during construction to protect indoor air quality such as: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of facilities.

2.E.2.5 Take steps during construction to protect surrounding ecosystem and community, such as: Develop and implement Construction Activity Pollution Prevention Plan to mitigate soil erosion, control sedimentation, protect streams and ecologically sensitive areas, reduce noise and dust exposure, prevent off-gassing of volatile compounds.

2.E.3 ☐ Design for water efficiency and reuse

2.E.3.1 Utilize water efficient plumbing fixtures.

2.E.3.2 Minimize vehicle washer water waste.

2.E.3.3 Reclaim and treat wastewater from car washing system for reuse within the washer.

2.E.3.4 Neutralize effluents from car washing system before they are directed to city sewers.

2.E.3.5 Design and operate water efficient irrigation systems. Make plant selections in accordance with water conservation principles.

2.E.3.6 Promote natural infiltration of water back into ground, filter contaminants, help prevent water pollution, recharge aquifer and slow down storm water runoff.

2.E.3.7 Design the project site to maintain natural stormwater flows by promoting infiltration.

2.E.3.8 Use storm water management techniques such as pervious pavements, bioretention basins (rain gardens), vegetated roof treatment, and landscaped areas.

2.E.3.9 Collect storm water and use for non-potable uses such as landscape irrigation, toilet and urinal flushing, and custodial uses.

2.E.3.10 Provide oil/water separator system, bioswale, or similar mechanism to intercept runoff from parking facilities and filter contaminants.

2.E.4 ☐ Establish greenhouse gas monitoring on facilities

2.E.4.1 Establish baseline of greenhouse gas emissions of facility and infrastructure use.

2.E.4.2 Monitor energy use in all forms (electricity, fuel, natural gas) as well as industrial use of gases with high global warming potential (including refrigerants).

2.E.5 ☐ Implement waste management and recycling procedures (other guidelines and standards)

2.E.5.1 Set target for construction and demolition debris diversion from landfill through on-site and off-site reuse and/or recycling.

2.E.5.2 Use recycling of certain materials as a source of revenue.

2.E.5.3 Include containers for recyclables at stations, station sites, transit nodes, and other facilities or establish robust post-collection recycling program.

2.E.5.4 Consider requiring concessionaires to eliminate non-compostable and non-recyclable items i.e. eliminating plastic bags.

2.E.5.5 Consider use of compostable food packaging and flatware in facilities' food service.

2.E.5.6 Minimize packaging of all of the incoming commodities.

3 rolling stock & fleet

This section provides guidelines for improving the sustainability of elements unique to the transit vehicle fleet. Recommendations are relevant to planning, procurement, design, construction and operation of fleet. For the purposes of these guidelines, the term fleet includes:

- Rubber-tired buses, including various types of propulsion systems such as diesel, diesel hybrid, hydrogen fuel cell, compressed natural gas (CNG), and electric-powered buses.
- Rail vehicles, including heavy and light rail as well as streetcars and self-propelled railcars.
- Non-revenue vehicles used by transit staff and contractors to support the transit service.

These guidelines are intended to integrate vehicle design with environmental principles in order to reduce the impacts over the vehicle life cycle. This would result in effectively implementing pollution prevention and creating savings over the vehicle life cycle by optimizing energy use and concurrently reducing emissions. They promote a positive rider experience and therefore encourage higher ridership and utilization of transit alternatives. The recommendations seek to provide ecological protection while maintaining stable economic conditions for the transit agency. Benefits include savings and revenue from improved environmental performance; enhanced environmental compliance; pollution prevention and resource conservation; more customers and markets; increased efficiency; reduced costs; enhanced employee morale; improved image with the public; and greater employee awareness of environmental issues and responsibilities. Innovations in industrial ecology are encouraged. Engineering tools for estimating costs and ramifications of sustainable development must be developed, tested, and evaluated. Processes and formulas must be developed to measure and report energy used per passenger miles traveled and passenger capacity per system mile available.

A. Smart Land Use & Livable Neighborhood

These guidelines are aimed at optimizing transit systems planning, land use and site configuration to reduce vehicle operational carbon footprint and enhance livable neighborhood measures.

3.A.1 ☐ Consider vehicle choice in system planning

- **3.A.1.1** Consider modal integration, context sensitive designs, correctly sizing the vehicles and frequency of service.
- **3.A.1.2** Match the size and speed of fleet to the neighborhood being served.
- **3.A.1.3** Match the type of fleet to the geography of the neighborhood being served. Steep grades require a different type of transit vehicle than do routes that are moderate in topography. This will affect the type of energy required (electric, diesel, hybrid, etc.). Fleets may be comprised of a variety of vehicles to suit varying local terrain conditions and size of ridership.

3.A.2 ☐ Design vehicle and fleet capacities to match transit network size

- **3.A.2.1** Consider use of smaller buses on low volume routes
- **3.A.2.2** Consider use of streetcar circulator to start or connect to a light rail system
- **3.A.2.3** Consider Intercity Rail Service using self-propelled DMU vehicles
- **3.A.2.4** Consider use of articulated buses for heavily traveled standard bus routes
- **3.A.2.5** Consider modified seating layout to delete seats allowing more standees and/or bicycles
- **3.A.2.6** Consider optimizing seat spacing on railcar designs to maximize seating capacity
- **3.A.2.7** Consider using exclusive/dedicated bus rapid transit (BRT) lanes and optimizing station spacing to emulate light rail vehicle (LRV) service

3.A.3 ☐ Design vehicle with neighborhood and geography in mind

- **3.A.3.1** Develop a neighborhood circulator bus or streetcar to link with rail service.
- **3.A.3.2** Utilize historic streetcars to brand specialized service, where appropriate.
- **3.A.3.3** Utilize historic streetcars or other vehicles to recall the nature of historic boulevards such as Market Street in San Francisco.

