REBUILDING AMERICA:

APA NATIONAL INFRASTRUCTURE INVESTMENT TASK FORCE REPORT

American Planning Association
REBUILDING AMERICA:
National Infrastructure Investment Initiative

Making Great Communities Happen

ACKNOWLEDGMENTS

APA's National Infrastructure Investment Task Force, Rebuilding America, was created to evaluate the current conditions and challenges affecting the nation's vital infrastructure, develop a new vision for that infrastructure, and identify recommendations for changes in public policy and planning practice. Through the Rebuilding America, APA is working to engage our members, allies and partners in a national conversation about how to avert an impending infrastructure disaster in this country. Rebuilding America is part of APA's Sustaining Places Initiative, a multi-year, multi-faceted program to define the role of planning in addressing all human settlement issues relating to sustainability. We want to thank the countless volunteers who poured their hearts into this report, particularly those that served on the sub-task forces, organized or participated in regional field hearings and the many chapters of APA that have or are organizing town hall meetings on this report across the country. We also want to thank APA's excellent staff for providing guidance, leadership and insight for this project.

APA is an independent not-for-profit education, research, and advocacy organization devoted to urban, suburban, regional, and rural planning. Through serial publications, research monographs, online resources, and distance and face-to-face training, we reach frontline professionals and decision makers. With more than 40,000 members and established partnershipswith numerous academic, nonprofit, and public institutions, APA is connected to the innovative thinking and the practical realities of the planning profession.

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INTRODUCTION

On August 1, 2007 during the evening rush hour the Interstate 35 bridge over the Mississippi River collapsed unexpectedly killing 13 people and injuring 145. While this tragedy was the most visible example, it was only one of many cases of infrastructure failure that demonstrated the growing crisis facing America. At the American Planning Association (APA) 2008 National Conference in Las Vegas Congressman Earl Blumenauer (D-OR) delivered the Opening Keynote address, and called for planners to take a leadership position on addressing the national infrastructure crisis and identifying real solutions. He noted that it is clearly time for a new infrastructure program for the 21st century — a program that would also necessarily consider the ***new*** infrastructure of aviation, green infrastructure, telecommunications and the internet. The congressman concluded by asking planners to show the same passion they show on their jobs in becoming more active on the local level. Specifically, he called for the involvement of planners in each congressional district to bring forward issues that could form a foundation for a new infrastructure plan.

In 2009, APA celebrated the centennial of the planning movement in the United States. As we look ahead, it is clear that in the next 100 years, our communities will face some of the greatest challenges they have ever faced. Issues of sustainability, climate change, globalization of the economy and of course infrastructure decline will challenge our members and the communities we live in and serve. Planners must act as key leaders in preparing our communities to face these new challenges and help them become places of lasting value. APA must be at the forefront in preparing our members and the general public for these challenges.

Last May, APA celebrated the Centennial of the American planning movement with a symposium at the National Building Museum in Washington D.C.. The symposium focused on what has happened in the last 100 years and contemplated what might happen in the next 100 years of planning in this country. Several clear themes emerged from the proceedings. First, successful planning reflects the context within which it is performed. There is no single process, program, or policy that provides a universal or timeless answer. Second, the world continues to change, often rapidly, and planning and planners must adjust to that changing context and reinvent themselves, their plans and communities to remain effective. Third, and most important, the planning profession is most effective when we are able to educate, advocate, and advance our ideas and ultimately see them implemented. This reflects the need for planners to be skilled leaders, motivators and communicators with the ability to sell their ideas and promote change. Applied to the context of Rebuilding America, it reflects the need for planners to reengage in, and reinvent capital planning, to develop plans for growth that don't require unsustainable expansion of infrastructure and to educate policy makers on the importance of adequately funding the maintenance of this key investment.

APA's National Infrastructure Investment Task Force, **Rebuilding America**, was created to evaluate the current conditions and challenges affecting the nation's vital infrastructure, develop a new vision for that infrastructure, and identify recommendations for changes in public policy and planning practice. Through the Rebuilding America, APA is working to engage our members, allies and partners in a national conversation about how to avert an impending infrastructure disaster in this country.

It is APA's position that we can no longer just engineer our way out of our infrastructure problems. Rather we need to recognize the connection between how we plan for the growth and development of our communities with the impact it has on the infrastructure needed to serve it. In many communities planners are not involved in the capital improvement planning process. Through Rebuilding America, APA hopes to provide our members and their communities with new models for planning for infrastructure to ensure that investments are made strategically, in keeping with a vision for the future, and that they promote sustainability.

Our Rebuilding America initiative began with a National Design Professionals Forum in Washington D.C. conducted as a partnership between the American Planning Association, American Institute of Architects and the American Society of Landscape Architects, followed by a series of Regional Field Hearings to collect information on infrastructure issues across the country. Next, a series of sub-task forces were charged with developing recommendations specific to individual infrastructure systems. The work of these sub-task forces is highlighted in this report and includes recommendations for transportation, energy, green infrastructure, water and wastewater, technology and telecommunications and other public facilities. APA's next step is to hold at least 100 Town Hall Meetings across the country to gain input into this report, refine it, improve it and finalize it as a guide for communities across the country to use in addressing their infrastructure issues. APA also intends for the report and its findings to inform development of new legislation to fund construction of the infrastructure of the future, recognizing that we have no choice but to evolve away from the inefficient and unsustainable practices of the past.

We want to thank the countless volunteers who poured their hearts into this report, particularly those that served on the sub-task forces, organized or participated in regional field hearings and the many chapters of APA that have or are organizing town hall meetings on this report across the country. We also want to thank APA's excellent staff for providing guidance, leadership and insight for this project.

In closing, we call upon planners across the globe to take a leadership role in addressing the growing infrastructure crisis in America and across the world. Now is the time for our profession to step up and demonstrate how planning can make a difference, not only in solving the national infrastructure crisis, but in building communities of lasting value.

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SECTION 1: TRANSPORTATION INFRASTRUCTURE

INTRODUCTION

In many ways, transportation infrastructure forms the backbone of the U.S. economy and our quality of life. Economic activity is dependent on an efficient and well-maintained system of roads and highways, bridges, rail lines, sidewalks, paths, and transit. Continued investment in our Nation's transportation is essential to keep our economy growing. But the current system is at a crossroads: roads and highways are aging, maintenance needs continue to grow, costs of maintenance and new infrastructure are increasing, and revenue levels have remained generally flat.

The challenges are manifested at the national level, where according to the American Society of Civil Engineers (ASCE) transportation infrastructure receives an overall grade of C-minus[1]. In addition, congestion costs have crept past $85 billion per year, and the estimated cost to repair and upgrade the current system is $225 billion per year. Local jurisdictions also face challenges, with increasing expenses for pothole repair and other maintenance, while their budgets become tighter.

These trends have spurred calls for a substantive change in how we treat transportation infrastructure at all levels. In 2007, a Congressionally-mandated Commission identified the "Consequences of Inaction":

- The Nation's transportation system that is already in disrepair will further deteriorate.
- Safety conditions will decline, potentially adding to the 37,000 annual roadway deaths and 2.6 million injuries.
- Congestion will worsen, both expanding to areas not currently affected and extending into longer hours of the day.
- Economic development will be threatened if goods cannot be reliably and efficiently moved.
- Underinvestment in all travel modes will continue, and all modes combined will not be able to meet future demand.
- Transportation policies and other national policy goals may be in conflict.
- Transportation financing will be continue to be politicized, preventing the public from developing confidence that infrastructure investments are reached in the public's best interest.
- Excessive delays in making investments will continue to waste public and private funds.

The nation currently has significant opportunities to address these issues through the realignment of federal, state, and local transportation policies. Transportation infrastructure can be improved through multiple means: increased funding, improved planning, and expanded performance measures and establishing clear objectives at local, state, and federal levels. In all likelihood, improving our transportation systems locally and nationally will require all of the above, combined with a commitment to re-thinking how we prioritize transportation investments, and how we integrate transportation and land use decision-making.

The planning profession is well poised to facilitate this needed shift in how we approach future investment in our transportation systems. Because planners look beyond the functionality of the infrastructure and focus equally on the contextual outcomes associated with transportation investment, planners can play a critical role in development of local capital investment programs and infrastructure investment decisions. With needs in excess of available funding, the skills planners bring are increasingly valuable to developing sustainable transportation investment programs. From developing the long-term vision for regional and state mobility to formulating alternative scenarios for realization of that vision, planners are relied upon to frame the decision-making context and guide the system evaluation and resulting investment choices at all levels of government.

Planners bring to transportation decision-making a broad perspective across the social, economic and environmental values needed to enhance the responsiveness of transportation choices to community needs. Through a comprehensive set of analytical tools – from financial planning, environmental review air quality and greenhouse gas assessment, system performance measurement, travel demand forecasting and land use scenario development, to the capital investment program formulation process - planners move the discussion beyond the concrete and steel to focus on broader issues fundamental to the creation and maintenance of sustainable, vibrant communities. This comprehensive approach enhances the ability of decision-makers to weigh options and evaluate trade-offs necessary to achieve regional and local goals through more efficient and effective use of transportation dollars.

There is no "silver bullet" to the transportation challenges we face. Improving the transportation system will require an assessment of our future needs, on the scale of what occurred when the National Highway System became our nations' top surface transportation priority. The completion of the National Highway System now provides the opportunity to diversify our transportation system through advancement of other modes to complement prior investments in our surface transportation and air transportation network, such as inter-city High Speed Rail, regional mass transit systems, and local bike and pedestrian circulation systems. This chapter is intended to show how tools and expertise from the planning profession can contribute to rebuilding our nation's transportation infrastructure as we contemplate the future of our existing and planned systems, and how we might better leverage prior investments to realize a more sustainable, multimodal transportation future.

FRAMEWORK FOR TRANSPORTATION PLANNING AND POLICY

The framework for transportation decision-making in the United States is driven by a number of federal, state and local laws and regulations, in combination with available funding programs. Much of the policy choices occur at the state and local level flows from federal policy and priorities, as a significant proportion of funding available for transportation infrastructure flows from

federal sources. Hence to achieve results, reforms to improve the effectiveness of transportation system planning, delivery, and operation must begin with restructuring of federal programs. However, there are also measures that can be undertaken at the state, regional and local levels to foster more effective and efficient investment in transportation infrastructure. The decision-making process can be improved by a better integration of transportation choices in ways that will lead to more livable, sustainable and economically vibrant communities.

In rethinking America's transportation infrastructure future, several key aspects of our current federal, state and local framework for transportation decision-making must be addressed:

- The lack of balance among federal, state and local decision-making, resulting in decisions that do not fully support transportation goals at any level of government.
- Restrictions and limitations in funding programs that inhibit leveraging of federal investment across programs such as housing, environment and transportation, even though all of these investments may affect the same community or jurisdiction.
- The program- based "stove-piping" of the elements comprising our transportation system that results in fragmentation of decision-making and limited consideration of integrated, multimodal solutions, including separations such as those related to surface and air transportation, and goods movement/freight and the movement of people, even though these functions are dependent on common infrastructure
- Difficulties inherent in reconciling public and private sector regarding land use decision-making with transportation decision-making at local, regional, state, and federal levels.
- The lack of regional collaboration beyond jurisdictional boundaries, and the extent to which jurisdictional boundaries and program level administrative barriers pose impediments to more efficient and effective transportation decision-making.
- Limitations on data availability and technical tools to support more comprehensive decision-making both across jurisdictional boundaries, as well as with other public infrastructure investment.

The following sections explore critical issues related to planning process, project development and funding for our nation's transportation system, and the role of federal, state and local frameworks in determining what transportation choices we make.

Federal Framework

Federal policy plays a major role in shaping transportation infrastructure; provisions in transportation legislation guide the federal expenditure of more than $50 billion per year for roads and highways, public transit, rail, and non-motorized infrastructure. These funds mostly go to state transportation departments, metropolitan planning organizations, and transit agencies to actually build or operate facilities, but the rules establishing how the money can be spent are provided in federal legislation and policy. They effectively determine the form and quality of the country's interstate, regional, and local transportation systems.

There are five key elements of current national transportation policy, as reflected in the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU):

1. *Transportation is viewed as a multimodal system*, with funds going to highway and transit projects either through allocation by formula or through discretionary programs. The formula programs allow states the flexibility to shift funds based on local priorities while the discretionary programs require applicants to compete nationally based upon criteria consistent with advancing specific federal interests. Formula funds primarily go into the Surface Transportation Program, which may be used by states and localities for projects on any Federal-aid highway, including the National Highway System, bridge projects on any public road, transit capital projects, and intracity and intercity bus terminals and facilities. Major capital projects are also funded by discretionary programs, such as the Federal Transit Administration's New Starts Program for fixed-guideway transit, and the Federal Railroad Administration's recently established initiatives for investment in High Speed Rail.
2. *Minimum funding* levels are guaranteed to the states. Overall funding is based on Highway Trust Fund receipts, mostly from the "gas tax." Each state is then ensured a minimum return of gas tax revenue collected from the state; the amount is currently 92 percent.
3. *Collaborative multimodal planning* is required, with Metropolitan Planning Organizations (MPOs) playing a key role in the development of regional transportation plans that set priorities and allocation of resources among potential investments. The planning process is intended to allow local flexibility, make resource use more efficient while ensuring that multiple stakeholders are involved in the planning process. MPO plans should identify transportation projects that are consistent with State and local planned growth and economic development patterns. Plans must address environmental mitigation, improved performance, mutimodal capacity, enhancement activities (see below), and tribal, bicycle, pedestrian, and disadvantaged interests are to be represented.
4. *Congestion Management* is an important objective, with large MPOs required to develop congestion management plans. The Congestion Mitigation and Air Quality program directly funds air quality improvement projects.
5. Provisions for *Transportation Enhancements* allow highway funds to be used for pedestrian and bicycle facilities, acquisition and improvement of scenic and historic sites, rehabilitation of historic transportation facilities, and

other similar purposes. Up to ten percent of each state's Surface Transportation Program funds are available for Enhancements.

The role of transportation planners is to think comprehensively and integrate various perspectives to help identify some critical issues not currently addressed by federal transportation policy, and explain how those issues and perspectives can become opportunities to enhance the transportation system. Perhaps most importantly, current federal policies and programs do not establish clear national priorities for transportation investments, and priorities are fragmented across modal programs. The lack of comprehensive, integrated national priorities that guide transportation planning and investment for both people and goods limits the effectiveness of state and regional transportation plans.

In its recently adopted "Surface Transportation Policy Guide," APA calls for a "national vision to guide Congress, states, metropolitan planning organizations, and others in developing, implementing and operating "next generation" transport networks, just as it had during the development of the Interstate (Highway) System. A unified vision is essential to maximize economic growth and reduce wasteful internal competition for scarce resources and funding." [2]

The APA Policy Guide identifies several key elements to such a national transportation vision:

- an emphasis on **pedestrians** (including elderly, young and disabled pedestrians) as the foundational element of mobility and access.
- **bicycling** as a viable transportation mode that includes development of connected on-road and off-road facilities designed to accommodate all types of users
- an increased emphasis on **public transportation**, including buses, passenger rail, and other modes, as a principal way to meet the mobility and access needs of our metropolitan regions.
- **high-speed rail and intercity passenger rail networks and intermodal passenger facilities** that can help to meet a significant portion of the travel demand currently being met through short-haul commercial aviation to connect communities across the country.
- **enhanced clean waterborne transportation** and associated intermodal transportation for both movement of goods and people as a key element of economic vitality in our metropolitan regions.
- use of **highways** as a component of overall multimodal transportation plans where necessary to meet specific mobility objectives that cannot be met effectively through other modes.
- Expanded use of **Transportation Demand Management** (TDM), including but not limited to such programs as ridesharing coordination through social networking, vehicle and bicycle sharing programs, and "safe routes to schools" programs.
- **Transportation Systems Management** (TSM) that improves the efficiency and safety of transportation system operations.

The APA Policy Guide supports a greater focus on transportation policy and funding authority within the country's metropolitan regions, to strengthen urban centers, improve multimodal connectivity within and between metropolitan regions, and to reinforce the metropolitan planning process for transportation decision-making. The Policy Guide states that "metropolitan regions are where our nation's transportation and economic needs converge. With three-fourths of our nation's population living in urban areas, the metropolitan regions have increasingly become the country's economic engine, and need empowered leadership and expanded funding authority and flexibility to meet their growing multimodal transportation needs."[3] At the same time, APA also supports planning for and provision of effective transportation in the nation's non-metropolitan areas, and recognizes the importance of rural planning organizations as part of a coordinated transportation planning and decision-making framework. This promotes flexibility and equality by focusing on farm-to-market access and other connectivity options without promoting sprawl into exurban and rural areas.

The current federal transportation law is likely to be reauthorized between 2011 and 2012, presenting a major opportunity to establish a new national transportation vision. At the same time, federal transportation reauthorization provides an opportunity to address other deficiencies in how transportation funding is linked to a national transportation vision:

- The respective roles of State DOTs and MPOs vary widely between jurisdictions, as does the effectiveness of regional coordination efforts. In some places, DOTs and MPOs have conflicting visions for transportation systems, making effective governance difficult.
- Despite the flexibility permitted in current legislation, opportunities to implement flexible funding have not been exercised by most states. In addition, increasing use of political "earmarks" can bypass the intended planning process without ensuring the most beneficial use of funds.
- With declining revenue from the federal gas tax, which (1) comprises the majority of federal transportation funding and (2) has not been increased in two decades, the challenges of providing an efficient and effective transportation system will grow. The reliance on a gas tax also creates an unintended effect where states need to increase gas consumption and vehicle traffic volumes in order to maintain funding levels. Unless the federal government establishes new transportation revenue sources, and/or restructures the gas tax to eliminate its unintended effects on highway travel, the pressures on states and local jurisdictions will continue to worsen.
- It is widely recognized that transportation plans interact with

land use plans and economic development plans, yet there is no federal requirement for integration of these planning processes. Aligning the objectives of plans, and improving our understanding of their symbiotic and interactive effects, could enhance the implementation and enhance the desired outcomes; continuing without integrated planning might exacerbate instances where outcomes counteract each other.

In addition to the upcoming transportation reauthorization legislation, a national climate policy would likely affect transportation investments. Most proposals would place a price on carbon, creating a two-fold effect on transportation infrastructure. First, the carbon price would increase the cost of transportation fuel, reducing overall travel as consumers seek to reduce costs. Second, most proposals would enhance transportation-related infrastructure, ranging from directly funding the Highway Trust Fund and Surface Transportation Program, to establishing incentives to promote lower-emission transportation modes, or supporting new technologies that would potentially change how people travel.

In addition, current proposals (including the American Clean Energy and Security Act, which has passed the House of Representatives) require the Environmental Protection Agency (EPA) to establish national transportation-related Greenhouse Gas (GHG) emissions reduction goals. This proposal would require that each state and MPO also develop GHG reduction targets and plans to meet the targets. The plans would then influence the development of transportation infrastructure, which must comply with the GHG targets. Revenue from the carbon pricing mechanism might also be used to help fund programs that reduce GHG emissions.