3.A.3.4 Use electric trolley buses in areas with extreme street grades of over 15%.

3.A.3.5 Utilize geographic landmarks such as San Antonio River Walk Streetcar.

3.A.3.6 Consider wireless power distribution to eliminate power distribution infrastructure from cluttering the landscape.

3.A.3.7 Use retro designs on new stations and guideways to recall historic times such as the Embarcadero “E” line in San Francisco or using historic neon signs at stations on the BRT system in Las Vegas.

3.A.3.8 Consider wireless power distribution to prevent electrification infrastructure from cluttering the landscape (e.g. Tethering, underground wire transformer, etc).

B. Materials & Construction / Operations Optimization

These guidelines are aimed at improving the sustainability of materials unique to transit. The long-term viability of these materials is critical for the sustainability of transit fleet manufacturing and maintenance processes that should take a holistic approach to green engineering for transit fleets. The guidelines include consideration for the advancements in computer applications and modeling methods such as life-cycle assessment, materials flow analysis, input/output economic models, and other novel metrics for measuring sustainable systems. Understanding materials flow and taking advantage of such understanding to substitute less toxic, longer-lived materials are important to enhanced sustainability. The effects of appropriate substituted materials on waste streams should be considered.

3.B.1 ☐ Incorporate environmentally preferable materials. Specify which environmental attributes are important – recyclability, weight, chemical safety, carbon footprint, etc and prioritize among them.

3.B.1.1 Consider the use of ultra-capacitors in conjunction with batteries to reduce the load on the batteries, extend their life, and reduce waste.

3.B.1.2 Encourage the development of improved electronics and battery materials.

3.B.1.3 Specify the use of lightweight materials including plastics, composites, aluminum and other materials. Consider offering weight saving incentives in the procurement contract.

3.B.1.4 Specify improved glazing materials and proper choice of exterior colors to reduce heat losses and to reduce undesirable heat gain.

3.B.1.5 Specify materials that are durable, easy to maintain/clean, and graffiti resistant.

3.B.1.6 Use improved insulation and sound-deadening materials to reduce thermal losses and lower noise levels.

3.B.1.7 Utilize environmentally acceptable refrigerant (in accordance with Montreal Protocol) in vehicle heating, ventilation, and air conditioning (HVAC) units.

3.B.1.8 Applying low VOC and water based adhesives and coatings reduces harmful emissions.

3.B.1.9 Consider flooring and other finishes selected with environmental as well as durability in mind (refer to LEED System for typical selection criteria).

3.B.1.10 Utilize multiplexing in electrical systems to reduce wiring, which will reduce copper usage and vehicle weight.

3.B.1.11 Consider requesting a life cycle assessment as part of vehicle design and procurement to be supplied according to ISO 14000. This assessment compares relative importance of environmental impacts during production, operation, and disposal.

3.B.1.12 Consider establishing a complete list of chemicals to be prohibited or restricted in vehicle production. The list should include a CAS identification number for each chemical.

3.B.1.13 Use LED lighting to reduce energy consumption and give a long life.

3.B.1.14 Request a detailed materials inventory to be supplied upon delivery of the vehicles. This inventory should list all materials, chemical ingredients (by CAS chemical identification numbers), their location, and quantity by weight.

3.B.1.15 Use toxics-free materials. When chemicals are demonstrated to not be economically replaceable, identify requirement leading to this toxic chemical, restrict use to a minimum, contain the chemical over the life cycle, and request a phase out plan from supply chain.

3.B.1.16 To extend use life and limit re-cycling needs, use re-usable instead of disposable parts, and use modular designs to address obsolescence issues.

3.B.1.17 To avoid waste generation, avoid unrecyclable mixes, use separable jointing methods, recyclable materials, and mark polymers to identify their content and allow economical sorting

3.B.2 ☐ Consider bus-specific preferred materials

3.B.2.1 Specify designs that minimize welding and allow for body panel replacement without using welding or fiberglass.

3.B.3 ☐ Consider rail-specific vehicle design and preferred materials

3.B.3.1 Consider using an electric locomotive if ridership on passenger rail can justify the expense.

3.B.3.2 Consider using alternative fuel powered locomotives such as LNG or fuel cell.

3.B.3.3 Utilize rail lubricators to reduce wheel/rail friction and improve fuel efficiency.

3.B.3.4 Consider recyclability of rail car materials during design.

3.B.3.5 Perform Life Cycle Assessment using the rail vehicle Product Category Rules (PCR). The results can then be communicated to stakeholders using a standardized document called an Environmental Performance Declaration satisfying ISO-14025.

C. Energy & Resource Efficiency

These guidelines are aimed at improving the sustainability of energy elements unique to transit fleet. The long-term viability of these elements is critical for the sustainability of transit fleet manufacturing and maintenance processes, which should take a holistic approach to green engineering for transit fleets.

3.C.1 ☐ Integrate vehicle design and related systems

3.C.1.1 Conserve energy through innovative, more efficient lighter weight vehicles and component design. Use aluminum and lightweight composite materials to reduce vehicle weight.

3.C.1.2 Consider the use of alternative propulsion systems include adding photovoltaic electric, battery electric, flywheel generator, hybrid battery-generator, fuel cell and regenerative electric drives or a gas turbine.

3.C.1.3 Develop contracts creating incentives for energy efficiency.

3.C.2 ☐ Consider alternate fuels and energy consumption

3.C.2.1 Utilize biodiesel fuel. It should be noted that the quality control of biodiesel fuel and what is used for feedstock to manufacture biodiesel fuel are critical elements to the successful use of this fuel. ASTM specifications for

this fuel must be followed. These are available at: www.astm.org.

3.C.2.2 Utilize diesel-electric hybrid buses.

3.C.2.3 Develop all electric and fuel cell buses.

3.C.2.4 Use regenerative braking in railcars and hybrid buses

3.C.2.5 Measure and target reduced consumption of energy.

3.C.2.6 Consider fleet electrification to reduce propulsion system complexity, eliminate vehicle direct engine emissions, and reduce vehicle weight.

3.C.3 ☐ Consider operation during design

3.C.3.1 Conserve energy by utilizing electronic engine and transmission controls.

3.C.3.2 Conserve energy by utilizing hybrid bus designs. These designs incorporate steady state operations and regenerative braking which reduces energy consumption especially on routes with frequent stops.

3.C.3.3 Investigate developments in battery and hydrogen fuel cell bus technology.

3.C.3.4 The use of synthetic lubricants will decrease the frequency of oil changes required and extend drive train life, which will reduce waste materials.

3.C.3.5 Developments in electronic technology allows for the use of modular and roof mounted air conditioning and engine cooling systems. This results in less auxiliary loads on the vehicle power plant thus reducing energy consumption.

3.C.3.6 Conducting proper prevent maintenance on rolling stock will increase fuel efficiency and reduce emissions.

3.C.3.7 Provide bus rapid transit, where feasible, saving energy and reducing emissions while improve service.

3.C.3.8 Utilize Intelligent Transportation and Transit Priority Systems.

3.C.3.9 Consider automated train control systems that optimize acceleration and braking and minimize power/brake transitions. This saves on power required thus conserving energy

3.C.3.10 Specify innovative and efficient railcars designs that incorporate ideas such as lighter-weight wheels, fewer motors, and lighter-weight HVAC systems. Lighter weight train cars decrease the amount of energy required to operate.

3.C.3.11 Use railcars equipped with regenerative braking systems to reduce energy consumption. Fleets can be retrofit during a midlife overhaul.

3.C.3.12 Consider using a system that stores regenerated electricity in either a wayside or on-vehicle storage unit.

D. Quality of Ambient Environment & Health

These guidelines are aimed at creating a positive, healthy ambient environment for riders on vehicles and vessels. When riding transit is enjoyable, people will be more likely to choose transit over other modes of transportation.

3.D.1 ☐ Design for pleasant riding

3.D.1.1 Transit vehicles should be clean, free of litter, unpleasant odors, and graffiti.

3.D.1.2 Low floor vehicles allow ease of passenger loading/unloading and reducing dwell time.

3.D.1.3 Minimize noise and vibration and maintain thermal comfort.

3.D.1.4 Lighting levels should be specified to provide good visibility and additional security. Lighting fixtures should be functional and aesthetic.

3.D.1.5 Design spaces and provide openings to visually connect the indoor environment and outdoor spaces. Use large windows and for underground travel consider using cameras filming the outdoor route with images displayed in vehicles.

3.D.1.6 Use universal design to improve experience for mobility/visual/hearing impaired.

3.D.1.7 Provide transit vehicles are well-designed and well-maintained with adequate passenger circulation, high-quality and well-maintained seating, good lighting and climate control, security cameras, good ride quality, bicycle and luggage storage facilities, and if possible an off-board fare collection system.

3.D.1.8 Provide excellent rider information; including maps, customer service bulletins, and public address systems.

3.D.1.9 Provide modern amenities such as wireless technology to provide maximum productivity for riders.

3.D.2 ☐ Enhance bus-specific riding experience

3.D.2.1 Branding and livery encourages new attitude towards bus riding.

3.D.2.2 Create ”Rail like” and “specialized” bus designs to attract new riders.

3.D.2.3 Bike rack inside the bus adds more security.

3.D.2.4 Rear facing wheelchair position on a bus is more easily operated by wheelchair bound passengers.

3.D.2.5 Kneeling buses allow easier access for mobility impaired.

3.D.3 ☐ Enhance rail-specific riding experience

3.D.3.1 Consider adding amenities such as power outlets for laptops and WiFi (wireless wide area) internet access.

3.D.3.2 Provide clear and interactive system maps and announcements of next stop

E. Emissions & Pollution Control

These guidelines are aimed at reducing greenhouse gas air emissions and potential contributions of the transit system’s fleet to air pollution, considering over-reliance on fossil fuels. When appropriate, the guidelines are developed to address specific modes, including bus and rail.

3.E.1 ☐ Measure and reduce greenhouse gas (GHG) emissions from vehicle operation

3.E.1.1 Baseline GHG emissions should be measured and GHG emissions following changes to vehicle operations can be calculated before the program is implemented and then measured for comparison. Many of the measures recommended and case studies cited for energy savings also reduce emissions and pollution.

3.E.2 ☐ Reduce diesel use from fleet operation

3.E.2.1 Consider using renewable or alternative fuels. Appropriateness of various fuels depends on agency specific conditions, such as weather conditions, fuel availability and route type. Alternative fuels that may be appropriate for an angency’s fleet include fuel additives and conditioners, bio-diesel, CNG, LNG, LPG, Dual fuel (diesel and natural gas), Fischer-Tropsch, Coal-To-Liquids (CTL), Gas-To-Liquids (GTL) or Biomass-To-Liquids (BTL), Methanol and Ethanol, Hydrogen and ultra-low sulfur diesel.

operations & maintenance

Once designed, constructed, and commissioned, the transit operation commences. The environmental sustainability opportunities in the operation of a transit system are addressed in this section. These opportunities include: operational efficiency; use of renewable energy; energy efficiency; pollution prevention; hazardous materials management; waste reduction and recycling; and responsible purchasing.