These two federal policies—surface transportation reauthorization and climate policy—have the potential to dramatically reshape the transportation system in the U.S. Although the guidance for these policies will come from the federal level, the programs – including most transportation planning, system repair, and construction - will be implemented primarily at the state, regional, and local levels.

State Framework

While the federal government plays a strong role in setting policy for transportation system planning investment, state governments also play a significant role in influencing transportation investment decisions through long-range transportation planning and mid-range transportation improvement programming.

State Long-Range Transportation Plans

Statewide transportation plans are written from the perspective of providing broad direction from a comprehensive and long-range standpoint. State plans are typically 20 year planning tools, calling for billions of dollars to implement hundreds of projects. Often the State-wide plan will incorporate the regional plans developed by the Metropolitan Planning Organizations. Each State plan contains projects and approaches to drafting the plan that are of regionally appropriate and unique to the needs of that State.

Topics covered in a typical State long range transportation plan include the following:

- Transportation System Update (Aviation, Bicycles and Pedestrians, Freight Railroads and Intermodal Facilities, Highways, Intercity Passenger Services, Public Transit, and Waterways and Ports)
- Trends, Issues, and System Conditions
- System Preservation and Maintenance
- Mobility and Reliability
- Transportation Safety
- Global Competitiveness and System Security
- Environmental Coordination and Quality of Life
- Transportation Funding
- Metropolitan Planning Organizations
- Public Involvement

In states where MPOs have developed sophisticated long range transportation plans, the role of the state plan has shifted toward a focus on interregional transportation issues. For example, "California Interregional Blueprint" (CIB) will provide the basis for the next update to the California Transportation Plan (CTP 2040) to be completed by 2015. The CIB will analyze the impact of multimodal interregional projects, under consideration in the state and regional agencies' long-range plans, on the overall statewide transportation system. It also will serve to expand the understanding of the interactions between land use and transportation investments in meeting critical climate goals. The ultimate benefit of this effort will be stronger partnerships with regional and local agencies and tribal governments, and better data for improved decision making at the State, regional, and local level.

State Transportation Improvement Programs

The Transportation Improvement Program (TIP) is typically a staged multi-year program that prioritizes transportation improvement projects for federal, state and local funding. The TIP is also the capital improvement element of the long range state transportation plan. The TIP has a role in putting the transportation plan into action as it not only lists specific projects, but also the anticipated schedule and cost for each project. The U.S. Department of Transportation will not approve use of federal funds for an improvement unless the project is identified in the TIP. Inclusion in the TIP does not, however, guarantee federal funding. The TIP is fiscally constrained with reasonable estimates of project costs balanced against anticipated funding. Projects not funded by the federal government are included in the TIP to provide a more comprehensive picture of the proposed allocation of transportation funds in the region. In accordance with most State laws, the first three years of the Adopted Work Program is intended to represent the state's commitment to undertake transportation projects that local governments may

rely on for planning purposes, and for the development of capital improvement elements of the local governments' comprehensive plans. The projects must meet the objectives and priorities of the State's adopted transportation plan.

Funding Sources

Funding sources for improvements to roadways and transit have numerous formula and discretionary sources such as state motor fuel tax, motor vehicle license fees and road impact fees, and automobile related user fees such as tolls. However, traditional funding sources such as the gas tax are no longer likely to provide the funds necessary to sustain and expand transportation infrastructure, and alternative sources, such as public-private partnerships and carbon taxes are under consideration to meet future funding needs.

Regional Framework

Regional transportation planning is guided by a combination of federal and state legislation. On the federal side, the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) share responsibility for oversight of metropolitan area transportation planning. These planning requirements are carried out by Metropolitan Planning Organizations (MPOs) and public transportation operators. MPOs are authorized by Title 23, Chapter 1, Section 134 of the United States Codes (23 USC 134) in 1964. 23 USC 134 requires each urbanized area, as a condition of the receipt of Federal capital or operating assistance, have a continuing, cooperative and comprehensive transportation planning process that results in plans and programs consistent with the comprehensively planned development of the urbanized area. Cities, counties, and transit agencies within the MPO boundary as well as the State Department of Transportation are members of the organization.

MPOs with populations over 250,000 are considered Transportation Management Authorities (TMAs) and have a direct relationship with the FHWA. MPOs with populations under 250,000 obtain their funding through their State Department of Transportation and have an indirect relationship with FHWA. Transit agencies in urban areas have a direct relationship with the FTA.

Federal regulations set out several requirements for these plans and programs, and include special requirements for metropolitan areas that are classified as or include an air quality non-attainment area. Ultimately, it is the MPO governing board that adopts the final plans and forwards them to the state for inclusion in the statewide plans and investment programs.

In some states, metropolitan planning is also guided by State Legislation such as growth management acts and regulations. Growth management attempts to direct priorities for land use development by establishing criteria for development of urban systems, such as transportation, wastewater management, ecological environs, and further serve to protect agricultural lands threatened by urban encroachment.

State and local initiatives to expand sustainability plans and practices while reducing greenhouse gas emissions are becoming more prevalent and also serve to guide transportation system planning and development. The transportation sector generates half the greenhouse gases in the United States. While the federal government has been slow to develop policy aimed at reducing mobile sources of greenhouse gas emissions, state and regional governments are beginning to take aggressive steps in reducing vehicle miles traveled particularly by single occupant vehicles. It is difficult to get people out of their cars when there are limited alternatives available for urban travel. Investment in major fixed guideway transit infrastructure is one popular approach. Investment in commuter rail, light rail, streetcars and bus rapid transit (BRT) systems has become a priority in major metropolitan areas. Other measures being considered include aggressive tolling to manage traffic flow and generate needed revenue to re-invest in urban transportation system reservation and efficiency

Regional Long-Range Transportation Plans

One of the major requirements in federal law is that every MPO prepare a long-range Metropolitan Transportation Plan (MTP) covering a minimum period of 20 years, which must be coordinated with the plans of all local jurisdictions within the planning area. The MTP must be updated at least every five years, or four years in areas with air quality problems. The MTP is required to include an assessment of transportation supply and demand for the metropolitan areas; operational and infrastructure investment strategies to improve the condition and performance of the system; and a financial plan that shows how the MTP can be implemented.

Systems Development

Federal guidance requires that transportation systems planning be continuing, comprehensive and coordinated. Air quality non-attainment regions, designated by the Environmental Protection Agency (EPA), are further required to demonstrate air quality conformity.

Federal laws lay out the basic requirements for metropolitan transportation planning. These laws and regulations set out guidance the MPO must follow, but do not dictate the decision-making or priority setting process. Generally speaking, when developing transportation system plans, MPOs have the authority to establish guiding principles that reflect the values of the region. These principles can be reflected in statements related to improving traffic level-of-service, reducing greenhouse gas emission from mobile transportation sources, or increasing the mobility options and connectivity of regional neighborhoods and urban centers. The regional plan is shaped to support the guidance adopted by the MPO Board and includes all modes of surface transportation, including non-motorized.

Systems Management

System management is a central component of transportation planning. Before planning for expansion, metropolitan regions find it valuable to ensure that existing systems are being utilized

to their highest and best use. This includes system preservation activities as well as development of policies that seek to optimize system performance. System management is increasingly important in an environment of limited transportation revenue. Aggressive system preservation extends the useful life of infrastructure and delays the need for major infrastructure rehabilitation and replacement. Unfortunately, system preservation needs have historically been underfunded. System performance policies, such as activities to decrease peak system demand, reduce congestion, and increasing public transportation system utilization, help to sustain the system and improve traffic flow and carrying capacity.

Demand Management

Closely related to system performance is transportation system demand management. Transportation demand management serves to improve system efficiency of the transportation network by making investments to improve alternative transportation systems. Policies related to enhancing public transportation system ridership, expanding telecommuting opportunities, increasing high occupant vehicle utilization and incentivizing alternative work week policies by employers all serve to manage peak system demand.

Regional Transportation Improvement Programs

Transportation Improvement Program (TIP) sets forth the priorities of the region for near-term expenditures. Transportation improvement programs (TIPs) allocate funding to specific policies and projects that receive federal funding assistance. All projects funded in the TIP must meet the criteria established in the long-range plan. Any new project identified in the TIP must first be included in the long-range plan either through original adoption of the plan or amendment of the plan.

Funding Sources

Regional transportation funding is interconnected with federal, state, and local funding, and regional decision-making generally focuses on prioritizing limited transportation funds – the need usually far exceeds the level of revenue. More and more states and regions across the country are exploring revenue generating alternatives, such as higher gas taxes, new or expanded use of and vehicle licensing fees, user fees (such as tolls), and contributions from new development (such as regional development impact fees).

In addition, for transportation system investment many regions are appealing to local voters to come up with expansion funding, in many cases through initiatives that call for sales tax or property tax increases with funding directed to high priority regional transportation investments. For example, in 2008 there were 33 ballot measures for regional public transit investments across the country. Voters approved 23 percent of these regional funding initiatives, representing nearly $75 billion in investment. In many cases, these funding initiatives are used to provide the local match for federal transit project funding, thus leveraging the commitment of local revenues.

Finally, there is growing recognition that congestion pricing (for example, use of variable toll pricing on managed highway lanes to maintain traffic flow at acceptable levels of service) is an effective tool for transportation system management and can generate significant revenues that can be used for transportation system development and operations. For example, the revenues obtained from operating a high occupancy toll network within a region can be used to cover the costs of operating the network and can also be directed to covering the operating costs of public transit services provided within the same corridors. Similarly, the use of parking pricing to reduce auto travel within urban areas that are well served by public transit can generate revenues that can be used to cover transit capital and operating costs.

Local Government

While long range transportation planning is guided by federal policy, and is implemented at both the state and regional level, local governments continue to play an important role in the planning of transportation systems.

Transportation elements of local comprehensive plans

Whether state-mandated or self-imposed, transportation elements of local comprehensive plans normally have some basic and common features. The base year of the plan establishes the inventory of existing conditions for a city's multimodal transportation network. Adopted land use, population, housing, and employment assumptions from the land use element are then entered into a software-based transportation model to produce 10- and 20-year forecasts of travel demand and transportation infrastructure performance. The reliability of forecast output from transportation models is dependent on the quality and accuracy of the input variables, and output will change as input changes, but there is value in using travel demand models as long-range predictive tools for planning transportation infrastructure needs.

Travel demand forecasts indicate where transportation infrastructure is projected to fall below adopted levels of service (LOS) standards. A jurisdiction then decides whether the existing and/or forecast condition warrants a policy approach or funding and construction for additional capacity to maintain the adopted LOS in the plan. Identified long-range transportation needs are translated into long-range transportation project lists, which are typically adopted in transportation element and used to inform annual transportation and capital improvement plans. Some jurisdictions prioritize the long-range transportation project lists in the comprehensive plan based on factors such as land use, housing, transit, and non-motorized transportation goals and policies. Some jurisdictions do not prioritize project lists in order to maintain maximum flexibility to respond to funding opportunities and unforeseen and changing circumstances.

In places with state-mandated long-range planning, jurisdictions must demonstrate that they can finance needed transportation improvements. If they cannot then the growth

assumptions in the land use element and the travel demand forecast model must be adjusted to reduce impacts to transportation infrastructure capacity in order to maintain the adopted LOS standards in the plan. This is typically demonstrated in the capital facilities element of a comprehensive plan and the capital improvement portion of annual budgets.

Another important aspect of transportation planning that is addressed primarily at the local level is provision of parking. The APA Surface Transportation Policy Guide recognizes the importance of planning and management of parking facilities in relation to overall transportation systems planning. The Policy Guide recommends that communities "provide the parking supply needed to meet community demands in a cost-efficient and equitable manner while being careful not to create inducements to encourage more driving or reduce the walkability of the community. Communities should manage the parking supply to maximize utilization in commercial areas, minimize the impacts on residential areas, and enhance user convenience while employing equitable, fiscally-sound, and environmentally sustainable practices. In order to allocate the scarce parking resource (and the most valuable, on-street parking resource), communities should allow the market to dictate the value of the space. Meter rates should be set at the lowest price necessary to achieve 85 percent occupancy – the rate that represents the best balance between making it easy to find a space while maximizing utilization. This will require differential rates by location, with higher rates in the most dense commercial cores, and time of day. "[4] A local government should address these policy issues in its comprehensive plan, and should provide guidance regarding provision of parking in a manner that complements other transportation and land use goals contained within the plan.

Local Transportation Improvement Programs / Capital Improvement Programs (TIP/CIPs)

Transportation Improvement Programs (TIPs) and/or Capital Improvement Programs (CIPs) are typically developed by local governments on an annual basis to demonstrate how public funding is to be invested in transportation infrastructure improvements over a particular time period. Six years is the most typical time period reported in TIPs to account for the time necessary to program enough money for designing, engineering, and construction of transportation infrastructure.

TIPs are often required for each jurisdiction by State governments and/or Regional Transportation Planning Organizations (RTPOS) and/or Metropolitan Planning Organizations (MPO) and are used locally to inform the budget and the overall CIP for each jurisdiction. Most States, MPOs, and RTPOs require that full funding be shown for all projects listed in the first three years of the six-year time period. If full funding is not available for the project, then it must be listed in the second three-years of the six-year time period.

Almost all state and federal grant funding agencies require jurisdictions to have applicable transportation improvement projects adopted in both a comprehensive plan and a local TIP as one of the primary criteria for project eligibility for grant funding. Inclusion in these planning documents demonstrates a jurisdiction's commitment to a project. A local matching fund, or a percentage of the overall project cost, is usually required as well.

Funding Sources Available to Local Governments

A wide variety of funding sources are available for transportation infrastructure. Some are competitive, some are controversial, and some are politically unpopular. Most transportation infrastructure funding is limited and overall local transportation needs are chronically underfunded.

1. Street or Road Funds – Most local jurisdictions have a base source of funding called a Street or Road Fund, which is derived from a percentage of annual local sales tax and/or gas tax receipts. This funding source is most often used for basic maintenance of the jurisdiction's transportation infrastructure, such as arterial resurfacing, with some funds used to leverage additional funding from other sources.
2. Retail Sales Tax. Many transit agencies rely upon a tax on retail sales for maintaining and operating transit service.
3. Real Estate Excise Taxes (REET) – Some jurisdictions collect Real Estate Excise Taxes, which are based on fractions of percents of receipts for sales of homes in the community. These types of funds are most often used to accomplish adopted community goals, such as non-motorized transportation system improvements.
4. Transportation Impact Fees (TIF) – Some states have enabled local jurisdictions to adopt ordinances that assess fees for new development based on the impact to local transportation facilities. The impact of a new project is typically measured by vehicle trip generation rates established for various land uses based on square footage or number of employees, such as those listed in the Trip Generation Manual published by the Institute for Transportation Engineers. The measured impact is then multiplied by an established base rate derived from the overall investment that the jurisdiction has made, or intends to make, in overall transportation system improvements over time. The base rate can be static or changed annually, and represents a proportional fair share unit cost of the overall investment in transportation infrastructure. In this sense, TIFs are a way for a jurisdiction to recoup a portion of the cost of accommodating new development, or growth helping to pay for the cost of growth.
5. Partnerships with other agencies – Many local jurisdictions enter into funding partnerships with other jurisdictions, transit agencies, tribes, and/or private businesses to combine funding sources to construct transportation infrastructure that results in benefits for all partners.
6. General Obligation Bonds – Jurisdictions can use their local bond ratings to borrow money and finance transportation infrastructure, but this is only typically done when there is a great deal of funding needed for a

project that is considered vital to a community, such as a bridge or perhaps airport or marine port expansion.

7. Local Infrastructure Financing Tool (LIFT) – Some states have enabled local jurisdictions to use a funding mechanism called a Local Infrastructure Financing Tool (LIFT), which is based on the amount of total sales taxes collected in a community by the State. LIFT programs are approved for specifically designated areas approved by the State and allow a jurisdiction to receive matching funds from the State for every dollar spent on transportation infrastructure up to a maximum amount.
8. State grants – All States support grant funding agencies that issue annual or biennial calls for project submittals when funding is available in the State budget. Most State grant funding programs are competitive with specified purposes, limited funding, specific criteria, and submittal deadlines.
9. Federal grants – The federal government also supports grant funding agencies that issue annual or biennial calls for project submittals when funding is available in the federal budget. Most federal grant funding programs are competitive with specified purposes, limited funding, specific criteria, and submittal deadlines.
10. Transportation Benefit District (TBD) – Some states have enabled local jurisdictions to create Transportation Benefit Districts (TBD) to assess a user fee in addition to the State-imposed licensing fee) for each motor vehicle that is registered and licensed within the corporate limits of the jurisdiction. Typically, a local legislative body can impose the user fee, up to a certain amount per vehicle, simply by establishing the boundaries of the TBD and adopting an ordinance without voter approval. If the user fee is above a certain amount per vehicle, then voter approval is required. There is also typically a maximum user fee that can be collected per vehicle. The user fees collected within the TBD must be spent within the TBD, but can be used for both maintenance and capital improvements to the transportation system.
11. Levy – Some jurisdictions have chosen to use voter approved levies such as increasing property taxes, to fund specific types of improvements to the transportation system, such as sidewalks or bicycle lanes. A jurisdiction may propose a package of improvements or a certain measurable amount of improvements per year, with a given cost, and ask the voters to help pay for it in a local election. If approved, each property within the jurisdiction is assessed a proportional fair share of the overall cost based on assessed valuation of property. These types of levies are usually for community-wide transportation infrastructure benefits and normally have specific time frames, such as 10 years or so.
12. Local Improvement Districts (LID) – Individual property owners may agree to assess themselves for the cost of having a local jurisdiction make transportation improvements by establishing Local Improvement Districts (LID). Similar to a voter-approved levy, the residents agree to pay a proportional fair share cost for the improvements based on property valuation. This type of funding mechanism is most often used for installing sidewalks, street trees, street lighting, etc.
13. Bridge/Highway Tolls – State and local governments (and in some cases regional governments) can impose tolls to collect money from system users to help pay for transportation infrastructure over time. It is also possible for tolls to be used as a revenue source for further investment in the transportation system once the infrastructure originally financed is paid for, but this is required to be established in the enabling legislation to create the tolling system. Bridge tolls are common, but more recently there have been highway improvements funded by High Occupancy Toll (HOT) lanes.[5]
14. Street Utility Fees – Some State have enabled local governments to establish Street Utilities, much like sewer or water utilities, which are essentially self-sustaining enterprise funds derived from user fees based on annual upkeep needs of system infrastructure. Fees are derived from property tax assessments, just like non-metered sewer and water utility fees.

Policy Recommendations

- Create a new national transportation vision, with goals and performance measures to guide planning and implementation of the integrated intermodal transportation system of the future.
- Establish equitable, sustainable and flexible funding streams for both capital and operations, considering the full costs of highway systems and other transport systems and providing equitable funding support for both.
- Recognize the importance of parking policy in meeting overall transportation planning goals, at both a local and regional level.
- Recognize the opportunities to use congestion pricing as both a transportation management strategy and a revenue source that can help cover the cost of system improvements and operations.