A. Smart Land Use & Livable Neighborhood

These guidelines allow a transit system to consider aspects of its operations and maintenance activities when planning new or updated features of the system, including facility configuration, land use, and site design.

4.A.1 ☐ Consider livable neighborhood measures for service planning and scheduling

- **4.A.1.1** Work with stakeholders to expand programs for populations with few transportation options.
- **4.A.1.2** Support and partner with initiatives that promote public transit use.
- **4.A.1.3** Develop a Service Model that cross-links factors such as minimum frequency of service to maximum walking distances to the service in order to maximize ridership and customer service
- **4.A.1.4** Coordinate with related transportation agencies, regional planning organizations, and/or municipal divisions and develop a strategic approach to ongoing transportation planning such as an overall “vision plan” across the various agency and departmental offices for individual projects.

4.A.1.5 Utilize public participation to build support for use and maintenance of transit. Utilize input from representatives of a broad cross-section of the community.

4.A.1.6 Ensure early, open dialogue with city/community officials and developers to create collaborative goals. Align interests with each party's development goals and agree on the scope of the transit sustainability initiatives.

4.A.2 ☐ Optimize type and siting of fueling and maintenance facilities

4.A.2.1 Evaluate the location of fueling sites for buses in relationship to the existing routes and new or modified routes during service planning in order to minimize deadhead distances and save fuel.

B. Materials & Operations Optimization

These guidelines provide activities and actions of sustainability for both organizational management and operational practices including policies, programs, and using materials for maintenance in a way that applies concepts of life-cycle analysis, increased length of use, potential for reuse/recycle, and reduction of toxics.

4.B.1 ☐ Policies, Programs, and Organizational Management

4.B.1.1 Make contracting with disadvantaged business enterprise (DBE) firms where available part of the design and construction policy.

4.B.1.2 Put sustainability on the agenda of regular staff meetings.

4.B.1.3 Establish an employee recognition program for contributions to the organization's sustainability efforts.

4.B.1.4 Put in place a sustainability hotline for employees and the general public.

4.B.1.5 Integrate sustainability into employee and contractor performance management.

4.B.1.6 Put in place a sustainable procurement policy and/or supply-chain policy which is based on comprehensive sustainability principles.

4.B.1.7 Become viewed as a sustainability leader in one's community or areas where can play an active role in the community through established community programs.

4.B.1.8 Establish a Chief Sustainability Officer or equivalent post within the transit agency or organization.

4.B.1.9 Establish a climate action plan for the agency/organization.

4.B.1.10 Obtain “green business” certification of all corporate offices (where available).

4.B.1.11 Establish policy to hold a regular and rigorous program of internal study/presentations into sustainable building and transit technologies.

4.B.1.12 Specifically target the business community to explain how transit can meet their needs. Highlight the potential competitive advantages of accessibility of the workforce and businesses to transit, including:

- Reduced absenteeism due to transportation problems: Access to transit gives employees options in case of car trouble or traffic jams.
- Increases the attractiveness of a business to potential new hires, (money savings, stress reduction for commute).
- Added value to company facilities.
- Reduce the need to build or otherwise subsidize parking.
- Capture trade of transit users by locating businesses in convenient proximity to transit (i.e. within transit-oriented development).
- Specifically target Economic Development entities to explain how transit is an advantage to a community’s economic health, by helping businesses, see above.

4.B.1.13 Create an internal marketing group or work with a private firm. Develop a marketing strategy. Ensure the public is getting the information to make informed choices. Considering targeting youth to develop habit of traveling by transit at an early age, before the auto-dependency forms. Encourage employers to provide passes for employees.

4.B.1.14 Ensure that the public is educated about goals and process through a community relations campaign.

4.B.1.15 Promote transit through advertising the benefits of a healthier, community-connected lifestyle. Use signs, commercials, and other media.

4.B.1.16 Put in place a service(s) to help customers become more sustainable themselves.

4.B.1.17 Put in place partnerships that can allow for resource exchange to achieve sustainability.

4.B.1.18 Develop an agency sustainability awareness program. Ensure early and ongoing dialogue to coordinate sustainability programs, share results of efforts, and reinforce an agency-wide ‘culture’ of sustainability.

4.B.1.19 Investigate how to quantify, measure, and determine the carbon footprint or CO2e for system operation, including products used.

4.B.1.20 Work systematically with customers to establish more sustainable processes and products.

4.B.1.21 Put in place targets for costs savings from use of recycled materials/energy efficiency measures in all new projects.

4.B.1.22 Put in place a regular internal reporting system on the progress of sustainability initiatives.

4.B.1.23 Establish an organization-wide policy and action plan which covers economic, social and environmental sustainability.

4.B.1.24 Initiate an ISO 14001, EMS and/or SMS process.

4.B.1.25 Carry out a system-wide energy and/or resource-use audit and a waste stream audit.

4.B.1.26 Set a minimum recycling policy.

4.B.1.27 Establish policies for reducing paper use.

4.B.1.28 Adopt an energy efficient appliance purchasing policy and other sustainable office equipment and supplies.

4.B.1.29 Establish a “sustainable proposals” policy (e.g. proposals for bids sent in on 100 percent recyclable paper, double-sided, only one hard copy, maximum set for amount of pages etc.).

4.B.1.30 Establish a comprehensive measuring and reporting process on targets set, progress made, results achieved which is disseminated both internally within the organization as well as externally, available to all interested stakeholders, including the publication of an annual sustainability report.

4.B.1.31 Formulate an environmental policy, stating environmental goals, intentions, and an overall mission. Set specific goals to improve environmental performance, detailing how goals will be met and employee responsibilities in meeting these goals.

4.B.2 ☐ Green Procurement for Maintenance and Upgrades

4.B.2.1 Establish a green purchasing policy for purchase of products and leasing/purchase of equipment – to address energy use, recycled content, transport distance, and recyclable packaging.

4.B.2.2 Consider application of life-cycle analysis (LCA) processes to equipment, product, and vehicular procurement, understanding that a realistic starting point and timeframe applicable to each specific LCA must be agreed upon and consistently applied.

4.B.2.3 Create an inventory listing of prohibited and limited-use chemicals, and include the inventory in the transit agency's Environmental Management System audit and continuous improvement programs. Include a procedure that allows for research and approval for use of alternative products to reduce the inventory of limited-use chemicals.

4.B.2.4 Establish minimum "green" qualifications for designers of renovations, specifiers, and purchasers.

4.B.2.5 Utilize standard environmental labeling programs for specifying products.

4.B.2.6 Put in place procurement methods that require (or favor) sustainable practices for at least one product line or area.

4.B.2.7 Identify and purchase office supplies that make use of recycled products or have other environmentally friendly attributes.

4.B.2.8 Research, access, and participate in state- or regional-level databases for reused and recycled materials such as that held by the California Integrated Waste Management Board (CIWMB).

4.B.2.9 Participate in multi-agency requests for proposals (RFP) programs, thereby increasing leverage in and encouraging sustainable approaches and reducing cost.

4.B.3 ☐ Paints, Solvents, and Cleaners

4.B.3.1 Utilize low VOC and water based paints and solvents.

4.B.3.2 Develop solvent reclamation program.

4.B.3.3 Specify non-toxic cleaners whenever possible.

4.B.3.4 Manage procurement of cleaning supplies on a regular or computerized schedule to reduce shipping and stock waste.

4.B.4 ☐ Refrigerants, oils, engine coolant and batteries

4.B.4.1 Specify non-toxic materials whenever possible.

4.B.4.2 Reduce refrigerant, oil, engine coolant and battery waste products by recycling or filtering for reuse onsite.

C. Energy & Resource Efficiency

These guidelines are aimed at reducing energy consumption in transit operations and maintenance, investigating ways to improve energy efficiency and identifying what renewable energy systems might work for various operations and maintenance activities within the system. When appropriate, the guidelines address specific modes, including bus and rail.

4.C.1 ☐ Develop and implement energy and water conservation procedures for:

- Bus operations & maintenance
- Rail operations & maintenance

4.C.1.1 Reduce water usage at facilities by:

a) Capturing, treating and reusing vehicle wash wastewater and storm drain run off instead of potable water in vehicle, equipment, and facility wash operations and for irrigation at yards and station campuses.

b) Installing water filters at taps in offices and shops instead of purchasing bottled water. Ensure regular replacement of filters.

c) Working with local agencies to promote potential for use of water from dewatering operations or other treated water of suitable quality to supplement groundwater recharge where geotechnical conditions are suitable.

4.C.1.2 Strive towards becoming paperless - take advantage of electronics and computerized systems to get away from paper-based culture in offices, yards, and shops.

4.C.1.3 Alter bus operations and routes based on optimized energy usage (computer models are available to do this).

4.C.1.4 Conduct or participate in an energy audit. Energy suppliers such as Pacific Gas & Electric offer free energy audits.

4.C.1.5 Tailor preventive and other maintenance to minimize energy usage – by automating equipment and vehicle maintenance schedules and developing an efficient maintenance training program. Shop tools and lifts can be also be used more efficiently, in a way that reduces energy consumption.

4.C.1.6 Communication-based train control (CBTC) improves the operational efficiency of a train system by allowing trains to be spaced closer together, resulting in more customers per hour. It also helps limit the amount of energy used because the train will automatically slow

down with a decreased need for energy needed for braking thus minimizing electrical consumption.

4.C.1.7 Use computer modeling of transit operations and passenger loading patterns to optimize stop locations.

4.C.1.8 Install automated on/off switching for auxiliary systems on light rail vehicles, especially useful during yard stays, thereby achieving significant savings in kilowatt-hours and energy costs.

4.C.2 ☐ Improve energy efficiency of operations & lower peak demand

4.C.2.1 Establish energy saving goals or protocols for operations and maintenance activities, matching, if possible, state and regional goals. Include staff training on energy and efficiency requirements into operation of vehicle. Right-size vehicles. Establish policies regarding location of meetings, avoiding unnecessary trips. Provide operator training to ensure smooth use of power and reduce fuel/energy consumption. Reduce fuel usage by reducing bus idle times.

4.C.2.2 Utilize energy saver and hibernate functions on motors and equipment.

4.C.2.3 Monitor vehicle fuel consumption: A transit agency's finance department typically keeps track of all fuel being used every day. This department can provide information regarding fuel consumption per bus, incentive for lowest fuel, individual accountability, and need to use energy responsibly.

4.C.2.4 Reduce ownership and operation of non-revenue vehicles: Consider participating in car sharing organizations such as Zip Car or City Car Share instead of owning a fleet of non-revenue vehicles. A transit agency, as a major customer, has influence, and the ability to leverage car sharing and encourage car-sharing organizations to use non-fossil or hybrid technologies.

4.C.2.5 Utilize telephone or web-based meetings and training sessions whenever possible.

4.C.2.6 Install signal to let vehicle operators or structure occupants know that doors are open to conserve heat/cooling. Be accountable for energy used year by year – include energy conservation as a performance measure for facility operators and owners/maintainers. Adjust set points for heating and air conditioning to save energy, wherever possible. Also facilities should be Provide controls and procedures to operate facilities with less heating/cooling when not occupied.

4.C.2.7 When replacing lighting, use energy-efficient technology such as fluorescent lamps including both thin tubes and CFLs for tunnel lighting, station lighting, etc, and Light Emitting Diode (LED) lights (in signals, emergency lights, signage, etc.).