The Relationship of Transportation Planning to Comprehensive Planning

At every level of government, many leaders are becoming increasingly conscious of the need to integrate planning for housing, economic development, the natural environment, quality place, and urban form with transportation. Rising fuel prices, environmental concerns, the recent mortgage crisis and a distressed economy have underscored the urgency to rethink our transportation system. Including what modes of transportation we support and where we make major transportation investments. These investments should happen where people live, work and gather, as well as in places where infrastructure already exists. Key plans, such as municipal comprehensive plans, regional comprehensive plans (also known as "regional framework plans" or "regional blueprint

plans") and statewide long-range transportation plans should guide strategic investments in transportation infrastructure by carefully integrating transportation considerations with land use planning, and considering environmental, economic, and social equity concerns.

In the past several years, many regional transportation planning agencies have recognized the need to develop regional comprehensive plans. Some of the pioneering regional comprehensive planning efforts began in Portland, Oregon, Seattle (Puget Sound), Washington, and Denver, Colorado, while many others have been undertaken during the past decade.

In California, successful regional comprehensive planning efforts in Sacramento and San Diego led the State Department of Transportation, working with other state agencies, to launch the California Regional Blueprint Planning Program. The purpose of this program was to document best practices in regional comprehensive planning as being practiced in those two regions, as well as those being undertaken in several other regions within the State. Grant funding was provided by the state to support these planning efforts, as well as to create a learning network in which best practices could be shared among participating state and regional agencies. One outcome of this program was the preparation of a report by the Public Policy Institute of California, which documented the regional blueprint planning efforts in the four major metropolitan areas of the State (Sacramento Area Council of Governments, San Diego Association of Governments, Southern California Association of Governments, and Bay Area Metropolitan Transportation Commission / Association of Bay Area Governments), and provided an evaluation of these programs and lessons learned for other metropolitan areas.[6]

At the same time that more and more regional transportation planning agencies are developing and implementing regional comprehensive plans, many cities and counties are re-thinking their local comprehensive plans, with an eye toward aligning them more directly with regional plans, and focusing more directly on long-term sustainability issues. For example, while the San Diego Association of Governments (SANDAG) was preparing and implementing its Regional Comprehensive Plan, the cities of San Diego and Chula Vista, and the County of San Diego, were updating their local general plans. In each case, the general plan update has placed a greater emphasis on long-term sustainability than was reflected in the previously adopted plan.

By way of illustration, the strategic framework for the City of San Diego's updated General Plan is called the "City of Villages" strategy. This strategy "focuses growth into mixed use activity centers that are pedestrian-friendly districts linked to an improved regional transit system. The strategy draws upon the character and strengths of San Diego's natural environment, neighborhoods, commercial centers, institutions, and employment centers. The strategy is designed to sustain the long-term economic, environmental, and social health of the City and its many communities. It recognizes the value of San Diego's distinctive neighborhoods and open spaces that together form the City as a whole."[7] The Conservation Element of the City's updated General Plan reinforces the plan's focus on sustainability. It states that "the City is implementing sustainable development policies that will reduce its environmental footprint, including: conserving resources, following sustainable building practices, reducing greenhouse gas emissions, and encouraging clean technologies. In sustainable development practices, economic growth is closely tied with environmental, "clean," or "green" technologies and industries. San Diego is well positioned to become a leader in clean technology industries due to its highly qualified workforce, world-class universities and research institutions, and established high technology industries. Clean technology industries demonstrate that environmental protection and economic competitiveness goals are aligned and mutually beneficial." [8]

In developing comprehensive plans at the regional and local scale, planners should take into account federal and state policy, and include metrics that evaluate how well the region plan is aligned with national and state visions. States should allow greater flexibility in the use of transportation funding to better integrate the activities of regional and local agencies responsible for developing and implementing transportation, land use (especially transit oriented development), economic development and housing policy.

Regional plans should be developed in close coordination with other regional and state agencies to address long-range energy security, environmental, housing, economic development, public health, safety and human service goals. Regions should undertake land-use based scenario planning as a way to evaluate the interrelationships of alternative land use patterns with transportation systems cost and performance, while also evaluating the effects of alternative scenarios on environmental, economic, and social equity considerations.

At the local level, comprehensive plans should foster basic livability principles and provide a regulatory framework to sustain a healthy environment at the City, neighborhood, block and street scales. Local governments should implement strategies such as transit oriented development where appropriate to integrate land use and transportation planning in a sustainable manner.

Finally, in determining the factors to be considered in developing comprehensive plans at the regional and local level, strong consideration should be given to the six basic livable community principles as described in the pending Federal Livable Communities Act:

1. *Provide more transportation choices.* Develop safe, reliable and economical transportation choices to decrease transportation costs, reduce our nation's dependence on foreign oil, improve air quality, reduce greenhouse gas emissions and promote public health.
2. *Promote equitable, affordable housing.* Expand location- and energy-efficient housing choices for people of all ages, incomes, races and ethnicities to increase mobility and lower the combined cost of housing and transportation.
3. *Enhance economic competitiveness.* Improve economic

competitiveness through reliable and timely access to employment centers, education opportunities, business markets and housing.

4. *Support existing communities.* Target federal funding toward existing communities -- through strategies that encourage transit oriented development, mixed use development and land recycling -- to increase community revitalization, conserve rural land and capitalize on efficient public works investments.
5. *Coordinate and leverage federal policies and investment.* Align federal policies and funding to remove barriers to collaboration among federal and state governments, leverage funding and increase the accountability and effectiveness of all levels of government.
6. *Value communities and neighborhoods.* Enhance the unique characteristics of all communities by investing in healthy, safe and walkable neighborhoods -- rural, urban or suburban.

Policy Recommendations

- Establish coordinated long-range comprehensive planning processes which foster land use patterns that can be served efficiently and sustainably by well-planned national, regional and local transportation networks served by a variety of transportation modes.
- Reprioritize project funding criteria to support livable community principles. Commitment to transportation investments that support compact, walkable mixed use, mixed-income development patterns that provide a variety of travel options.
- Develop methods for evaluating combined housing and transportation affordability that can be used in the preparation of integrated transportation / land use plans.
- Invest in transportation choices for rural, suburban and metropolitan America that improve economic opportunity, quality-of-life, help to prevent the conversion of rural lands to low-density suburban development, and connect communities.
- Adopt standardized, enhanced comprehensive technical assistance programs for land use and transportation planning that will result in desired outcomes.

National Level

- Establish as a national priority that land use and transportation be planned in a coordinated and integrated manner at the state, regional and local levels of government.
- Develop technical assistance and guidelines for coordinating state and metropolitan transportation planning with other planning processes to ensure integration of land use and transportation activities. Strengthen intergovernmental communication and partnerships to better integrate conventional plans that address single aspects of infrastructure.

State & Regional Level

- Require both rural and urban regions to engage in regional planning processes that integrate transportation, housing and economic development. Regional planning agencies should have the authority and funding to create regionally integrated transportation master plans based on input and review by local governments.
- Support region-wide multimodal transportation options that meet nationally directed outcomes such as economic development and sustainability, reduced energy use, reduced greenhouse gas emissions, environmental resource protection/sustainability and equity of access to jobs from affordable housing.
- Require the use of tools such as the Housing and Transportation (H+T) Affordability Index as a planning tool and as a criterion in the allocation of funding for transit, highways, economic development and housing projects; the distribution of economic incentives to businesses and the siting of public facilities.
- Establish transit oriented development as a "transportation purpose" under applicable federal and state transportation funding programs, giving more flexibility in project financing and making the regulatory connection between sustainability, transportation and land use.
- Give transportation funding priority to regional planning entities that coordinate transportation planning efforts, including long range plans, with adjacent regions.

Local Level

- Support locally-appropriate decision-making and development strategies by empowering regional transportation planning entities. Increase their capacity and decision-making authority and allow for direct allocation of federal funds to support local programs that implement a regional vision.
- Increase local flexibility and self-determination by removing barriers to use of federal transportation funds for investments in land use and local infrastructure that reduce vehicle miles traveled.
- Within regions, implement standardized methods, measures and policies to review local traffic impacts of individual development applications during site plan review period.

Transportation Planning Practices

Transportation planning includes numerous tools and practices within the profession to undertake analysis. The analysis is often designed to help make decisions regarding transportation infrastructure, policy, plans, management of the systems or project implementation. The analytical framework for transportation planning and policy along with the relationship to comprehensive planning drives the development of the analytical tools and practices. The need to understand the effects of and relationships between comprehensive and land use planning, transportation systems, travel behavior, environmental systems, and economic systems is key to developing sustainable communities. To assist in accomplishing this, tools and practices integrate the various

disciplines at the appropriate scale (federal, state, regional, local, neighborhood etc.) and provide an integrated system of performance measures in order to support the decision making process. Further discussion regarding transportation planning practices can be found in the appendix.

Policy Recommendations

- Support additional resources to be made available for the development and expanded use of integrated planning tools such as GIS based sketch planning and integrated land use and travel demand models.
- Support the expansion of Public Private Partnerships and user charges such as tolling through the removal of barriers to implementation.

Performance Measurement

There is a growing recognition of the importance of performance measurement in developing sound transportation planning and investment strategies. According to the APA Surface Transportation Policy Guide, "transportation needs to be driven by outcomes. This is the essence of blueprint or scenario planning, in which desired end goals drive land use and transportation planning and decision making." The Policy Guide goes on to state that "there is an old saying that you fund what you measure. Conventional indicators of transportation performance focus on speed (roadway level of service or travel time, duration of congestion, etc.) and this results in an emphasis on highway capacity improvements at the expense of other modes. Transportation planning and development agencies need shared measures of performance that focus on multimodal transportation quality of service (not just speed), as well as the contextual impacts of potential investment decisions on the environment, historic and natural resources, land use and energy sustainability."

Many experts are now suggesting that performance measurement used in transportation planning should be based on two broad categories: those related to **the quality and functionality of the transportation system** itself (which have been the focus of transportation over the past several decades), and those related to the **sustainability of the overall social, economic and natural environment** in which transportation systems reside. As discussed in Section 3, in order to address these broader sustainability goals, long-range transportation planning needs to be developed in the context of overall comprehensive planning, which can occur at a state, regional, and local level.

One example of how this holistic approach to transportation planning can lead to addressing broader sustainability goals is found in California's Regional Blueprint Planning Program, which is now being used to address climate change goals. Under Senate Bill 375, Metropolitan Planning Organizations in California are now required to prepare a "Sustainable Community Strategy" in conjunction with their long-range regional transportation plans. The Sustainable Community Strategy is required to demonstrate how the regional plan has incorporated land use and transportation strategies that will lead to meeting a specific greenhouse gas reduction target in the years 2020 and 2035. At the same time, these plans will be evaluated in terms of other performance measures that are related to both transportation performance as well as economic, environmental, and social goals. For example, there is a growing interest in measuring the overall **cost of housing and transportation** together, as a key economic and social equity performance measure.

At the local government level, counties and cities have been using transportation performance measures in their planning and growth management programs over the past two decades. However, as discussed above in relation to state and regional planning, there is a growing awareness of the need to consider multimodal performance measures in transportation planning, and also to look at the interaction of transportation and land use policies at the statewide, regional, corridor and project levels.

In advancing a performance measurement based approach to transportation decision-making, several key principles are essential:

- The performance measurements must be multimodal in nature, – i.e., providing comparisons across different modes of travel or goods movement based on outcomes associated with different transportation choices, without modal bias. For example, the use of travel time savings would be a more appropriate measure than level of service when evaluating choices between highway and transit investments. Such an approach would enable a "level playing field" in the evaluation of investment choices – such as between highway and transit choices, or between motorized and non-motorized travel.
- Performance measures must accommodate both quantitative and qualitative criteria in order to capture social and environmental intangibles and externalities beyond the actual infrastructure itself.
- Performance measures must be "scalable" to accommodate evaluation of regional and project level benefits and disbenefits in a wide range of communities, from urbanized to rural.

These principles should be incorporated as part of future federal transportation program development during the upcoming Reauthorization, and should also form the basis for subsequent evaluation of transportation priorities at the regional, state and local level. Potential measures of transportation performance at both the system level as well as at the project level may include the following considerations:

- Mobility
- Accessibility
- Safety
- Operating efficiencies
- Cost-effectiveness
- Life-cycle costs

- Equity
- Sustainability
- Livability
- Land use compatibility
- Economic development
- Return on investment

The development of specific, outcome-based criteria for each of these measures should be developed regionally in response to federal goals and objectives. This approach would enable regional considerations and local project sponsor needs to be incorporated during system planning as well as during individual project development to meet specific local needs.

Policy Recommendations

- Establish a national vision, goals and performance measures to guide planning and implementation of the integrated intermodal transportation system of the future.
  - support policies that foster integration of planning for transportation with planning for land use, economic development, and the environment.
  - support development of a single system of integrated performance measures that provide a level playing field across all modes.
  - support policies that call for better balance between mobility and access to focus on the overall quality of the transportation experience, and the use of transportation as a place-making tool.
  - support policies that establish balance between movement of people and movement of goods and minimize conflicts between movement of goods and movement of people by considering the goals of each individually and both collectively during the transportation planning process.
  - support policies that foster integration of multiple transport modes and accommodating multiple transport modes throughout project delivery.
  - support the development and integration of new technologies to reduce reliance on gasoline powered vehicles.
  - support establishment of equitable, sustainable and flexible funding streams for both capital and operations.
- Expand funding sources to meet transportation needs in ways that are flexible, performance-driven and linked to outcomes.
  - support an expansion of transportation funding methods, including innovative approaches like infrastructure banks and mobility fees based on vehicle miles of travel that move away from single-mode funding streams, with declining reliance on the gas tax over time.
  - support the continued structure of proportional partnerships that requires state and local cash or in kind matches for federal transportation funding investments.
  - support a system of flexible transportation funding and accountability that links long range transportation plans, "regional blueprint plans" and comprehensive plans with benchmarks and outcomes.
  - support the use of transportation block grants, greater sub-allocation funding authority for metropolitan planning organizations, and other flexible funding methods to incentivize comprehensive, community-based transportation plans.

Potential Areas for Future Research

To optimize research resources, it will be important to tie research to policy. Key efforts will need to include ways that integrated transportation and land use models can and will support decision making. For example, alternative financing sources and models are increasing in visibility and it will be important to support new policies in these areas with solid research. Additional information regarding research and technologies related to transportation can be found in the appendix. Similarly, some other areas that might be explored include:

- Restructuring of federal transportation, housing and environmental programs to streamline federal review procedures and better leverage federal investment dollars.
- Simplification of federal transportation programs and elimination of modal stove-pipes to foster more integrated transportation system solutions that address movement of people and goods.
- Institutional models and governance structures to better promote more comprehensive regional transportation decision-making which is based not only on infrastructure performance criteria, but broader consideration of social and environmental factors.
- Outcome based multimodal performance measurement to help assess investments across different transportation choices.
- Effectiveness of public private partnerships and alternative delivery methods that reduce costs and timeframes associated with infrastructure investment.
- Implications of "smart" infrastructure technology in reducing operations and maintenance costs or "right-sizing" infrastructure through improving efficiencies and better leveraging prior investments, freeing up capital for service and structural improvements.
- Alternative financing sources and models such as VMT fees and system pricing.
- Additional research into the relationships between transportation systems, land use, travel behavior, environmental and economics with the goal of implementing the research into tools useful to planners and decision makers is needed. These tools should be developed to help analyze those interactions for a wide range of geographic scales. Currently a number of larger MPOs are developing or utilizing the next generation of transportation and land use models that address a number of these interactions. Tools and applications need to be developed based upon observed behavior.

Transportation planning is moving into a new era. We are not only finding out better ways to keep larger human populations mobile, we are finding out more about ourselves as humans. We are realizing the link between balanced, multimodal transportation and walkable/livable communities. How we communicate to the public the importance of transportation is also undergoing some significant changes as our world becomes ever more connected and networked. For instance, DOT's and transit agencies are now able to make a 3-D computerized video of their project proposals to share with their citizens via YouTube. This kind of public outreach was not available 20 years ago, and it's hard to imagine what kinds of tools we will have access to over the next 20 years.

The most important thing that we transportation planners have realized is that transportation is more than about one mode or system capacity, rather matching appropriate transportation system to the community they are serving. We must begin to integrate transit and multimodalism into our existing roadway ROW's and footprints. Integrating the tools listed in this chapter and in this report into our transportation system will help to ensure cleaner, cheaper, faster, and significantly enhanced mobility in the future.

APPENDIX

Transportation planning practices

Transportation planning includes numerous tools and practices within the profession to undertake analysis. This appendix focuses on the a couple tools (GIS, Modeling) and funding practices (PPP, User charges) that are important in transportation.

Scenario planning using GIS-based sketch planning tools

Scenario planning provides a format for decision-makers to evaluate the relative impact of varying policies, program and investment choices on the long-range composition of the organization, community or region. Scenario planning can be structured to assess a number of interrelated areas such as how land use changes could affect travel behavior, transportation needs, and changes in greenhouse gas emissions.

Geographic information systems (GIS) provide a tool for the spatial analytics and computing power to build models that assist in evaluating alternative choices for the future. For example, GIS provides the ability for planners to evaluate in a relative context the impacts of alternative land use scenarios on environmental and transportation system performance. Such scenario evaluation would be extremely time consuming and labor intensive without the benefit of GIS. With GIS, planners and decision-makers can more easily compare the compatibility of dispersed versus compact development choices with environmental stream quality concerns or a transportation network reliant on high capacity transit for future capacity expansion.

Transit-oriented development planning

Use of GIS-generated information can be particularly effective developing plans for transit-oriented development (TOD). GIS provides the ability to evaluate land use choices around a defined high capacity transit station or center and then relate those land use choices to transit system performance and ridership outcomes. Working jointly, a transit agency planning a major capital investment in a corridor has the ability, enabled by GIS, to work with multiple jurisdictions along the corridor to develop a corridor-wide balanced approach to TOD planning. Working in isolation with each individual jurisdiction it would be easy to over plan (over zone) for future development in the corridor because each jurisdiction is individually choosing to maximize their individual perceived development benefit. Working with land use data sets from each jurisdiction, within one GIS model, the transit agency or MPO can demonstrate the synergistic effects of balancing development along the corridor in a way that allows each jurisdiction to receive an appropriate allocation of future development potential that otherwise might not be achieved if the individual station areas are "over zoned."

Enhanced transportation modeling capabilities

Transportation modeling is based on established econometric theory to relate land uses, transportation infrastructure, travel behavior, and rational decision-making to travel demand. Traditionally, transportation models use data on individual trip segments in isolation to forecast travel demand – for example, a basic trip from home to the park and ride might include a stop to get gas followed by a stop for coffee, in which the traditional model counts this as three individual trip segments.

Emerging transportation models, such as activity-based or tour based, model the activity pattern-tour-trip segment relationship. This provides an individual's overall travel behavior linked together by mode, destination, time-of-day, and other activities in the daily pattern. This approach differs from traditional trip-based modeling where trip segments are largely treated as unrelated events. Activity based models are currently in use or being developed in a number of MPOs and states around the county including California, Ohio, New York, and Washington.

The Transportation Research Board (TRB) has a link to an excellent paper describing activity-based modeling and the associated data requirements at: http://onlinepubs.trb.org/onlinepubs/circulars/ec008/workshop_j.pdf .