4.C.2.8 Use motion sensors and photoelectric dimmers in ancillary rooms and other remote work areas to reduce electricity consumption.

4.C.2.9 Use photocells and timers to control exterior lighting fixtures.

4.C.2.10 Incorporate microprocessor-based lighting control and power reduction system to increase or decrease voltage to minimize power consumption.

4.C.2.11 Install energy metering specific to facilities. Where individual cost centers have separate metering, they can be held accountable for energy consumption.

4.C.2.12 Establish a policy of re-commissioning existing HVAC systems to ensure optimal performance and energy efficiency.

4.C.3 ☐ Use renewable energy resources

4.C.3.1 Purchase Renewable Energy Credits (RECs) – by participating in a state-level REC program, a transit agency can legitimately claim to use green power, incentivizing carbon-neutral power suppliers and essentially subsidizing power-generating utilities that obtain some or all of their electricity from renewable energy such as solar or wind power.

4.C.3.2 Purchase electricity directly from renewable sources

D. Quality of Ambient Environment & Health

These guidelines are aimed at transit system operation and maintenance practices to create a positive, safe and healthy ambient environment for patrons.

4.D.1 ☐ Provide clean and attractive vehicles, stations, and transit nodes

4.D.1.1 Keep vehicle windows, wayfinding signage, and interiors clean and free from graffiti.

4.D.1.2 Repair body damage and repaint when needed, and regularly on predetermined schedules.

4.D.1.3 Provide periodic thorough cleaning to eliminate stains and odors, particularly elevators.

4.D.1.4 Allow for rider input at stations regarding status of restrooms, escalators, and elevators – check regularly and provide prompt response.

4.D.1.5 Maintain properly stocked First-Aid kits and emergency responder supplies at stations.

4.D.2 ☐ Ensure friendly and courteous services

4.D.2.1 Provide training to operators to be helpful and courteous. Train them to be good will ambassadors and the face of transit to the riding public.

4.D.2.2 Provide for an operator's rapid contact with and connection to available internal and external emergency support services on buses and rail.

4.D.2.3 Prohibit texting and other operator distractions while driving.

4.D.2.2 Enforce agency uniform standards.

4.D.2.3 Provide information to the operator on delays on road calls so they can make informed decisions about their options.

4.D.3 ☐ Plan for crowd control and monitor riding comfort

4.D.3.1 Consider the needs of all riders: Some may wish to sit and read, daydream, chat, look out the window, and experience the sensation of movement. Others may prefer to stand, especially if they have strollers or luggage with them. Take steps to understand and address riders' wants, through surveys or other methods.

4.D.3.2 Optimize headways and scheduling to prevent vehicles from becoming overcrowded. Incorporate customer experience into level of service. Where appropriate, set a target for every passenger to get a seat after a certain time limit standing and monitor to ensure results.

4.D.3.3 Inform riders of the length (in cars) of approaching trains and where to stand along the platform. With this information, passengers can appropriately distribute themselves along the platform and increase their chances of quickly entering and finding a seat.

4.D.3.4 When possible mark platform to indicate where car entrances are located to facilitate organized queuing and easier exiting for disembarking passengers.

4.D.3.5 Monitor and control noise levels to which riders are exposed.

4.D.3.6 Monitor and control air temperature and flow.

4.D.3.7 Maintain and publicize safety records to make riders feel safe on transit.

4.D.3.8 Maintain tracks and wheels to reduce in-vehicle noise.

4.D.3.9 Announce each stop visually and verbally.

4.D.3.10 Maintain electronic security cameras on buses and trains, providing regularly scheduled testing and repair/replacement.

4.D.4 ☐ Consider innovative health and safety devices and programs

4.D.4.1 Coordinate with local police security organizations to allow for passenger escorts at stations, stops, or parking lots/garages during late-night operations or for those who may require help.

4.D.4.2 Partner with local health agencies to support health-based initiatives.

E. Emissions & Pollution Control

Pollution reduction and prevention requires close monitoring of operations and implementation of environmental policy, as well as training. Training for emergency response for situations such as spills, for example, is normally part of an Environmental Management System. A transit organization's Environmental Management System uses management policy, commitments, and implementing procedures to set goals, achieve them, and monitor and continuously improve environmental performance.

For a transit agency, reduction of pollution and emissions primarily relates to prevention of spills, leaks, and air emissions as well as reduction of waste and the reduction and proper storage, use, and disposal of hazardous materials. Where possible, materials purchased should be evaluated to ensure that the least hazardous materials appropriate for the designated use are being purchased. Hazardous materials should be tracked and systematically eliminated from use, where possible. As discussed in 4.B.1, Materials and Construction for transit agency operations and maintenance, a green procurement process can be used to track and prevent the purchase of identified hazardous materials.

The reduction of solid waste can be achieved in many ways. Preventing waste and recycling are the most prevalent. Most materials can be recycled or reused. In a transit organization, it is typical to recycle metals, wood, paper, batteries, waste oil, solvents, grease, used oil filters, antifreeze, tires, and electronic equipment, to name a few. Also, at the end of their useful life, vehicles can be sold for scrap or for other uses. From an environmental sustainability perspective, it is important to know the end destination of these recycled products. Green procurement, or environmentally responsible purchasing, is valuable for establishing this type of information in a large organization.

4.E.1 ☐ Implement pollution reduction strategies - eliminate, reduce, re-use, and recycle

4.E.1.1 Reduce hazardous waste and chemical usage in all agency facilities through the use of an inventory and criteria for what is to be eliminated, what is to have limited use, and processes to ensure proper management of these wastes and chemicals.

4.E.1.2 Establish a system to divert organic waste to composting facilities where available.

4.E.1.3 Establish a reduced idling policy for buses and other revenue and non-revenue vehicles

4.E.1.4 Introduce methods that extend life of lubricants.

4.E.1.5 Reduce pesticide and herbicide use. Utilize Integrated Pest Management. Refer to EPA's Integrated Pest Management program at www.epa.gov/pesticides.

4.E.1.6 Reduce vehicle wash water use reduction through efficient system design (spray, pressure, reused water cycles). Take care to ensure that recycled water does not contain contaminants such as chlorides.

4.E.1.7 Implement waste reduction and recycling programs, such as recycling of railroad ties, electronic devices, lamps, and ballasts.

4.E.1.8 Document the final destination of recycled products such as motor oil and computer components.

4.E.1.9 Divert waste from landfills, - recycle paper products, bottles, cans, and compostable materials such as landscape and food waste.

4.E.1.10 Keep records of existing hazardous material quantities in stock and store them in an established, secure onsite location by type as close as possible to where they will be used, along with standard MSDS precautions and spill response supplies.

4.E.1.11 Optimize employee travel by the use of teleconferencing equipment, transit ridership, cycling and walking and car-pooling and other sustainable options

- Have a green mobility plan (bike, telecommute, web-casting, car-sharing, ride-sharing, no-parking policy, etc) for the agency/organization and offer transit passes as part of employee benefits.
- Establish a business travel policy focused on sustainability, encouraging the reduction of carbon emissions and air pollutants

4.E.1.12 Reduce carbon footprint of meetings e.g. establishing collaborative sites and email distribution of documents as part of a paper-reduction policy

4.E.1.13 Initiate training for employees on sustainability overall and/or on EMS (Environmental Management Systems), SMS (Sustainable Management Systems) and/or ISO 14001 practices

4.E.2 ☐ Enhance facility performance and longevity

4.E.2.1 Perform regular and appropriate maintenance to optimize quality and longevity of facilities, systems, and vehicles.

4.E.2.2 Monitor energy use and emissions and make adjustments to optimize efficiency of systems.

4.E.2.3 Research, plan, and perform upgrades to optimize efficiencies and reduce emissions of facilities, systems, and vehicles.

4.E.3 ☐ Manage wastewater

4.E.3.1 Treat wastewater from car washing system for recycling within the washer.

4.E.3.2 Neutralize effluents from car washing system before they are directed to city sewers.

4.E.3.3 Utilize oil-water separators and maintain their operation.

5 implementation tools

This section includes tools that have been successfully used by transit agencies to implement the sustainability guidelines provided herein. This section is limited to overview information. Details and case studies are available in Transit Sustainability Practice Compendium. The following table lists key implementation tools and benefits.

Tool	***Key Benefit***
Advocacy – Transit Benefits Advocacy – Green Practices	Increase ridership and public support for transit. Build/strengthen image as an environmental leader.
External Partnering Internal Partnering	Get the support needed to implement practices recommended in this document and institutionalize sustainability within agency.
Life Cycle Assessment Multiple Account Evaluation	Gain a fuller understanding of environmental impacts that result from agency decisions. Get a better understanding of where to focus sustainability efforts.
Environmental Management Systems/ Sustainability Management Systems	Develop a systematic, comprehensive framework for approaching and improving sustainability.
Measurement	Determine if efforts to improve sustainability are achieving intended results or if approaches should be changed.

5.1 **Advocacy:** Promoting sustainability internally and to the community. Actively marketing the benefits of transit to the community. One of the primary goals of the guidelines is to enhance transit so that it becomes a more viable mode of transportation than traveling by automobiles – An empty bus cannot be a sustainable bus. Learn from the effectiveness of the automobile industry's commercialization, which convinces the public to buy and drive cars. Be sure the community is getting information on the "good neighbor" role transit plays in reducing pollution.

Reframe transit by promoting its strengths. Highlight the competitive advantages of choosing transit over driving, including the following:

5.1.2 **Save Money:** Reduce vehicle use and ownership; consider costs such as car purchase, insurance, repairs, maintenance, gas, and parking.

5.1.3 **Safety:** Highlight reduced safety risks from transit. Use statistics to inform the public of transit's safety records. Provide information on how much less likely accidents and injuries are on transit vehicles compared to automobiles. Consider displaying comparative safety statistics in stations, transit nodes, and vehicles and through television commercials and website articles.

5.1.4 **Comfort:** Promote the design features of transit that make riding comfortable, such as large windows and sufficient personal space.

5.1.5 **Improve Health:** Increased physical activity from walking to stops and biking to stations. Clarify the health benefits associated with transit, such as comparing average air quality on a subway car and a freeway. Obtain data from Public Health Departments on the community to be served, when possible.

5.1.6 **Environment:** Reduce greenhouse gases, other emissions linked to cancer, asthma, etc.

5.1.7 **Improve Time Management:** Know exactly when transit will arrive and depart.

5.1.8 **Reduce Stress:** Relax or work on trip; dependable; easy to use; and no traffic frustrations and parking challenges.

5.1.9 **Improve Quality of Life:** Strengthen community by getting people into public spaces.

5.1.10 **Enjoyment:** Riding transit can be a fun experience, spending more time in the community helps people feel connected.

5.2 **Partnering:** Building mutually beneficial relationships with a diverse group of external stakeholders and internal staff, management, board members, and others. Ensure early and ongoing dialogue to coordinate sustainability efforts, share results, and institutionalize an agency-wide

'culture' of sustainability. Provide appropriate funding and resources for sustainability education, training, and outreach functions.