The article, "Data Needs, Data Collection, and Data Quality Requirements of Activity-Based Transport Demand Models," by Theo Arentze, Harry Timmermans, Frank Hofman and Nelly Kalfs, was presented at TRB's International Conference on Transport Survey Quality and Innovation, Grainau, Germany, 1997.

Transportation Funding Practices

As stated previously, in the long-term, the current practices of paying for the maintenance, preservation, and expansion of the transportation system to meet future needs is unsustainable.

There are a number of practices that have in the past been used or currently are being examined that improve the ability to fund the transportation system.

Public / private partnerships

Public / private partnerships (PPP) in transportation planning generally represent a sharing of cost or allocation of risk among a public entity and a private organization. The national Council for Public Private Partnerships (http://ncppp.org/) defines PPPs as

> "… a contractual agreement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility."

The most common type of arrangements include some type of lease buy-back structure in which a private interest provides up-front capital for a public asset and is paid back over an extended term, recouping the initial investment and a minimum return on that investment. The benefit to the public entity is the ability to finance the asset without impacting bonding capacity or threatening bond ratings. The private investor usually incorporates the risk of default in the minimum investment return calculation.

User charges (tolls, etc.)

User charges, fees, fares, or tolls represent opportunities to manage demand for transportation infrastructure through pricing, and to recoup operating or capital costs required to provide the facility or service. User charges are common in the transit industry. The far majority of transit agencies recoup at least a portion of their operating expenses through customer fares. Tolls are increasingly looked to as a congestion pricing mechanism in addition to the more traditional use of tolls as a revenue source to payoff infrastructure bonds. The concept of high occupancy toll (HOT) lanes is being evaluated around the country as a way to fill available high occupancy vehicle (HOV) lane capacity by allowing single occupant vehicles access to HOV facilities for a fee. MPOs such as the Puget Sound regional Council in Seattle, WA are increasingly including user charges and congestion pricing in their long-range plans to assist in paying for the projects and programs identified to sustain their regional transportation systems.

Areas for Future Research

There are a number of areas of transportation planning that can and should be researched further, advocated for, connected to policy, and brought into the forefront of current planning practice.

The Transportation and Land Use Connection

Connecting transportation planning to comprehensive planning is a way to connect transportation and land use. By connecting transportation and comprehensive planning, we can begin to educate our citizens on the importance of multimodalism, and incorporating transit into our transportation system and our communities.

Often the development of transportation plans, land use plans, economic development plans and other community planning activities have occurred in a linear, functional manner that creates silos based on professional disciplines and areas of specialty. This process typically builds upon fixed assumptions that drive decision-making, when in reality there is a symbiotic and interactive relationship between land use and transportation decisions. We must align federal, state, regional and local plans to solidify the integration of comprehensive plans and transportation plans in order to anticipate and plan for change. Results of successfully integrating transportation planning will be enhanced air and water quality, reduced climate impacts and the region's carbon footprint, and protected high priority natural resources rather than just mitigation of the impacts upon the environment of transportation system investments. Long Range Transportation Plans, when properly integrated with community-based comprehensive plans, can provide the framework for urban and regional sustainability through wise, resource-efficient investments and short-term strategies.

Research needs to focus on these interrelationships with the goal of developing tools and practices that can be integrated into the planning and decision making process at all levels and geographic scales.

Bicycle and Pedestrian Planning

Land use patterns and their effects on bicycle ridership and pedestrian miles travelled will be an important and emerging research topic in the future. One interesting question likely to be the subject of future research is: What types of areas and urban settings are more likely to generate a high level of bicycle and pedestrian miles travelled? Current trends suggest that it will likely be areas that place more amenities closer to where people live.

Ground-breaking bike/pedestrian initiatives, such as a National bicycle path network, should begin to be researched and implemented. Another example that bicycling advocates in Colorado have been talking about is "Fast Routes." A "Fast Route" is a grade separated, concrete, multiple-use facility, typically 8–12 feet wide.

"Fast Routes" give cyclists priority, allowing cyclists to ride at 20+ mph. Another term for "Fast Route" is "Cycle Track" and is commonly used in European cities and many college campuses. They can be separated from the roadway/sidewalk by a median, tree lawn, parked cars, bollards, etc. Cycle Tracks in Europe typically have their own smaller size traffic signals that are integrated into the traffic signal system when a shared-grade crossing must be made. Cycle Tracks and Fast Routes should also utilize grade separated crossings whenever possible. Cycle

Tracks tend to attract more bicycle ridership than bike lanes due to cyclists being physically separated from auto traffic.

PPP's in High Speed Rail Planning

A national high speed rail network is forecast to be the modern equivalent to the building of the Interstate Highway System. For this multi-billion dollar infrastructure investment, however, we now have some unique financing opportunities to aid in its implementation. A concept to consider is exploring Public Private Partnerships with airlines for the design, construction, finance, operation, and maintenance (DBFOM) of national high speed rail networks. This strategy, if properly executed, would be mutually advantageous to both high speed rail and airline providers as they would become partners, rather than competitors. A reasonable fear is that a successful national high speed network would undermine domestic air travel so much that many airlines would go bankrupt. For this reason, we should begin to research ways to gradually shift domestic air travel to high speed rail, while cooperating with the private sector. More research should also be done on next generation high speed rail and emerging technologies as well.

Exploring New Technologies

New technologies should be explored as part of transportation research. For example, in certain cases, high speed multiple-station detachable gondola systems or Cable Propelled Transit (CPT) can be more competitive than conventional bus and surface transit. This is due to a couple of reasons. CPT is grade separate, electric, requires a minimal footprint and infrastructure intensiveness (towers can be ¼ to ½ mile apart), and can be more cost effective long-term when compared to bus.

CPT is also supportive of walkable compact growth, and since the carriages are detachable, has flexible frequency and volume, meaning that it can adjust to different traffic flows. CPT is mobility ready, so that when a rider arrives at a station, a carriage is waiting for them, unlike surface based systems in which riders often must wait up to 30 minutes for a bus or train to arrive. CPT also has the potential to have different sizes of carriages available per line to accommodate peak period flows and off-peak flows. CPT runs in a straight line, except at touch-down/station locations where the cable can turn and travel in a new direction, making route planning easier.

CPT has a few drawbacks which must be taken into consideration when planning for new alignments. The first is passenger safety perceptions. Since the CPT is high in the air people with a fear of heights may be reluctant to ride it; however it seems that many more people will ride it due to the height, uniqueness, and views associated with CPT. The second potential drawback is noise. For instance, when a carriage passes a tower, there is usually a clicking noise. New materials and emerging technologies could potentially help to mitigate this. The third drawback is viewshed impacts. With towers and cables strung high into the air, the viewshed is disturbed similar to overhead power lines. However, there is another side to the viewshed argument in that the CPT offers views of the city for those riding it. Airspace impacts over private property (Airspace ROW) should also be considered when planning new alignments. Perhaps one way to mitigate this is to run the CPT in roadway ROW, or power line ROW. However, to take full advantage of CPT capabilities, agreements must be signed to permit CPT to fly over private property and existing buildings. This brings us to our final point of planning for CPT, which is the associated rescue footprint in case of malfunction or catastrophic failure. Rescue personnel will need access to the bases of the towers, and some minor access underneath the cable itself. Examples of operational CPTs can be found in Portland OR and Caracas, Venezuela.

ITS 2.0

Intelligent Transportation Systems is currently being used throughout the country. The evolution of ITS or ITS 2.0 is the concept of networking the transportation system so that cars can not only sense intersections and traffic signals, but other cars, emergency response vehicles and transponder equipped bicyclists, pedestrians and motorcyclists. The idea of ITS 2.0 for the entire transportation network is a vast and complicated one, but very important for efficiency, information sharing, and safety. ITS 2.0 will allow cars to communicate with each other over a special encrypted channel to avoid crashes, trigger airbags and other safety systems before a crash occurs. Networked cars could also "platoon" in close quarters with each other on highways to ease congestion, pollution, and driver stress. This network would be able to carpool-match commuters with ease, taking ever greater numbers of cars off the road. Eventually the system would take over more and more of the actual driving. After all, human error is responsible for almost all traffic accidents.

By connecting it all with the GPS, via-wire systems, and sensors already in cars, the result will be machines that could broadcast their position, speed, vehicle weight, and other critical data at least 10 times per second. In effect, cars will become traveling probes, delivering real-time traffic, weather, and accident data on all roads. It is estimated that there are over 37,000 traffic deaths, 4 billion hours of travel delays, and 2.81 billion gallons of wasted fuel in America each year. An ITS 2.0 system could make major reductions in these numbers. In 2013, the National Highway Transportation Safety Administration may promote consumer adoption by requiring cars to offer a networked wireless system to earn its coveted five-star safety rating...

Vehicle Miles Traveled (VMT) Fees as the primary source of Transportation Finance

VMT represents fair and equitable transportation finance due to roadway users paying the actual costs of the use their vehicle inflicts to the roadway system. VMT user fees can potentially extend to transit users as well. Moving to a VMT based system is critical because the Gasoline Tax is currently insolvent and not generating enough revenue to keep up with the maintenance needs of our existing transportation system. As gas efficient and electric vehicles become more common, DOTs will need to find a way to ensure that electric vehicle users are paying their fair share

into maintaining the transportation infrastructure network. VMT Fees are relatively simple, and can be summed up in an equation: Vehicle Weight * Distance Travelled = VMT Fee.

One of the main concerns people have of VMT based transportation finance is privacy. Many people do not like the idea of being electronically tracked. User based reporting could solve the privacy issue by merely having roadway users report their odometer reading on their tax form every year. In order to keep people honest, every other year the odometer would have to be physically inspected. However, this may not even be necessary if ITS 2.0 is successful and already using GPS to track roadway users. As people continue to embrace technologies such as cell phones, GPS, and social networking, it seems their attitudes towards VMT based user fees will continue to change.

SECTION 2: ENERGY INFRASTRUCTURE

INTRODUCTION

Energy infrastructure in the United States is vast and complex, encompassing the generation and transmission of electricity, the powering of almost all modes of transportation, and the production of heat for industrial processes and space heating. The infrastructure currently in place to extract, process and distribute energy resources for consumption is primarily in the hands of the private sector, although government regulation or oversight at all levels plays an important role. The following image[9] illustrates the complexity of what is considered energy infrastructure.

As the image illustrates, energy infrastructure in the United States encompasses a broad range of energy sources, technologies and uses. Government oversight is complex as well. Electric generation, transmission (overland) and distribution (to the end-consumer) are regulated by state regulatory commissions, as are natural gas utilities. The federal government oversees the national transmission grid, and the U.S. Environmental Protection Agency enforces the Clean Air Act and other federal laws concerning pollution caused by the extraction or use of energy resources. Additional regulation maintains the public interest for other aspects of the energy infrastructure.

The United States depends almost exclusively on fossil fuels to meet its energy needs. Close to 70 percent of the nation's electricity is generated with either coal or natural gas. Almost all transportation, including cars, trucks, busses, trains, ships and planes operate on gasoline, diesel or other petroleum fuels. Heating homes, businesses and institutional buildings is done with natural gas, heating oil or fossil-fuel-generated electricity, as are industrial processes requiring heat. Fertilizer, chemicals and many other products are made from natural gas or petroleum byproducts. The combustion of fossil fuels has generally been accepted as the major source of CO2 emissions from human activity, and continuing to depend on fossil fuels can only exacerbate global warming and climate change.

In looking at rebuilding the various aspects of America's

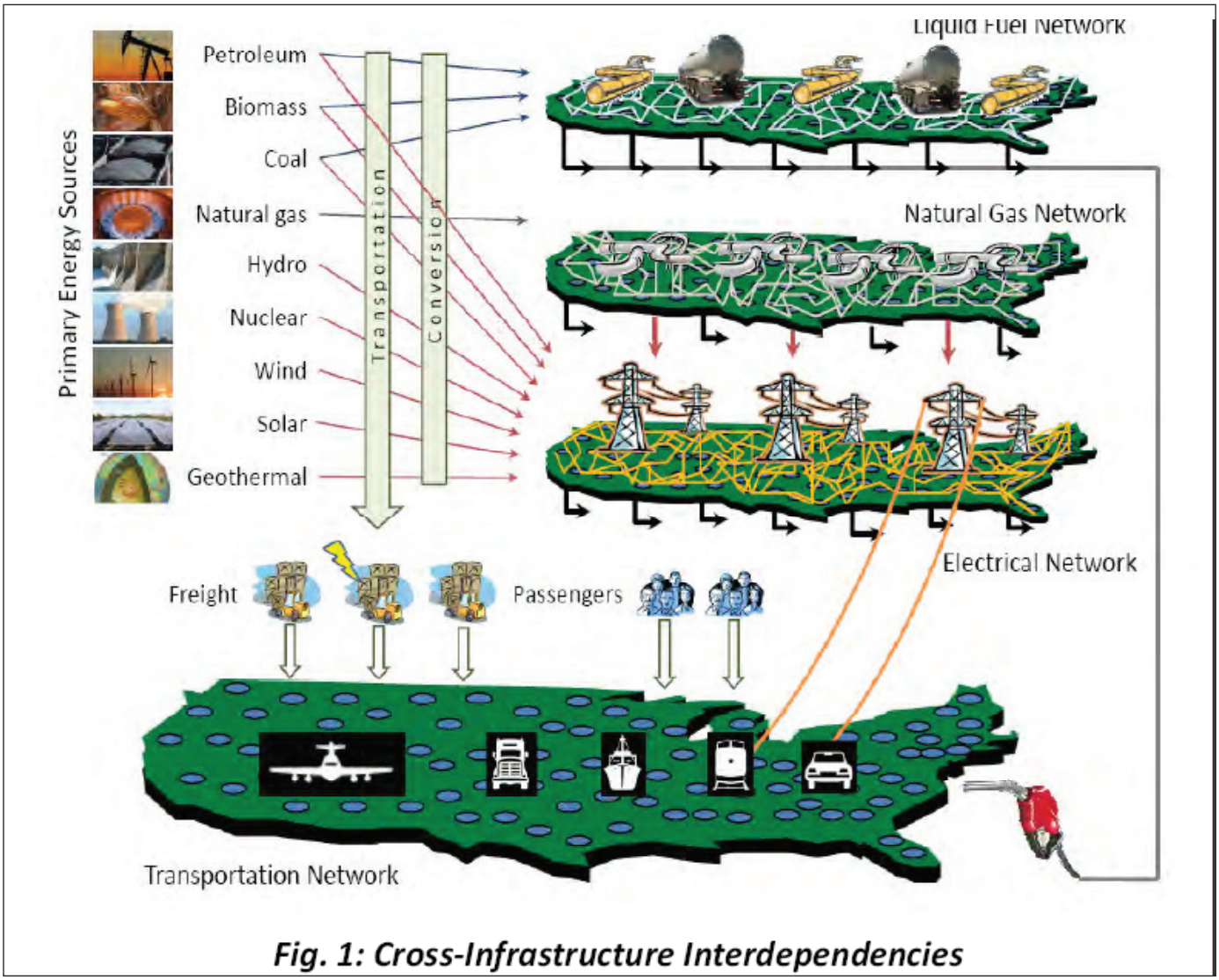


Fig. 1: Cross-Infrastructure Interdependencies

Illustration used with permission from Power Systems Engineering Research Center

infrastructure, energy is unique because the infrastructure doesn't need to be repaired or refurbished, rather the energy infrastructure needs to be transformed to one that produces and sells clean energy. This is the major challenge of the energy industries going forward, and a challenge we must all cooperate in meeting because we are all energy consumers.

Energy and the energy infrastructure are highly relevant political issues due to their impact on the economy in general as well as the (real or perceived) quality of life of the nation's citizens and residents. Concerns about increasing costs, dependency on foreign energy resources, (carbon emissions in particular) have caused many to question the existing energy infrastructure and regulatory guidelines. Critics contend that the present system is not sustainable when we consider how resources are currently obtained and used, and whether or not those resources will be available for future generations.

It is important to note that energy infrastructure is central to the concept of sustainability, both for environmental reasons and for moving toward national energy self-reliance. The choices we make now about how we will produce and use energy in the future are very important. It is necessary to implement policies that will guide the development of an energy infrastructure that will enable both – the use of more sustainable, less polluting, safer resources as well as lower production and distribution cost and impacts. Specifically, a new energy infrastructure needs to provide better opportunities for the cost-effective integration of energy efficiency technologies and renewable resources, and to integrate with other sustainability planning to help provide economical and livable communities.

This chapter is divided into two parts. The first part looks at the macro-view of transitioning the nation to clean energy, and offers policy rationale and general policy recommendations applicable nationwide for both policy makers and practicing planners. The second part gives details on fossil and renewable energy sources and outlines the primary issues that surround each with regard to its future as part of a clean energy economy. Because many energy issues are local or regional, it is recommended that planners and policy makers examine the issues of particular concern to their area and use the general policy recommendations as a guide to addressing them.

POLICY RATIONALE AND RECOMMENDATIONS

Electricity Generation

Finding clean ways to generate electricity to meet America's growing demand will be a top priority of updating the nation's energy infrastructure. From a policy perspective most experts agree that the United States needs to move toward reducing and ultimately eliminating fossil fuels from the generation mix. Many would also like to phase out nuclear power as well. Both these sources have significant negative environmental and social impacts that would be highly expensive to mitigate satisfactorily. Renewable energy technologies are still in the expensive, developmental phase and a renewable energy infrastructure has yet to be put into place. Either way, electricity will cost more in the future.

To be successful in moving away from fossil fuel-generated electricity, advancements in the transmission and distribution system will be essential. The development of a "smart grid" could theoretically improve system efficiency and provide the flexibility to take advantage of an increase in customer-sited renewable generation, which could move the national grid from the current highly centralized generation model to a more secure distributed model.

There are opportunities for public input into this highly structured sector, and planners can play an important role in helping the public understand the management of energy in sustainable community planning. They can also help create bridges between the public and the utility industry by engaging utility professionals in planning and visioning processes.

Transportation

The use of fossil fuels is only one issue to address with regard to creating a more sustainable transportation infrastructure in the United States. Chapter XX is dedicated to examining the overall challenges of improving America's transportation infrastructure. This chapter looks at the planner's role in reducing the use of fossil fuels for transportation, including development of clean fuels and strategies for reducing vehicle miles traveled (VMT).\

Biomass transportation fuels that are currently commercialized include ethanol and biodiesel, both of which are agriculturally based. In many minds (particularly those whose primary aim is to reduce our dependence on foreign oil), these biobased transportation fuels will simply become the substitute for petroleum and we can proceed with business as usual. This constituency might be willing to discuss hybrid vehicles or raising the mpg of existing models, but there are still too many unanswered questions about the production and impacts of biofuels to embrace this approach as the magic bullet. Another path under discussion is electric vehicles, which would be recharged from the existing electricity grid. The practicality of this approach will be dictated by how sustainable we can make our electricity generation. Either way, the "alternative fuels" discussion focuses on technology that will allow us to maintain our current transportation habits and patterns.

Reducing vehicle miles traveled will also effectively reduce use of fossil fuels, but this approach is far more complex because it depends on changing peoples' patterns, from personal driving habits to the design of cities. Here is where the many other issues involving transportation become intertwined with fossil fuel reduction, such as public transit and bicycle paths, accessibility to jobs, walkability of neighborhoods and reduction of pollution. Planners are well placed to influence the reduction of fossil fuel use through their involvement in these issues. Quantifying how much fossil fuel (and CO2) can be reduced adds to the argument that reducing VMT for all the other reasons stated above is a good idea. Ultimately, a sustainable transportation infrastructure will involve the integration of alternative fuels and VMT reduction strategies.

Heat Production

Residential and commercial heating needs are generally provided by natural gas, heating oil or electricity. Uses include furnaces and other space heating systems, hot water heaters and stoves, and small electric appliances such as toasters and hair dryers. Replacing fossil fuels for this sector could include biomass sources such as wood, solar water heaters, or ground source heat pumps (if run with renewably generated electricity). Industrial processes currently use a lot of natural gas, as well as electricity. For example, processes that require drying ovens would use natural gas much like a home oven. There are examples of wood products companies using their own production waste to create process heat, or others that use the heat from a combined heat and power unit that is also generating electricity. Replacing fossil fuel use in industrial applications is a highly specialized field of engineering, but the options are similar: biomass or solar hot water. However, whether residential, commercial or industrial, the primary strategy for reducing fossil fuel use is to improve the energy efficiency of equipment and raise the conservation consciousness of the users to an effective level.

Moving to a Clean Energy Future: Energy Efficiency and Renewable Energy

Transitioning the nation to a clean energy future will involve a dramatic increase in energy efficiency in all sectors. This needs to take place not only through the use of efficient technologies but also through everyone taking personal responsibility for the energy they are in charge of using, both at home and at work. Planners are in a position to help individuals and communities use energy more wisely through their roles as organizers, designers, educators and networkers. Likewise, local sources of renewable energy will need support for their development and planners can harness the same skills to promote their use.

Moving away from fossil fuel dependence will be difficult not only because the fossil fuel industries play such a huge part of the nation's economy, but because Americans alive today have known no other system. The present energy infrastructure is constructed to favor fossil fuels, from utility regulation to federal energy subsidies to the economic formulas used to set energy prices. In order to encourage use of clean energy sources, national energy policy must be coaxed away from this bias to begin recognizing the environmental and societal costs of fossil fuel reliance. This will take strong support from organizations such as the APA and others who are actively promoting the advance of sustainable community planning and design.

Practicing planners currently oversee many areas of community concern that connect or relate to energy. Many planners are already addressing sustainability issues such as environmental quality and equity, the curbing of urban sprawl, accessible public transportation and local food systems. These and other aspects of sustainability planning have important energy components. Many communities have set goals to reduce CO2 emissions which will primarily involve reducing use of fossil fuels. As this pressure grows, planners must be ready to assist. Yet most planners have little knowledge of the nation's energy resources or industries, or how energy is interconnected with issues they deal with on a daily basis.

National Policy and Practice Recommendations

Energy infrastructure policy recommendations in this chapter are focused on the transition to clean energy sources from fossil fuels for electricity generation, transportation fuels, and production of heat for domestic applications and industrial processes. Recommendations are made for APA at the national policy level, and at the level of planners in practice, both with the goal of moving the nation's energy infrastructure toward a clean energy future.

The American Planning Association Policy Guide on Energy, adopted in April 2004, provides additional guidance on energy issues, particularly the Policy Findings and General Policy Statements, and its Policy Position. This chapter reiterates that position, stated as follows:

"APA and its Chapters recognize regional, community, and site planning and design as central and integral determinants of our nation's energy future and overall well-being. In response, APA and its Chapters endorse managing energy consumption and encouraging efficiency by modifying development patterns, architecture, and the design of household, commercial, transportation and industrial technologies to reduce energy demand, and by forecasting the energy demand of long range land-use plans and strategies, and mitigating the impact of that demand.

Furthermore, APA and its Chapters endorse supply-side investments, subsidies, policies, and education that support clean energy fuels, renewable energy sources, zero-waste distribution systems, and the decommissioning of hazardous energy sources."

Policy Recommendations

1. Work with planning schools nationwide to promote integration of curriculum regarding energy issues and community energy planning into planning degree programs, and coordinate with schools of architecture and engineering to create cross-disciplinary opportunities for aspiring planners, architects and engineers to work together to address energy issues as part of sustainability planning.

Reason to Support: In order for planners to assist effectively in the reduction of fossil fuel use, it will be essential to increase knowledge and awareness within the planning profession of the nation's energy infrastructure and its connections and impacts on society and the economy, and the issues involved with the nation's transition from fossil fuels to clean energy. Planning schools need to begin educating their students regarding the role of energy in sustainable community planning.

2. Provide technical assistance to policy makers and legislators working on such issues as carbon credits, renewable energy portfolio standards, transmission grid redesign, and green

energy job creation regarding the impact of their policies and legislation on land use and other sustainable community design priorities.

Reason to Support: Too often integration of disciplines does not occur in energy planning, particularly at the policy and legislative level. Much time is wasted and efforts can be negated when all aspects are not considered from the beginning of the policy process. Frequently technical or business interests dominate the discussion, leaving societal interests underrepresented. Planners can bring communal and integrative skills and experience to the table.

3. Collaborate with other professional organizations dedicated to promoting or developing green design standards for buildings, equipment or landscaping, to look at ways of integrating their guidelines and standards into comprehensive and sustainable community planning

Reason to Support: There are many pieces to the puzzle of assembling a clean energy infrastructure. Organizations with similar views and priorities, who frequently end up participating in or influencing the outcome of the same projects will broaden their impact by working together.

4. Work with organizations interested in transportation fuel issues to exchange knowledge and experience regarding fossil and biofuel infrastructures and their impact on communities, and to develop ways to increase understanding among planners and transportation fuel professionals

Reason to Support: The petroleum industry has considerable impact on local environments and communities. The recent Gulf oil spill is an example. Moving away from petroleum to biofuels will also have local impacts, and land-use issues will be a major consideration. Planners need to work with transportation fuel advocates and professionals to assist in projecting future impacts and understand how to undertake disaster mitigation planning.

Initiatives from the Policy Guide on Energy at the National Policy Level

Policy initiatives in the APA Policy Guide on Energy (2005) include a number of nationally-based recommendations for supporting development of clean energy infrastructure. Among them are the initiatives:

1. *Regarding support for increasing the corporate average fuel economy (CAFÉ) standards (Initiative 7)*
2. *Regarding support for the adoption of consistent initiatives by state public regulatory commissions nationwide for net metering, renewable energy portfolio standards, and the establishment of public benefits funds that encourage all customer sectors to conserve energy and invest in renewable sources (Initiative 10)*
3. *Regarding support for reducing the negative environmental impacts of current fossil fuel extraction and electricity generation through research, technology, and community involvement (Initiative 14)*
4. *Regarding support of the development of new renewable energy technologies and endorse an unbiased evaluation of their environmental impacts (Initiative 15)*
5. *Regarding support of efforts to include energy efficiency in all affordable housing guidelines*

Recommendations for Practicing Planners:

1. Encourage creation of a community energy plan that involves all stakeholders, sets measurable goals, and create programs to promote energy efficiency and renewable energy as part of their community's sustainability vision
2. Include energy implications in comprehensive planning, from efficient housing and building stock, to environmental improvement of local air and water, to planning for options for future development of renewable energy.
3. Encourage installations of renewable electricity through convenient and affordable permitting and inspection processes
4. Make connections with the local utility to promote efficiency in the community

Initiatives from the Policy Guide on Energy for Practicing Planners

Policy initiatives in the APA Policy Guide on Energy include a number of locally-based recommendations for supporting development of clean energy infrastructure. Among them are the initiatives:

1. *Regarding reduction of energy consumption through comprehensive planning and urban design that incorporates strategies for both mobile and non-mobile energy efficiency (Initiative 1)*
2. *Regarding development of guidelines and codes for energy-efficient site planning and building methodologies (Initiative 2)*
3. *Regarding support of education, incentives, and subsidies that reduce consumption at the individual level (Initiative 6)*
4. *Regarding development of procedures and standards to ensure that siting decisions for energy generation, transmission and distribution facilities will be evaluated to ensure consistency with community and regional development objectives (Initiative 11)*
5. *Regarding development of community-based lighting design guidelines that promote energy efficiency and safety while reducing light pollution (Initiative 13)*
6. *Regarding integration of community energy efficiency goals into the "smart growth" planning process (Initiative 18)*

ENERGY SOURCES AND ISSUES

I. Fossil Fuel Infrastructure – Description and Issues

A. Coal

Coal has been used for many things over the years including

heating fuel for homes, buildings and industry, transportation fuel for trains and ships, and as the raw material for coal gas which replaced candles for light in the "gaslight" era. Today, it is used to generate electricity. Coal is mined by private extraction companies and hauled to utility generation plants via diesel powered trains, often over a mile long.

The coal mining industry is highly regulated: the U.S. Environmental Protection Agency (EPA) oversees enforcement of federal pollution regulations regarding coal burning, the U.S. Occupational Health and Safety Administration (OSHA) is responsible for mining safety, and the U.S. Department of the Interior oversees reclamation and enforcement. Even with strict regulations in place, actual enforcement has been uneven, largely for political reasons, and the sound of money talking. Mine safety is an area where this is highly evident.

The coal mining industry is a dying employment opportunity. The average age of working coal miners in Appalachia is close to fifty, and surface mining requires far fewer operators.

The United States does not need to import coal. There are still significant deposits of high sulfur coal in the Eastern states, and vast quantities of low sulfur coal in the west, primarily Wyoming. Eastern, high sulfur coal has more energy content than low sulfur coal but has lost market share for two reasons. First, Eastern coal operations mined coal from underground, more expensive and dangerous than Western coal which is surface mined and is far less labor-intensive. Second, utilities realized that if they used the lower-energy but also lower-sulfur Western coal, they could meet EPA regulations with installing expensive scrubbers on their plants. To cut costs of underground mining, eastern coal companies, principally in Appalachia, began to do "mountaintop removal" mining which has proven to be highly destructive to the landscape and to local communities.

Production of electricity in the United States depends primarily on coal burned in large, centralized generation plants. Plant construction is time intensive and expensive, and increasing environmental regulation raises costs and permitting processes even more. There is now greater public scrutiny of proposed coal plants than in the past, and because potential costs for new regulatory requirements and accountability for carbon emissions is uncertain, traditional investors in costly coal generation plants are becoming more and more wary. Even if reliable technology is possible, "clean coal" will be very expensive.

About 40 percent of the nation's coal comes from Wyoming, and about 24 percent from West Virginia and Kentucky combined. Montana, Pennsylvania and Indiana combined produce about 14 percent. Coal is transported to generation plants via rail, and the trains are powered with diesel fuel, meaning that the cost of electricity is indirectly dependent on the price and supply of petroleum.

Issues regarding the future of coal in a clean energy economy:

1. Environmental, social and economic impacts of combustion for electricity generation
    a. Carbon dioxide management from the combustion of coal: Trade-offs in investing in unproven (and potentially very expensive) "clean coal technology" and carbon sequestration
    b. Other major pollution issues – mercury, SO2, NOX, particulate pollution
2. Environmental, social and economic impacts of extraction
    a. Mine safety issues, and health of coal miners
    b. The tremendous environmental and societal impacts of mountaintop removal mining – from watersheds to local communities
    c. Land remediation
3. Particulate pollution and human health
4. Reliance on railroad and diesel (fossil) fuel for transportation
5. Transformation of local coal economies to renewable energy and energy efficiency opportunities

B. Oil

According to the U.S. Energy Information Administration, the United States currently imports about 57 percent of the oil it uses. The U.S. produces about 10 percent of the world's oil and uses 23 percent. The top five sources of net oil imports are Canada (20.1%), Saudi Arabia (13.8%), Venezuela (10.5%), Nigeria (8.8%), and Mexico (8.7%). Oil is used in the U.S. primarily for transportation and small engine fuel (gasoline, diesel), although there is some use of oil for space heating (heating oil, propane) and. industrial uses and lubricants. Very little electricity is generated with oil in the U.S. It is only used in locations like Hawaii where coal and gas are unavailable or highly expensive.

Obtaining oil requires several steps that comprise different segments of the petroleum industry: exploration, extraction, refining, transporting and marketing. Oil is drilled on private leased land and on government owned land that is designated as multiple-use. There is considerable pressure from the oil industry to be given access to the government lands currently off-limits due to their wilderness designation. The oil industry operates in the private sector but it is subject to environmental regulation by the U.S. Environmental Protection Agency, and the federal government oversees the Strategic Oil Reserves.

Conveniently extractable supplies of oil worldwide are almost depleted which has led to what is known as "peak oil.' This refers to the fact that new sources of oil are being discovered more slowly than the world is using oil from known sources. As the price of oil rises with its growing scarcity, more expensive and environmentally intensive methods such as extraction from oil shale or oil sands will be necessary to meet demand.

Oil refined into gasoline and diesel fuel that is used by cars, trucks, trains, planes and heavy construction equipment emits a number of toxic pollutants including nitrous oxide (NOX), sulfur dioxide (SO2), carbon dioxide (CO2) and lead. Transportation exhaust creates ground-level ozone which is damaging to lungs and exacerbates asthma and other respiratory conditions.

Transportation using petroleum contributes substantially to CO2 emissions, but the health impacts from other emitted pollutants could be said to provide a compelling argument on their own to dramatically reducing petroleum use for transportation.

Issues regarding the future of oil in a clean energy economy

1. Desirability of reducing dependence on foreign sources of petroleum
2. Easily accessed onshore resources have peaked in U.S., leading to higher economic and environmental costs for extraction (tar sands, oil shale)
3. Refineries – need for more refineries, but siting new facilities is difficult and expensive (NIMBY and EPA)
4. Environmental and economic impacts of domestic extraction:
   a. Using conventional drilling methods; processing tar sands or oil shale
   b. Environmental and health impacts of distribution and combustion for transportation and heating
5. Challenge of transforming transportation sector to biofuels and electricity
6. Transformation of local oil economies to renewable energy and energy efficiency opportunities

C. Natural Gas

Natural gas is the least carbon dioxide-intensive fossil fuel, producing about one quarter of the amount than coal when burned. Because of this, it is considered by many to be well suited as a transition fuel as we move to a clean energy economy. Natural gas is used primarily as a source of space heat for homes and businesses, and since the 1980's it has become the most popular technology for generating electricity, particularly in peaking plants because it can be brought on-line quickly when the base load (usually coal) plants are maxed out. Natural gas is also essential to the chemical and fertilizer industries both for feed stocks and process heat. In recent years there has also been a movement to use natural gas as a transportation fuel, primarily in public transportation systems and municipal fleets.

Primary Uses of Natural Gas

1. Space heating – residential, commercial, institutional, industrial
2. Water heating, cooking, clothes drying – all sectors
3. Electricity generation (primarily for peaking power)
4. Industrial process heating
5. Chemicals/plastics

The fluctuating and unregulated price of natural gas depends totally on supply and demand. Prices are very volatile from season to season, and incidents like Hurricane Katrina, which reduced production dramatically, can have a marked influence on the price across the country. The major drawback of considering natural gas to be the transition fuel used to get us from fossil fuels to renewable energy is the uncertainty of its future sources and the consequent volatility of its price.

Natural gas is found with coal and oil deposits, or on its own, and the presence of impurities varies with the source. Natural gas is produced by privately-owned drilling companies and refineries, and distributed through a national network of pipelines. Natural gas pipeline distributors sell to local utilities. There are 6300 producers in the United States, with 530 natural gas processing plants and 160 pipeline companies. The U.S. Environmental Protection Agency regulates the pipeline, and states regulate their local utilities.

Most of the country's natural gas supply comes from on-shore and off-shore drilling within its borders or from Canada. Natural gas is difficult to transport in its gaseous state except through pipelines. To transport it economically between continents it must be cooled to the temperature where it liquefies so it can be shipped. Overseas sources of natural gas must have the facilities to liquefy that gas for shipment. To import it, the United States must build the facilities to transform it back to its gaseous state and inject it into the pipeline network. Currently there are very few liquefied natural gas facilities at U.S. ports. Needless to say, importing liquefied natural gas is more expensive than domestic pipeline gas.

Vast new supplies of natural gas have been discovered in shale deposits found in Pennsylvania and Louisiana which could be extracted using horizontal drilling and hydraulic fracturing. However, the environmental implications of this extraction have not yet been established. For example, the process requires use of great quantities of water, a resource currently under scrutiny for its own limitations.

Issues regarding the future of natural gas in a clean energy economy

1. Its potential role as a transition fuel (because it's the least polluting of the fossil fuels)
2. Future supplies will determine its potential transitional role
   a. Possible need to import liquefied natural gas from overseas presents siting and other economic challenges
   b. Environmental impacts yet unknown of accessing possible new oil shale sources discovered in U.S.

D. Uranium (as a fuel for electricity generation)

Uranium occurs widely in nature, including in sea water. The world's supply of mined uranium comes from a limited number of nations. According to the World Nuclear Association, the top five producers in 2009 were Kazakhstan, Canada, Australia, Namibia and Russia. The United States still produces some uranium ore but the majority of the industry closed down in the 1970's. While these mines were operational, safety precautions were minimal and health problems endured long after the closing of the mines. Several mining methods are used to obtain uranium ore, but the ore must be crushed and heavily refined to produce commercial-grade uranium.

The primary civilian use of uranium is for generating electricity. The heat generated by the process of nuclear fission is used to create steam to operate turbines for generating electricity. According to the U.S. Energy Information Administration, 31

states have operating nuclear power plants. The last nuclear plant in the United States was built in the late 1970s.

Nuclear generation fits into the centralized plant infrastructure model alongside coal plants for base load generation. The United States has largest installed capacity in the world even though it provides just less than 20 percent of the nation's electrical energy. By contrast France uses nuclear energy for 80 percent of its electricity, but China and India use it to generate only 2%. The useful life of a nuclear plant is 40 to 60 years, and much of existing capacity will be slated to be decommissioned between 2030 and 2070. Thirty new reactors have been proposed for siting in the U.S. using Advanced Light Water Reactor technology (Generation III reactors), ostensibly a safer technology.

Nuclear power is a legacy of the "Atoms for Peace" program created by President Dwight Eisenhower to offset fears of nuclear annihilation during the early days of the Cold War. It has become increasingly controversial over the years because of issues surrounding plant safety and nuclear waste disposal and transportation. However, according to its proponents, because no fossil fuels are being combusted in the fission process, the carbon footprint of nuclear power makes it an attractive option for future clean energy. Other difficult issues surrounding nuclear energy will likely continue to outweigh this perceived advantage, not the least of which is the general rejection by the general public to siting plants and nuclear waste storage facilities, and the high expense of building plants.