5.2.1 Generate open, early dialogue with stakeholders.

5.2.2 Seek and utilize input from a broad cross section of stakeholders.

5.2.3 Align interests and develop collaborative goals.

5.2.4 Begin commissioning by creating measures to accompany goals.

5.2.5 Document meetings and distribute information to partners to promote common understanding and accountability.

5.2.6 Work with state and local officials to develop collaborative goals. Agree to the scope of the transit project as it aligns with relevant jurisdictional goals and programs. Seek input from stakeholders in relevant state and local jurisdictions. Authorities and agencies to consider include the following:

Examples of State agencies:	**Examples of Local agencies (City, County, other):**
Dept. of Transportation	Dept. of Transportation
Parks and Recreation	Parks and Recreation
Historic Preservation Office	Historic Landmarks
Environmental Quality	Water
Housing and Community Services	Housing Authority
Economic Development	Local and Regional Planning
Land Conservation	Economic Development
Economic Development	Environmental Services
Public Health	Arts and Culture

5.2.7 Provide adequate feedback and strong graphic component to outreach to ensure good public relationship and mitigate risk.

5.3 **Systematic Evaluations:** Multiple Account Evaluation is a systematic, comprehensive evaluation method, incorporating both qualitative and quantitative costs and benefits, used to compare and assess alternate projects or initiatives. Performance Management means tracking how an agency is performing and documenting results.

Measurement will allow the agency to monitor projects and programs to make them more effective, and to more efficiently use resources. Agencies should develop an internal or third party sustainability commissioning program. Those individuals charged with developing sustainability measures should meet with agency administration, human resources, legal, planning, operations, maintenance, marketing, and public affairs stakeholders to align interests, goals, opportunities, protocols, and reporting processes.

5.3.1 Establish sustainability metrics and measurement procedures.

5.3.2 Obtain third party verification of measurements and reductions.

5.4 **Life Cycle Assessment:** A tool to evaluate and weigh 'cradle to grave' environmental impacts and costs of materials and processes.

5.5 **Environmental Management Systems/ Sustainability Management Systems (SMS):** A systematic, comprehensive approach to managing environmental impacts (and social and economic impacts for an SMS) in ways that are best suited for each individual agency.

5.5.1 Establish resources and tools for use by employees, clients and the community on what sustainability means and how it can be achieved

5.5.2 Establish an in-house knowledge management system on sustainability

5.5.3 Establish employee green team(s) or other formal programs for employee input coordination/engagement in the organization's sustainability program

5.5.4 Achieve carbon neutrality and/or have a carbon neutral policy.

5.5.5 Delegate responsibilities, set-up and conduct employee training, and communicate EMS goals and procedures to employees.

5.5.6 Assess environmental impacts, goal attainment, and methods used to monitor and measure environmental impacts. Record past environmental issues and the mechanisms utilized to prevent recurrence.

5.5.7 Evaluate the system in terms of effectiveness and appropriateness for reaching agency goals. Identify new goals and make adjustments to the EMS.

6. Background and More Information

Information within this document is based on content from the Transit Sustainability Practice Compendium, which is a living document created by an expert team of transit practitioners. The Compendium is far more comprehensive in scope and detail, while this document is limited to high-level information.

The Compendium provides transit agencies with a broader range of best practices and case studies for improving their systems and achieving their sustainability objectives. It focuses on practices which are unique to transit. Best practices that are not unique the transit industry but are applicable to many aspects of transit facilities and operations – such as the LEED Rating System and ISO 14000 – are listed as Reference Standards.

The Compendium addresses all modes of transit, all service areas and all sizes of operations. Recommended practices attempt to consider the degree of control or influence transit agencies have in particular areas as well as expected environmental and social improvements. The compendium serves as:

- A reference book for transit professionals and decision-makers looking for tangible means to improve the sustainability of transit systems,
- An informational resource for (1) policy makers seeking a holistic approach to environmentally sustainable transit and (2) transit professionals, municipalities and communities looking to become more informed,
- A reference to promote a common language and maximize effective transit investments,
- A resource to highlight the need and advantages of partnerships, and
- A tool to aid in better understanding and accounting for the sustainability of current systems.

The Compendium is available on APTA's website.

Participating organizations and individuals:

Federal Government:

US Environmental Protection Agency (EPA)
– Jennifer Blonn, Carolyn Mulvhill, and Timonie Hood

Industry Association:

American Public Transportation Association (APTA)
– Rich Weaver, Jeff Hiott, and Petra Mollet

Transit Agencies:

Chicago Transit Authority (CTA) – Check Webber
Los Angeles Metro (LA Metro) – Aspet Davidian
Metropolitan Atlanta Rapid Transit Authority (MARTA)
– Jayant Patel and Nick Lawrence
Miami Dade Transit (MDT) – Albert Hernandez
New York City Transit (NYCT)
– Thomas Abdallah and Judith Kunoff
Regional Transportation District of Denver (RTD) – Andy Mutz
San Francisco Bay Area Rapid Transit District (BART)
– Tian Feng
Toronto Transit Commission (TTC) – Susan Reed Tanaka
South Coast British Columbia Transportation Authority of Vancouver (TransLink) – Michelle Blake
Tri-County Metropolitan Transportation District of Portland (TriMET) – Bob Hastings
Washington, DC, Metropolitan Area Transit Authority (WMATA)
– Joan LeLacheur

State Government:

Florida State University (FSU) – Melanie Simmons
Florida Department of Health (DOH) – Daniel Parker
Florida Department of Transportation (DOT) – Diane Quigley

International Consulting Firms:

Bechtel – Patricia Gaither
Jacobs Engineering Group – Mary Nowee and Bob Highfill
HDR – Lauren Casey
Parsons Brinckerhoff – Susannah Kerr Adler
VIA Architecture – Catherine Calvert and Alan Hart