Issues regarding the future of nuclear energy in a clean energy economy

Exacerbating all of the technical issues surrounding nuclear energy is the continued and notable distrust of the technology on the part of the general public. Even if the technical issues could be successfully addressed, it is difficult to imagine the public being convinced. The primary issues are as follows:

1. The safety of generation plants
2. The disposal of nuclear waste, both the transport and siting of storage facilities
3. Security considerations surrounding the fuel and the vulnerability of generation plants (Links to nuclear proliferation make for political and security difficulties)
4. Rapidly escalating costs of both building and decommissioning plants (Although economically competitive on an operating basis, nuclear plants require very high capital investment for construction and high-risk regulatory environment increases potential risk of investment)
5. Volumes of water required for the generation process, even for the Generation II reactors which need less water than older technologies

Renewable Energy Infrastructure – Description and Issues

The major differences between renewable energy and fossil energy:

1. Renewable energy sources regenerate – they are not used up (although bioenergy must be sustainably managed to remain renewable)
2. To greater of lesser extent – renewable energy sources must be harnessed where they are found, leading to a more decentralized energy infrastructure
3. Renewable energy is not as concentrated as fossil energy – requiring more space for systems, and greater need to use the energy efficiently

E. Solar energy (electricity)

The sun's energy can be harnessed in all climates through photovoltaic panels, which are made of layers of specific materials that essentially create an electric current between them in the presence of light. Photovoltaic panels can be used in large arrays in the open landscape or on large, flat roofs, or in small installations for individual homes or businesses. Photovoltaic panels have been used for many years to power highway signs and isolated water pumping systems.

In climates where there is a high level of sunlight, solar thermal generation and solar concentrator technologies are already generating electricity at utility scale. There are trough and parabolic dish concentrators and power towers that concentrated the sun's heat to generate steam to power turbines.

Solar power is very popular with the public because it produces clean, quiet power and is long-functioning. Many regard the sun itself as an endless source of energy that should be harnessed to provide all the power needed. While the systems currently being installed are producing reliable power, there are many new ideas being developed to increase the efficiency and reduce the cost of generating electricity from the sun.

Issues regarding the future of solar energy for generating electricity in a clean energy economy

1. Current costs of photovoltaic panel manufacture and installation are limiting its adoption in the mainstream
2. Siting issues for utility-scale systems: controversies are emerging regarding placement of large solar arrays on public lands
3. Solar rights and access are challenged at the local level in many places, and many subdivisions invoke covenants against installing solar equipment
4. Local permitting costs and ordinances are often not solar-friendly
5. Encouraging the development of U.S. solar industry to reduce costs and create jobs (China has taken the lead internationally for photovoltaic panel production)
6. The need to develop new economic models that help potential owners to afford a system (i.e. PACE financing)
7. Technical challenges include development of power storage strategies to make solar energy available around the clock

F. Solar Energy (heat)

Heating water with the sun has been done for a long time. The differences in systems available today is that new technologies

are able to store the heat longer, and can be integrated with other source of energy to maintain heat. Solar thermal systems work in all climates, although in the colder climates a larger system is required to produce the same amount of heat. These systems work well in applications where a steady supply of hot water is needed. They work for both single-family and multi-family residences, hospitals, hotels, prisons, food service buildings, athletic facilities, fire stations, and other facilities where people reside year-round. Solar-heated water can be used for space heating as well as domestic use. There are also some applications where solar hot water is used for commercial or industrial processes.

Issues regarding the future of solar energy for heating water in a clean energy economy

1. Current costs of panel manufacture and installation are limiting its adoption in the mainstream
2. Solar rights and access are challenged at the local level in many places, and many subdivisions invoke covenants against installing solar equipment
3. Local permitting costs and ordinances are often not solar-friendly
4. Encouraging the development of U.S. solar industry to reduce costs and create jobs (China has taken the lead internationally for photovoltaic panel production)
5. The need to develop new economic models that help potential owners to afford a system (i.e. PACE financing)
6. Overcoming negative reputation from the 1970's when repeal of federal tax credits caused the industry to crash, leaving behind non-functioning "orphan" systems

G. Wind Energy

Wind turbines and wind farms have made the biggest impact as a renewable source of electricity in the United States (other than hydropower). Wind turbines require a steady wind resource for wind power to be economical – in the United States this occurs most reliably in the plains states down through Texas, but many other states have areas suitable for wind farms. According to the American Wind Energy Association, the top five wind power producing states are Texas, Iowa, California, Oregon and Washington. The greatest area of wind potential is the plains states which have begun to develop their resources, but proximity to transmission lines has slowed the process.

Wind power is a growing industry in the U.S. and internationally, and promises to create new jobs in manufacturing, installation and maintenance. Utility-scale turbines are usually installed in wind farms in rural areas and provide bulk power. The current standard sizes range from 1.5 megawatts to 2.5 megawatts per turbine. Developers of commercial wind farms lease land from property owners, purchase and install turbines and sell the wind farm to an independent operator or local utility. According to the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 34,863 megawatts of wind power were generated in the United States in 2009, up from 2,539 in 1999.

Wind power generates no greenhouse gasses and uses no water or fossil fuels to generate electricity. Rural communities in windy areas can benefit from development of the resource by creating a new source of income for landowners and tax revenues for local governments. There is a high energy payback ratio, and wind power helps diversify the nation's energy mix and reduces demand for fossil fuel production and imports.

However, wind power is not without its critics. Many do not like the appearance or sound of wind turbines, and some are concerned with safety issues and property values of homes near wind farms. Turbine impact on migratory birds is also frequently mentioned. Many studies have been done about this and other technical issues, and much progress has been made to reduce impacts. Public perception continues to be a challenge regardless of research results. Offshore wind farms are the latest thrust of wind power development and they are creating their own set of issues and challenges.

Issues regarding the future of wind energy in a clean energy economy

1. Siting of wind farms near populated areas is controversial, as is siting offshore, both off the U.S. coastline and in the Great Lakes
2. Research and education about environmental impacts of wind energy, particularly on wildlife
3. Local government adoption of zoning controls that limit negative impact of turbines (Includes procedures, definitions, special use permit, site plan review, application and review process, abandonment and removal procedures)
4. Height regulations, including FAA regulations near airports
5. Up-front investment costs: transportation, installation, land purchase and leasing; allocation of transmission cost

E. Biomass

Biomass energy includes agricultural crops, animal manure, wood and waste from harvesting forest resources, sewage, food production waste and some components of the municipal solid waste stream. Essentially, biomass energy can be extracted from organic wastes or from crops grown specifically for their energy content. Biomass energy can be used to generate electricity, produce heat or to fuel vehicles. Biomass energy is considered to be carbon neutral because when it is burned it is releasing CO2 that was already in the atmospheric cycle rather than mined from deep in the ground.

Biomass fuels provide about 3—4 percent of the energy used in the United States—many manufacturing plants in the wood and paper products industry use wood waste to produce their own steam and electricity. Municipal solid waste (MSW) is the source of about 10 percent of the total biomass energy consumed in the United States; this includes both energy produced at waste-to-energy plants and methane produced by decomposition at landfills, which is then captured and used as fuel. Utilities are beginning to use biomass fuels such as waste wood or trees grown as fuel crops and switchgrass in their power plants to augment coal. Anaerobic digesters

can extract methane from sewage, animal manure or food processing waste and used just like natural gas to generate electricity or it can be cleaned and injected directly into the natural gas pipeline. Transportation fuels such as ethanol and biodiesel are being produced from corn and other crops as well as crop waste and algae.

Issues regarding the future of biomass energy in a clean energy economy

1. The use of animal manure for energy is controversial among environmentalists because it seems to encourage "factory" farming of livestock
2. Definitively answering the question of whether biomass combustion is or is not "carbon neutral"
3. Consistent management of agricultural and forest biomass resources to assure sustainable uses: forest and crop management issues revolve around the balance of using these resources for food and other products or burning them as energy
4. Environmental impacts and regulation of particulate pollution from burning biomass
5. Integrating new technologies and research on best methods of growing or harvesting biomass that can be used for electricity generation
6. Reconsideration of municipal solid waste as a source of energy for electricity generation to relieve pressures on new landfill siting
7. Development of "drop-in fuels," or biomass transportation fuels that don't require their own distribution system but can be fed into existing gasoline pipelines

H. Wave and Tidal Energy

One of the newest areas of renewable energy development is harnessing the energy in the waves and tides. These systems are configured to use the steady movement of waves and tides to power a turbine or piston. To capture the power of the tides, dams or reservoirs trap water at high tide to be released through a turbine. Other systems operate much like wind turbines under water, turning with the flow of the waves or tides. Another technology is ocean thermal energy conversion which uses the temperature differences in the ocean. None of these technologies are in commercial production yet, but developments are encouraging that they could eventually provide a small portion of the nation's electricity. Wave or tidal power is regarded as a utility-scale technology, and is seen as promising because it is more predictable than wind and solar. This is still a developing technology.

Issues regarding the future of wave and tidal power for electricity generation in a clean energy economy

Little is known yet about the potential for reduced tidal flow, silt buildup, effect on wildlife, or the intermittency of power delivery

I. Hydropower

Hydropower is the harnessing of flowing water to turn a turbine which generates electricity. Hydropower was one of the first technologies to generate utility-scale electricity in the U.S. Many towns dammed their local river to generate power, and the federal government built huge hydropower dams, including Hoover Dam near Las Vegas and the Bonneville Dam on the Columbia River between Oregon and Washington.

There arte three main types of hydropower plants: impoundment (dam and turbine), diversion (run-of-river), pumped storage (storage of energy). There are currently 80,000 dams in US, although only 2,400 produce power. Hydroelectric generating plants in the U.S. produce about 7 percent of the nation's electricity.

Hydropower is regarded as renewable energy that emits no pollution. Hydropower dams are also employed as flood control, and the lakes they create offer recreational opportunities. However, much more is known now about the environmental and societal impacts of damming rivers such as fish spawning requirements and disruption of communities. Most major rivers in the U.S. have been dammed, but new technology that can efficiently generate power from less flow may increase hydropower potential once again.

Issues regarding the future of hydropower in a clean energy economy

1. Environmental impacts of damming rivers, and the potential of removing some older dams
2. Effect of hydropower on river ecology and water quality
3. Development and use of new technology that reduces environmental impact of hydropower

J. Geothermal

Geothermal energy comes from the center of the earth where the temperature is 9000 degrees Fahrenheit. In certain places on earth this heat comes to the surface, such as Yellowstone National Park, the location of the Old Faithful geyser. This heat can be directed to heat water and generate electricity. It is accessed by drilling water or steam wells. Geothermal energy is naturally present and abundant within the earth. It is a clean and reliable source of energy for generating electrical power. The greatest environmental drawback is the amount of water that is needed for some processes. This is true for enhanced (or engineered) geothermal systems which can extend use of geothermal resources to larger areas by drilling and fracturing rock, and allowing water to permeate.

Most of the geothermal resources in the U.S. are in the western states. In the U.S. there are currently 2,930 MW of installed geothermal capacity and about 2,900 MW of new geothermal power plants are under development. Some industry experts see a potential for 100,000 MW of geothermal electricity production by 2050.

Geothermal energy can also be used simply for heat. Iceland uses its geothermal resources to heat all its buildings. Other applications of direct-use geothermal heat include greenhouses

and agriculture, industrial processes, and the hospitality industry which builds resorts around hot springs.

Issues regarding the future of geothermal generation in a clean energy economy

1. Greater understanding of environmental impacts during exploration and drilling, including potential ground subsidence
2. Heavy use of water with some geothermal technologies

K. Geothermal (ground or water source) heat pumps

Geothermal, or more accurately "ground source" heat pumps do not use heat from the center of the earth, but rather rely on the constant temperature of the earth just below the surface. In the summer, heat from inside the building is dispersed via a glycol solution through piping underground, and in the winter the cycles is reversed. These systems use as refrigeration cycle to control the level of heating and cooling. These systems offer an efficient way to use electricity for both heating and cooling, particularly in colder climates. Ground source heat pumps can also be used to heat water.

2. Electricity Infrastructure – Description and Issues

At the present time approximately 48 percent of U.S. electricity is generated with coal, with about 21 percent coming from natural gas and 20 percent from nuclear power. The remaining 11% or so is generated with hydropower and other renewable energy. The generation mix in individual states varies greatly, from Rhode Island which generates 100 percent with natural gas, to Vermont with its mix of 75 percent nuclear generation and 25 percent from hydro and other renewable sources, to Indiana which uses over 90 percent coal in its generating plants.

The traditional electrical utility infrastructure in the United States is based on large, centralized generation plants powered by coal or nuclear energy (and some large hydroelectric projects like Hoover Dam) with the electricity then delivered over a vast network of high voltage transmission lines. Generally speaking, the transmission system fell behind in maintenance and expansion during the deregulation heyday in the 80's

Each energy source has its own infrastructure of source, extraction, production and use. Practically speaking, moving from fossil and nuclear sources to renewable energy will require both technological and political creativity, and cannot be accomplished overnight. The electric utility industry is primarily investor owned and is therefore managed to accommodate its financial bottom line. State regulation attempts to balance utility fiscal imperatives with requirements to promote energy efficiency and renewable sources. Municipal utilities and rural cooperatives are essentially customer-owned and could therefore be more responsive to grass roots campaigns for clean energy, but in both public and private utility worlds, the will to make substantive change from traditional practices has yet to be fully born.

Distributed Generation—Customer sited

The current utility model for generation and distribution of electricity is employing large, centralized generating plants (such as coal, nuclear or hydropower) and distributing the electricity along a vast grid of transmission lines to substations, where distribution lines carry it to local customers. The transmission system is interconnected is a complex pattern to allow utilities to obtain the electricity they need to manage their demand. This model works well for using easily transportable fuels like coal that can take advantage of economies of scale to deliver cheap electricity.

For the most part it is impractical to harness renewable energy for large, centralized generation plants. To begin employing various renewable sources of energy for generating electricity it will be necessary to alter this model to allow many small generation systems to contribute to the electricity supply. Whether it includes small, residential solar electric systems, anaerobic digesters on farms, or wind turbines owned by rural land owners, utilities and state regulatory agencies are coming to terms with the idea of "distributed generation." The advent of "smart grid" technology, which will essentially keep specific track of customer electricity use (and production), will open up new possibilities for managing this more complex approach. Distributed generation would not eliminate the grid or large generating plants, but could add flexibility, security and potential economic opportunity for communities.

Issues regarding the future of the electricity industry in a clean energy economy

1. The largest issues for the electricity industry and its regulators will be transitioning to clean energy, and moving from centralized to distributed generation as part of accomplishing this
2. Rights of Way for new transmission lines to serve large renewable energy generating facilities (such as wind farms) in isolated locations
3. Development of smart grid to promote distributed versus centralized generation infrastructure and to introduce flexibility and security in the system
4. Developing greater cooperation among states and federal government to update and streamline transmission grid
5. The use of electricity for automobiles needs careful planning to make it a clean energy option, including impacts of new load on the generation infrastructure, the development of economical batteries, and the creation of plug-in stations and other infrastructure

Issues regarding the role regulatory structures will play in the future of a clean energy economy

1. Transforming the existing state-level regulatory structure where utility profits are connected to power sales rather than energy efficiency, thus encouraging the status quo
2. Need to develop regulatory structure that encourages development of clean energy resources
3. Issues about public/private interface to balance market based, vs. public good based investment and funding decisions

Energy Efficiency and Conservation

Energy efficiency and conservation are essential components of the energy infrastructure policy discussion. Eliminating waste makes renewable energy sources more practical and economical, and investments in efficiency and conservation generate the fastest clean energy return. According to the Rocky Mountain Institute, up to 65 percent or more of building energy use could be reduced through currently feasible and identifiable efficiency and conservation measures.

Furthermore, greenhouse gas emission reduction goals are unlikely to be met without a strong demand reduction component. This would include stronger and more widely enforced energy codes, product standards and efficient building guidelines, and behavioral changes such as developing greater awareness of personal energy habits.

Utility demand-side management programs over the years have shown that energy efficiency is the most cost effective way to reduce fossil fuel demand and support a reduced baseline load for energy generation. There are many proven, off-the-shelf technologies that can begin saving energy immediately after they are installed. Also, investments in energy conservation and efficiency "infrastructure" improvements create jobs in the national and local economies that cannot be exported.

Development of smart grid technology could contribute dramatically to reduction of energy use by providing up-to-the-minute information to both utilities and their customers. Feedback to customers on energy use and potential savings is essential to motivate and reward action, and such information systems should be considered part of our energy infrastructure. A smart grid is important in allowing more efficient use of electricity generation capacity through time of day pricing. This could also be a key factor in supporting the adoption of electric car technology.

Tools for Implementing

Building codes are regarded as essential for raising the efficiency of the nation's building stock. The International Code Council (ICC) develops codes addressing both residential and commercial built environments. The most recent code to be drafted is the International Green Construction Code or IGCC. The IGCC will address a variety of sustainability aspects including energy efficiency to renewable energy use. A final code is expected to be in place by 2012. However, jurisdictions can use the current IGCC draft in place of a final code.

IGCC is coordinated with all the International Codes and the National Green Building Standard, ICC 700-2008. Developed by the National Association of Home Builders and the Code Council, the standard provides guidance for safe and sustainable building practices for residential construction, including both new and renovated single-family to high-rise residential buildings. All ICC codes are developed to be complimentary to the LEED rating system, as well as other rating systems and standards within the sustainable building market.

Another important tool is new financing structures that will assist both individuals and communities to make the up-front investments that will be required to improve building efficiency as soon as possible. One popular option is Property Assessed Clean Energy (PACE) Programs. These programs are comparable to providing sewer or water service via a district and provide a public financing mechanism to overcome obstacles to implementing otherwise cost-effective energy demand reduction improvements in buildings. They can also be used to spur development of renewable energy systems.

Issues regarding the role energy efficiency and conservation will play in the future of a clean energy economy

1. Raising public awareness of the importance of valuing energy more highly
2. Adoption and enforcement of energy codes for building renovation and construction
3. Redesigning products to use less energy and be less energy-intensive in their manufacture and disposal
4. Regarding the energy reduction aspects of urban and community design

ENERGY INFRASTRUCTURE RESOURCES

Kelley, Ingrid, Energy in America: A Tour of Our Fossil Fuel Culture and Beyond, 2008. University Press of New England, Lebanon, New Hampshire

Web Resources

http://www.eere.energy.gov/

The U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE) Web site – covers energy efficiency and renewable energy technologies and programs in biomass, geothermal, hydrogen and fuel cells, solar, vehicle fuels and technologies, wind and hydropower.

http://www.nrel.gov/

Web site of the U.S. Department of Energy, National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL is a high-tech research and development lab working on biomass (including vehicle fuels), geothermal, hydrogen and fuel cells, solar and wind technologies. NREL wind resource maps can be found at http://nrel.gov/wind/resource_assessment.html .

http://www.ucsusa.org/clean_energy/

The Union of Concerned Scientists is an advocacy group promoting clean energy technologies. They cover a wide array of issues related to clean energy, presenting good technical information while addressing political and social aspects of renewable energy development.

SOLAR

http://www.ases.org/

The American Solar Energy Society, established in 1954, is the leading national solar organization

WIND

http://www.awea.org/
The American Wind Energy Association is the preeminent national wind energy organization

http://www.windustry.com/
Windustry is a Minneapolis-based non-profit that promotes wind energy projects to rural communities.

WOOD HEAT

http://www.woodheat.org/
Woodheat.org is a Canadian-based organization that promotes use of wood for heating homes.

http://epa.gov/air/woodstoves/partner.html
A U.S. Environmental Protection Agency Web page that features a number of links about clean burning wood stoves and fireplaces

GEOTHERMAL – GENERATION AND HEAT PUMPS

http://geothermal.marin.org/
An educational non-profit offering information about geothermal electric generation.

http://www.geoexchange.org/
GeoExchange, or the Geothermal Heat Pump Consortium is a trade association that offers information about heat pump systems.

SECTION 3: GREEN INFRASTRUCTURE

INTRODUCTION

The discipline of urban planning has traditionally focused its study and practice on the city as a place created by people and shaped by their technologies and values. Built urban spaces have been—and continue to be—carved out of rural wilderness or surrounding agricultural lands as cities and urban regions are created or expanded. Until recently, natural systems and features have been seen as existing characteristics or aesthetic features and have been poorly integrated with city building.

The conservation movement that emerged in the early 20th century to moderate the unrestricted human encroachment on rapidly disappearing wilderness areas embodied not only the Jeffersonian idea of the rural, but also more subtly the subject-object relationship between humans and nature. When it was planned into the cities of this era, nature took the form of isolated parklands in which urban factory workers could conveniently encounter idealized nature. Ebeneezer Howard's Garden City and Le Corbusier's modernism demonstrated urban space surrounded by rural nature; Olmsted's Central Park in New York City and Burnham's Grant Park in Chicago are examples of nature encapsulated by urban development. Such traditionally planned urban green spaces use nature as a design feature within an essentially urban place, in much the same way as a distinctive landmark tower or an entrance arch might be included in a city's design.

Since the publication of Rachel Carson's Silent Spring in 1962, society has increasingly strived to mitigate the detrimental effects that technology and urban development can have on nature. The publication of Ian McHarg's Design with Nature a year later signaled a shift in thinking by planners about the interface between urban development and natural areas. In the second half of the 20th century, emerging research and the problems facing urban development that ignored its environment have led to environmentally-based planning with a greater appreciation of nature and an increased respect for natural systems. Today, communities face increasing environmental threats (such as pollution, climate change, loss of critical habitat and depletion of non-renewable natural resources) as well as important social and economic consequences of decades of development that ignored nature. As a result, planners now recognize that urban development must be integrated—and not merely inserted—into the natural world if both are to survive.

As planners consider the expansion and rebuilding of cities for the 21st century, the relationship between urban and natural features and activities must be reconsidered and reconstructed so natural systems are an integral and valued part of the city – the 'green infrastructure' that is the foundation of the urban area and a vital part of daily life for the city's residents.

What is 'Green Infrastructure'?

Green Infrastructure is represented by natural systems, human technologies, and the merger of natural systems and human technologies and is structured into three general applications:

1. Natural systems (e.g. protected lands, open areas and greenspace, parks, natural corridors and estuaries), acting alone, to provide ecosystem services performing as infrastructure;
2. Human technologies, such as permeable pavements, cisterns and other rain harvesting apparatus, and SilvaCells® that increase capacity and heighten performance; and
3. A merger of natural systems and human technologies (e.g., green roofs, green 'cloaking', green walls, bioswales, trail systems and low-impact development design techniques) that elevate the performance of conventional infrastructure and offer economic efficiencies.

This flexible, three-tiered structure accommodates the use of green infrastructure to influence and support urban, suburban and rural human communities.

Just as 'grey infrastructure' systems – transportation, power, sewerage, storm drainage, and other mechanized systems – facilitate the social and economic functions of our built environments, green infrastructure systems provide an "array of products, technologies and practices that use natural systems (or engineered systems that mimic natural processes) to enhance overall environmental quality and provide utility services."[10] Green infrastructure shapes the relationship of human communities to their environment, and defines the manner in which human settlements are integrated into the greater ecological context. As such, the health of green infrastructure systems reflects the value, or lack of value, that humans place on the environment in which they live. In a rapidly urbanizing world, the quality of our green infrastructure will significantly impact the ultimate sustainability of our environment and urban areas.

Benefits of Green Infrastructure

Green infrastructure provides a variety of inter-related environmental, economic and social benefits. Different groups and individuals perceive these benefits and their values differently, while many are unaware of the advantages realized daily from the green infrastructure systems operating in their communities.

The portfolio of services and benefits provided by green infrastructure to urban, suburban and rural residents includes stormwater management, water and air quality management, improvements to public health and safety, climate action, control of ambient environments and suppressed urban heat island effects. In addition, green infrastructure provides ecological assets including habitat for indigenous species, migration pathways for migrating species and recharge zones for depleted aquifers. These systems provide a myriad of recreational opportunities through a network of connected features such as greenspace and protected environmental lands, functional parks, water bodies, working lands and trails. In today's urban areas, green infrastructure combines built and natural systems to resolve challenges such as constrained spaces, hardscape and non-point source pollution, and to exploit the compounded performance and cost[11] reductions presented by integrated systems. Properly engineered and integrated, this combination of nature and nurture serves to enhance and sustain the human environment while preserving the natural ecosystems where people live.

Table 1: Green Infrastructure Benefits as Valued by Different Groups Key: ↑ Increase; ↑ Decrease				
Types of Benefits that have Environmental, Economic and Social Returns	**Individuals**	**Developers**	**Business Owners**	**Government**
Stormwater Management	↑ Health and Well-being	↑ Capital costs of stormwater infrastructure	↑ Use of potable water for irrigation	↑ Cost to maintain infrastructure; ↑ Flood potential
Surface and Ground Water Quality	↑ Health and well-being; ↑ Taxes/fees for potable water	↑ Capital costs of well or water filtration infrastructure	↑ Taxes/fees for potable water	↑ Cost to treat potable water
Air Quality	↑ Health and well-being	↑ Capital costs of air filtration systems	↑ Costs to filter and purify air	↑ Regulation to achieve air quality standards
Biodiversity Protection	↑ Opportunity to view	↑ Costs to comply with future regulations to protect biodiversity	↑ Potential future products	↑ Cost to protect Threatened & Endangered species
Climate Protection	↑ Air conditioning costs	↑ Consistency in knowing future product delivery is climate specific	↑ Opportunity for new markets and products	↑ Cost to reduce urban heat island effect
Preservation of Prime Farmland	↑ Access to fresh food	↑ Capital costs by utilizing existing infill infrastructure	↑ Local products from the land; ↑ Transport costs	↑ Cost to maintain infrastructure; ↑ Local food production
Transportation	↑ Access to greenway bicycle and pedestrian trails	↑ Marketable value	↑ Recruitment of staff	↑ Cost to maintain road network; ↑ Congestion costs
Return on Investment (ROI)	↑ Land and property values	↑ Land values; ↑ Uncertainty about future land value; ↑ Opposition to development	↑ Levels of investment	↑ Stimulates economic activity; ↑ Public/Private partnerships
Public Health	↑ Healthcare costs; ↑Health and wellbeing	↑ Healthcare costs; ↑ Worker absenteeism	↑ Healthcare costs; ↑ Productivity	↑ Healthcare costs; ↑ Retention of staff
Aesthetic Character	↑ Land and property values	↑ Marketable value	↑ Customers	↑ Marketability to future residents and businesses
Open Space and Recreation	↑ Health and wellbeing; ↑ Travel time to access low cost recreation	↑ Marketable value	↑ Profit from tourism; ↑ Labor productivity	↑ Tax revenue from tourism; ↑ Diversity of economy
Community Character / Sense of Place	↑ Sense of community	↑ Marketable value	↑ Revenue from tourism; ↑ Jobs and retention of employees	↑ Community involvement / public participation

Table 1 lists major benefits of green infrastructure and provides some examples of how various groups might value the same benefit differently.

Green infrastructure systems offer an important and effective way to address the nation's serious fiscal and operational demands of its 'grey' infrastructure. A more thorough understanding of the fiscal and operational potential of green infrastructure is not only necessary but timely – as documented by the American Society of Civil Engineers' 2009 finding that a majority of the country's 'grey' infrastructure ranks a 'D' in condition, and the report's estimate that the nation will need to invest at least $2.2 trillion over the next five years to avoid spiraling decline, failure and accidents.

The perception that green infrastructure costs more than traditional grey infrastructure is usually the result of analysis that considers only the initial capital costs of a project. Any cost/benefit analysis of green infrastructure is woefully deficient absent an objective evaluation of the project's triple-bottom-line, cost avoidance opportunity and life-cycle costs. This level of analysis shows that green infrastructure is profitable. The city/county projects and programs listed below are among the examples that demonstrate green infrastructure profitability.

- **Philadelphia**. Philadelphia's $1.6 billion "Green Cities Clean Waters Plan", which will convert more than 4,000 acres of impervious municipal area to greenspace and implement a widespread 'green streets' program, is currently the largest green stormwater infrastructure program in the country. A triple-bottom-line analysis of the Plan published last year projects a present plan value of $2.6 billion dollars, represented by reduced mortality rates, improved mobility, higher air and water quality, avoided infrastructure costs, reduction in construction-related disruptions, energy savings, green job benefits and reduction of the municipal carbon footprint. By contrast, conventional systems were projected to provide less than $150 million in benefits, partially because the application of conventional systems is compartmentalized and targeted to a specific purpose or benefit.
- **Toronto**. A comparative study of conventional and green roofs in Toronto showed that green roofs reduced summertime roof membrane temperatures by more than 35°F, and that summertime heat flow through the roof was reduced by 70 to 90%. By greening 8% of its roofs, Toronto could realize capital savings of more than $200 million and $300 million in operational costs (more than $100 million of which is attributed to stormwater infrastructure).
- **Baltimore/Washington**. The loss of urban trees in the Baltimore/Washington area between 1973 and 1997 accounts for approximately half the increased costs in stormwater infrastructure over that period ($1.8 billion).
- **Jacksonville**. As of 2002, Jacksonville, Florida's urban trees provided 928 million cubic feet in stormwater containment services, valued at $1.86 billion. Anticipated loss of canopy to urbanization by 2020 is identified as a key factor in the need for a projected additional $82 million in stormwater infrastructure.
- **Miami-Dade County**. A CityGreen Study of Miami-Dade County, Florida's urban forest concluded that replacing its palms with canopy trees (oaks) would reduce its stormwater by 8%.
- **Atlanta**. The City of Atlanta has saved more than $883 million in stormwater retention facilities because of its urban canopy.
- **Brockton**. In Massachusetts, the Brockton Brightfields is the largest solar energy installation in New England. Developed on a former brownfield site, this 425-kilowatt (KW) photovoltaic solar energy system cost $3.037 million to build and expected to generate 535 Megawatt hours of electricity, reduce 589,570 lbs. of carbon dioxide emissions per year, and will secure $130,000 in revenues annually for the City of Brighton. It is expected to pay for itself in 15 to 20 years.
- **State of Connecticut**. The state's Nitrogen Credit Exchange Program has been recognized by EPA for its role in improving the water quality of Long Island Sound. Water quality trading is an innovative approach to achieving water quality goals efficiently and economically. The program allows waster water treatment facilities facing higher pollutant control costs to meet their regulatory obligations by purchasing credits from those facilities that discharge below their allocated limits and thus have credits to sell. In 2008, Stamford, Connecticut received $939,510 in credits, an annual payment, the highest in the state, due to its advanced wastewater treatment plant.

CHALLENGES TO PLANNERS

In spite of the considerable benefits to human communities and nature attributable to well designed and constructed green infrastructure, challenges remain for its inclusion in urban development. Four major challenges are described below.

1. Rethinking 'highest and best use'.

Perhaps the most significant challenge to the use of green infrastructure is the traditional land use and development practice that emphasizes the development of urban real estate to its 'highest and best use', measured in terms of short-term market value and, therefore, rapid economic return on investment. Allocation or reclamation of open space to green infrastructure may not generate the short-term bottom-line payback that is often expected from urban development projects. This focus on short-term economics ignores the long-term benefits of green infrastructure to the surrounding community as well as to the individual landowner or developer. When life-cycle costs of maintenance and operation are considered along with initial capital costs, green infrastructure may be the most economically beneficial over the life of a project. So planners and decision-makers must change their assumptions about 'highest and best use' and must recognize that retaining valuable natural resources may in fact be the 'highest and best use' for some properties in urban areas.

2. Informing people about the benefits of green infrastructure.

The second most significant challenge is the general lack

of understanding about the real value and role of green infrastructure in the creation of thriving, sustainable communities. Many planners, and the residents and decision-makers of the communities they serve, are not aware of the benefits that result from using green infrastructure systems rather than investing in grey infrastructure. Therefore, they do not understand what they are losing when a natural environment is replaced with concrete and steel, and they do not know what they could gain – in lower costs, better health or higher quality of life – by investing in green infrastructure systems.

3. Updating public policies, standards and criteria so green infrastructure investment is on an equal footing with grey infrastructure.

The general lack of understanding about green infrastructure's benefits has kept these systems from enjoying the same level of policy support as grey infrastructure solutions to urban problems. At all levels of government, and in the private sector, there are extensive sets of standards and designs that specify how to use HVAC (heating, ventilation and air conditioning) systems to maintain a desirable temperature inside a building. There are not yet such policies and standards for the use of trees to shade the building, and for the building's siting and windows to take advantage of prevailing breezes. These practices might offer a far better solution to the problem, but since there are not established standards for them it is less likely they will be chosen. While there is a growing body of examples of individual green infrastructure projects, there is not yet a set of widely accepted standards for green infrastructure systems. Establishing such standards would create consistency, predictability and flexibility for specific circumstances, thus providing guidance on green infrastructure practices that is comparable to guidance on grey infrastructure. These standards will give planners the tools to guide and successfully influence decision-makers, as well as the tools available to overcome entrenched traditional land use and development practices that assume grey infrastructure design solutions.

Since the benefits of green infrastructure are significant to a wide variety of stakeholders, the planning community should work to overcome these challenges and to ensure that these green infrastructure concepts and designs are readily available as part of the 'toolkit' for planners.

4. Using life-cycle costs as the basis for investment & development decisions.

Green infrastructure is often the most cost-effective solution to an urban service or development concern over the entire life of a project – considering initial construction costs and annual operation and maintenance costs. But frequently these life-cycle costs are not the basis for the choice among infrastructure systems. Two examples illustrate this challenge:

- A project with lower capital costs but higher long-term operational costs may seem to be the best choice from the perspective of an elected official with a short term of office and the need to run for re-election.
- A project where one entity (e.g. a developer) must pay the initial costs while another group (like future homeowners) will pay the annual electric bills also leads to choices that are less costly in the short-term but more costly in the long-term.

As America focuses on rebuilding its infrastructure, it must invest in facilities and systems that are sustainable over the long-term. Green infrastructure systems often meet this criterion but are not selected because decision-makers – both public and private – are focused on initial capital costs rather than life-cycle costs. Partnerships between the public and private sectors should help to balance the burdens and benefits on all parties and create the incentives that make a life-cycle investment decision more feasible.

Local Green Infrastructure for Global Impact

Although frequently implemented at the local or regional level, green infrastructure initiatives have real global impact. Our growing understanding of the ecological complexity of our urban spaces provides convincing evidence that decisions made locally are manifested globally. The 'butterfly effect' metaphor captures the far-reaching ecological and climatic consequences of our municipal and regional planning choices.[12]

As designers of urban spaces and managers of these spaces' relationship to the natural environment, planners have a special responsibility to employ green infrastructure to erase the artificial boundaries we, ourselves, have constructed between urban and rural. We must rebuild the city as a participant in Earth's larger ecosystems. We must ensure that the nation's infrastructure needs of the future are met by sustainable, green infrastructure systems.

Green Infrastructure in Current Planning Practice

For some communities, the idea that natural systems can provide an urban area with services typically provided by concrete and pipes seems very new and untested. But the experience of places making these investments shows that green infrastructure can be an integral and positive component of an urban region. In fact, green infrastructure can be applied at all the geographic scales at which planning is practiced. The section below explains how green infrastructure systems relate to these planning scales, from a region to a building site. It illustrates the ways green infrastructure is integrated into typical planning programs and processes that most agencies use at these scales. The section further demonstrates that green infrastructure is indeed an important next step in the investments needed to rebuild America's cities and urban areas.

Using Planning Scale to Direct Policy and Implementation

Green infrastructure can be incorporated into the planning and development process so resources are protected from destruction or pollution while making these resources an integral and functional part of urban development. This

approach enhances community life, increases land values and reduces public maintenance costs. Since green infrastructure practices and policies are still fairly new in the planning arena, there is not a settled framework for their application. This Sub-Task Force has chosen to organize its discussion of green infrastructure according to the geographic scale at which it will be most effective. Since green infrastructure resources tend to overlap jurisdictional boundaries, scale is an extremely important consideration for effective management and to ensure inclusive participation and equitable distribution of the resources.

The largest planning scales - at a global resource level down to a major regional watershed - are typically implemented through multi-lateral agreements between nations, agencies, organizations or regions. The county and municipal levels are perhaps the most utilized for green infrastructure planning, because these are the levels at which land use policies are often set and implemented. Very localized levels, such as projects, buildings and sites afford opportunities for demonstrating green infrastructure practices and building community support. Table 2 presents a listing of planning scales, the type of resource targeted for sustainable planning and examples of planning actions at each scale. The role of green infrastructure is considered at each scale of planning focus.

National Level Planning for Green Infrastructure

United States

The U.S. federal government establishes policies that govern the management of national parks, forests and rangelands and has enacted legislation to protect these critical natural resources. The umbrella legislation for protecting resources at the federal level is the National Environmental Policy Act (NEPA), a legal mechanism to identify key resources for protection and to help mitigate damage created through federal actions. The federal government also enacts budgets for planning and implementation of these policies and programs, such as stormwater planning for municipalities.

Three U.S. laws – the Clean Air Act, Clean Water Act and Endangered Species Act – were all passed in the 1970s and provide the regulatory backing for green infrastructure policies at all governmental levels. U.S. policies for planning and implementing green infrastructure tend to lag behind international practices and policies, with less attention paid to climate mitigation, carbon sequestration, ecosystem protection, scientific land use planning and biodiversity conservation than in other developed nations. These policies have significant economic upsides as well. The U.S. stands to reap major benefits from the recognition of new resource values, improved public health and disinvestment in costly grey infrastructure.

The American Planning Association (APA) can urge a broader, scientifically-based ecological perspective that will recognize the values of sustainability and the desirability of green infrastructure nationwide. New regulations based on scientific ecosystem management are necessary to achieve the environmental benefits of incorporating green infrastructure into regional, state and local land use practice. As initial steps, the federal government can support: (1) state infrastructure plans that are synchronized with regional land use planning, regulations and incentives; and (2) sustainable, local environmentally-based solutions to mitigate the growing demand for increased infrastructure capacity.

Other Nations

European nations have taken leadership on the climate change initiative, bringing both a strong sense of urgency as well as informed science to the green infrastructure planning arena. ICLEI - Local Governments for Sustainability - is an international advocacy group that functions as a clearinghouse for climate mitigation and adaptation, often involving planning for green infrastructure. Five European countries have created the European Capital of Biodiversity Award which promotes the extension and accessibility of urban green areas. Germany has a history of successfully managing stormwater in urban settings and Germany's green roof program has led the way for technology development and adoption worldwide.

In Europe, there are also a number of continental, regional, national and municipal green infrastructure plans, pursuing various objectives from species and ecosystem integrity to urban land use planning and securing human health in urban environments. Some of these national plans include:

The Nutra 2000 Network, spreading across all of Europe, represents the largest network of conservation areas in the world. It was planned to save threatened species and ensure genetic diversity. Other national and regional green infrastructure systems that have similar purposes include Estonia's Green Network and the Carpathian EcoRegion Initiative. Germany's Biotope Network uses a Biotope Area Factor System backed by German federal and local law, which requires the protection and restoration of community ecosystems in their natural diversity and protection of specific biotopes from development.

France's "Trame Verte et Bleue" (Green and Blue Network) was developed to understand and engage ecological networks in spatial development and planning policies. Greenspace Scotland operates as a think-tank, research and piloting program, and most recently explored the link between vibrant, interconnected greenspace and human health in urban areas.[13]

State Level Planning for Green Infrastructure

Similar to the federal government, state governments prepare plans for parks and public lands and enact legislation authorizing watershed management and planning and zoning at the local level. While there are some examples of planning for green infrastructure, additional policies and legislation are needed to empower local government to implement new and creative sustainable planning initiatives, particularly in recognizing the value of green infrastructure.

At present, several states have adopted an ecosystem-based approach for managing state conservation lands, state gamelands and as a framework for their natural resource departments. Michigan, Minnesota, Florida, California, Missouri and Pennsylvania are among states that use the science of ecosystem management as a basis for state land management. This effort

Table 2: Examples of Green Infrastructure Application by Geographic Scale and Topic Area

Resouces	Water	Air	Soils	Open Space	Biodiversity	
Scale						**Planning Activity**
Multinational	Great Lakes; Coral reefs; Wetland systems; Floodplains	Carbon	Ecosystems	World Heritage Sites Rainforests	International fisheries Endangered species Ecosystems	International agreements such as Ramsar, CITES [14], Climate exchanges
National	Wetlands; Waterways; Floodplains; Lakes	Air quality Carbon	Soil conservation Farmland	Parks Ranges	Wildlife refuges Endangered species	NEPA, Clean Air & Water Acts, Endangered Species Act, Federal programs & grants
State	Watersheds; Floodplains; Lakes, Stormwater	Air quality State forests	Soil conservation Farmland	Parks Forests	Endangered species	State programs & grants, ordinances, emissions control acts, hunting permits, fees
Regional	Watersheds Wetlands	Air quality Carbon	Farmland	Parks; Forests Greenbelts	Migratory corridors Refuges MOA's	Strategic plans, implementation programs,
County/Rural	Watersheds Aquifers	County forests	Soil conservation Farmland	Parks; Forests Greenbelts	Preserves	Comprehensive plans, zoning codes, ordinances, taxes
Municipal/ Suburban	Surface waters Stormwater	Air quality Urban forests	Soil conservation Community gardens	Urban forests Parks; Greenways	Sanctuaries Botanical gardens	Plans, codes, ordinances, fees
City	Stormwater Surface waters Streams	Air quality Carbon Tree canopy	Soil conservation Community gardens Urban farms	Urban forests Parks Greenways	Sanctuaries Botanical gardens	Plans, zoning codes, ordinances, fees, taxes, incentives
Neighborhood/ Sub-Area		Street trees	Soil conservation Community gardens	Parks Streetscapes	Tree canopy	Small area plans, LEED_ND[15]
Project/ Development	Stormwater Surface waters	Site trees	Site soils	Site landscape	Landscape plants	Zoning, setbacks, fees, incentives, LEED
Site	Stormwater Surface waters	Site trees	Site soils	Site landscape	Landscape plants	LID, Stormwater BMPs (bioswales, etc.), Sustainable Sites[16] tools
Building	Rainwater Green roofs Cisterns	Green walls Green roofs		Courtyard Green gardens & roofs	Street trees	Rainwater capture (cisterns, green roofs), LEED

is administered and facilitated mostly by state land managers, often in partnership with land trust organizations, providing a model for effective natural infrastructure management.

The practice of incorporating green infrastructure into ecosystem planning, particularly in urban areas, is relatively new to most states. Green infrastructure planning has been greatly facilitated by development of state Geographic Information Systems (GIS) databases and networks, often through partnerships with major state universities such as Penn State and Florida State. Maryland's GreenPrint program is targeted at identifying significant areas and connecting corridors, thus suggesting priority locations for urban green infrastructure development. Natural Connections is a partnership involving Wisconsin, Indiana and Illinois to share GIS data, mapping and policy coordination for green infrastructure planning. These examples illustrate the enormous contribution to green infrastructure that states can provide – comprehensive GIS databases networked through open source servers that can be accessed by other state agencies, universities, municipalities, counties, non-profit environmental groups and community organizations.

Regional and County Level Planning for Green Infrastructure

Watershed management, agricultural preservation, forests, parks and greenways are appropriately the subject of regional and county government planning. These efforts are particularly important when there are watersheds that overlap multiple political jurisdictions and unique landscapes or prime farmland in danger of loss from urban growth. Regional and county agencies are in a strong position to identify environmental corridors along surface waterways and areas to protect for groundwater recharge.

Incorporation of green infrastructure tends to occur during updates of a county comprehensive plan and related environmental ordinances. County plans provide the opportunity to update information on land use and the conservation opportunities remaining in a region. County plans bridge the divide between state policies and local land use and zoning, and are often able to address corridor, watershed, agricultural and habitat protection with more refined and detailed plan development.

A web-based source for regional and county plans, as well as technical data, resources and case studies is the Green Infrastructure Wiki, a living encyclopedia of green infrastructure data. Plans and policies are listed separately by state and county as well as resource category. The Green Infrastructure Wiki website can be found on the Internet at http://www.greeninfrastructurewiki.com. Other helpful website links are listed in the appendix of this report.

Municipal, Urban and Suburban Planning for Green Infrastructure

United States

The local level of government that controls comprehensive planning and regulation of land uses through zoning, subdivision and other ordinances offers a significant opportunity for implementing green infrastructure. This power is authorized for different levels of local government by state statutes, with authority wielded at the city, town, township, boroughs or village level depending on the state. Local governments establish policies and comprehensive plans for parks, forests and open space, greenways and environmental corridors and for roadways and streetscape treatments. They can also adopt standards and provide incentives for green infrastructure, tree preservation, permeable surfaces, low impact development (LID), open space, urban gardens, the application of best management practices (BMPs) and other green infrastructure applications.

Some examples of state statutes establishing green infrastructure implementation through local government regulations are the Maryland's Forest Conservation Act and Stormwater Management Act of 2007. The Maryland Forest Conservation Act provides guidelines for the amount of forest land retained or planted after the completion of development projects. The Maryland Stormwater Act requires that environmental site design (ESD) be implemented to the maximum extent practicable, through the use of nonstructural best management practices (BMPs) and other improved site design techniques.

Codifying green infrastructure presents a challenging opportunity for any local jurisdiction, given regional variations in land use, local development practices, community values and the varying levels of environmental protection in place. The best evolving sets of guidelines for green infrastructure are included in the principles of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) rating system, the Sustainable Sites Initiative developed by the American Society of Landscape Architects and the ICLEI STAR Community Index. The LEED® rating system, in particular, has been adopted directly into local ordinances by several municipal governments, an unanticipated byproduct of the success of the voluntary green building movement. The LEED® system however, is not (yet) specifically adapted to local and regional ecosystem variation, a cautionary note in terms of its applicability to green infrastructure ordinances. The STAR Community Index is one of the initiatives led by ICLEI-USA to benefit its member communities.

Several U.S. municipalities are providing innovative planning leadership for green infrastructure policy and practice. New York City's Plan2030 is among the most comprehensive; Portland's (Oregon) Grey to Green Initiative is well designed and targeted; Philadelphia is aggressively linking stormwater recycling and management with community benefits. Many California cities and metropolitan regions are incorporating green infrastructure in their comprehensive plans and regional 'blueprint' plans. These examples and many others are listed in the appendix of case studies.

Effective use of green infrastructure techniques also requires a decision-making process that balances and integrates investment choices. The Sustainable Action Model (SAM) created in Olympia WA, is a good example of such a sustainable decision-making process. This process was created to implement a City

Council goal, adopted in 2005, of "putting sustainability to action." A group of Department Directors, the Sustainability Super Team (SST), determined that a successful decision model is one that:

- Will help identify balanced solutions.
- Will help decision-makers see the trade-offs and opportunities, not just the pros and cons.
- Will be simple and user friendly.
- Will tell a story, be visual, and easy for the average person to understand and see the connections between seemingly unrelated things.
- Can be replicated in any City Department.

With the help of students from Evergreen State College, the decision-making strategy was created that is reflected in the Sustainable Action Map (SAM) below.[17] Decision-making tools such as this SAM provide the opportunity for planners in public agencies to more clearly identify and evaluate the choices between traditional grey and green infrastructure approaches and to communicate these options to colleagues and elected officials.

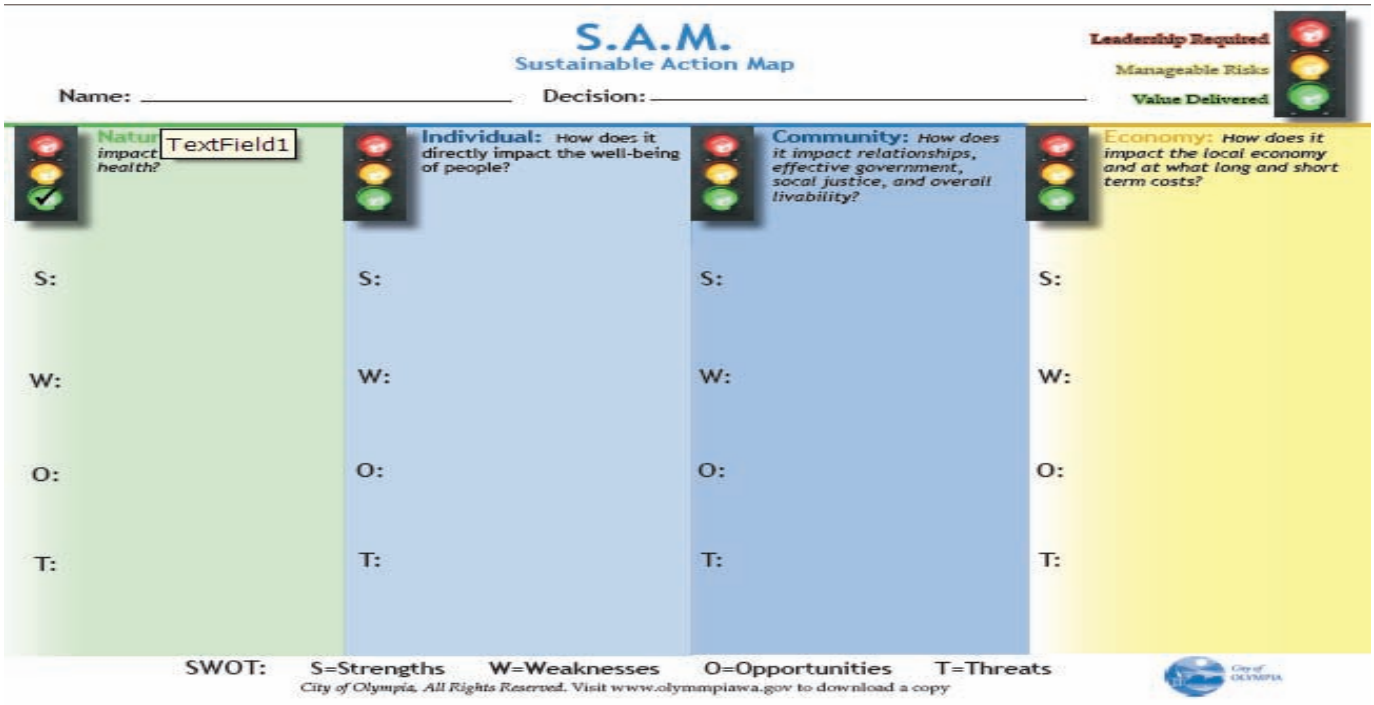
Other Nations

Internationally, some of the best examples of green infrastructure plans have been generated at the local or municipal level. European cities, notably Barcelona, Spain; Berlin and Bonn, Germany; Copenhagen, Denmark; Helsinki,Finland; London, England; and Malmö, Sweden, offer excellent examples of this approach. Green infrastructure is now being implemented to retool under-performing urban areas (e.g. Hamburg Harbor Revitalization and Greening), or to launch entirely new masterplanning for high-performance urban cities, such as Spain's Logrono-Montecorvo, a recently-launched urban center designed to be waste and carbon neutral and fundamentally based on green infrastructure principles. The Malmo Green Space Factor (MGSF) System in Malmö, Sweden, requires that all buildings and developments to achieve a threshold of 'green points', represented by thirty-five separate measures for the incorporation of green infrastructure into the building/development design. Those measures include canopy tree colonies, green roofs, green walls, low-impact development features, bioswales and eco-corridors.

Curitiba, Brazil is a remarkable case study of a poor city that drew on local entrepreneurial resources to implement innovative green infrastructure systems and effective development policies. Bogotá, Colombia and Kampala, Uganda are examples of cities in developing nations that have repurposed urban green space for watershed protection and urban agriculture.

Neighborhood, Project, Site and Building Green Infrastructure

Project development and implementation is the innovative 'living edge' of green infrastructure planning. The lessons derived from demonstration projects can be instructive for planners. Some green infrastructure techniques (e.g. corridor management) are highly scalable, whereas other techniques (e.g.constructed wetlands) may not be effective in smaller-scale applications. The technical literature for green infrastructure is quickly becoming more accessible for the planning setting. A newer rating system, LEED® Neighborhood Development (LEED-ND), links green building with smart growth practices such as compact development and walkable streets as well as green infrastructure concepts such as wastewater recycling and food production.



The case study literature of site applications has grown exponentially in the past five years. Planners will need to keep in mind that not all techniques work well in all localities because of climate, ecosystem and cultural differences from one community to another. The Center for Watershed Protection, based in Maryland, has an excellent list of resources for communities, including site technologies and a sampling of model ordinances. Many case studies from diverse communities were identified by Sub-Task Force participants and are summarized in the last section of this report.

Emerging Opportunities for Green Infrastructure

Trends and Gems

Trends and Gems reviews conventional application of green infrastructure, summarizes trends, and introduces programs, projects, policies and initiatives that are finding broader, more creative, and more productive application of green infrastructure. Trends are distinguished as green infrastructure models that bond and act as a catalyst with smart growth, building design, climate plans, local agriculture, public health objectives and sustainability.

Green infrastructure has served historical roles in watershed management, biodiversity, and open space conservation, the latter traditionally designed as a greenbelt at the exurban boundary. As green infrastructure evolved to include technologies, management strategies and urban application of ecosystem services, it was employed to enhance air and water quality, manage stormwater, harvest rainfall, promote public health and safety, increase the value and desirability of public and private property, and to mitigate urban heat islands and other adverse impacts of development.

Beyond this diverse portfolio of uses, planners, developers, environmentalists and governments now recognize the utility of green infrastructure as a response to climate change, mounting urbanization, constrained resources and the limitations of conventional infrastructure. As a result, communities now incorporate green infrastructure in Climate Action[18] and State Implementation Plans[19], in economic development models, energy use and to increase the performance and longevity of built infrastructure. In addition, the federal government has incentivized application of green infrastructure concepts and technologies to attainment of Clean Water Act goals,[20] and is developing a web-based green infrastructure resource center at EPA to assist communities in meeting permit requirements and evaluating green infrastructure project benefits.[21]

In addition to these 'trends', this section describes a selected set of 'gems' in current green infrastructure practice. What distinguishes a 'Gem' is a program, policy, project or initiative that:

- Finds interdependencies among, and intersects with, other disciplines, constructs and models;
- Complements, cross-functions with and reduces the cost of conventional built systems or models;
- Offers additional economic gains through cost avoidance and indirect benefits;
- Promotes the success of one or more priorities, such as public health, safety, the value and desirability of the community and its substainability potential/quotient.

Trends for green infrastructure are presented in Table 3. Each trend is summarized in the far left column of the table. The remaining columns summarize the 'gems' that exist today and are models for the future inclusion of green infrastructure in our communities.

Following the chart, results of green infrastructure implementation are reported, along with the results of incentives provided for green infrastructure use. While much more research is needed to quantify the value of green infrastructure, this information documents the potential for green infrastructure to return benefits for a wide range of urban concerns. As America invests in new infrastructure, this approach will meet functional needs while also creating amenity value, building healthier communities and strengthening a community's relationship to its natural surroundings.

Results of Green Infrastructure Applications

Stormwater Management

An Illinois study found stormwater infrastructure savings of $340/acre when conservation solutions were employed upstream instead of conventional systems (Johnston et al. pg. 42). The benefits multiplied when savings in property values from reduced flooding were factored in. Additional research quantifying both direct and external values could be performed for other climate zones or land use types, such as arid or especially rainy climates, rapidly suburbanizing areas or urban retrofits.

Faced with compliance with EPA mandates to reduce combined sewer flows, the Philadelphia Water Department has developed estimates for upstream low-impact stormwater design and contrasted the benefits with a typical combined sewer overflow (CSO) large storage tunnel. The savings from planting trees, retrofitting green roofs and bio-retention areas throughout the area are substantial when the spectrum of benefits is considered. Green infrastructure could provide up to $2.8 billion in avoided disruption, water and air quality, heat stress reduction, green jobs and increased property values versus $122 million in benefits from conventional infrastructure. Research from other municipalities faced with the expense of CSO reduction could tip the balance in favor of implementing green infrastructure for municipal water planning.

Air Quality

Urbanized regions can use EPA air quality data as well as public health statistics to model and quantify urban forest benefits. American Forests uses its CITYGreen technology to accurately map community urban forests and project dollar values for benefits, including urban heat island reduction and decreased asthma rates (www.americanforests.org). An American Forest audit performed for San Antonio in 2009 estimated that the

Table 3: Trends and Gems for Use of Green Infrastructure

Trends	Gems			
	Programs/Policy	Legislation	Planning/Design	Institutional/Intellectual
Water Quality Use natural drainage and vegetation to improve the quality of stormwater flowing through the urban area.	"Clean Waters, Green City," City of Philadelphia Program for Long-Term Plan for Combined Sewer Overflows Control[22] State of Connecticut Nitrogen Credit Exchange Program	State of Illinois Green Infrastructure for Clean Water Act 2009 Substitute Ordinance No. BL2008-345; Nashville and Davidson County State of Maryland Storm Water Act of 2007 State of Maryland Bay WIP Regional Exchanges	*Managing Wet Weather with Green Infrastructure Municipal Handbook Water Quality Scorecard (Aug 2009), EPA-833-B-09-004* Milwaukee Metropolitan Sewerage District's "Greenseams" Program	*A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century* (Aug. 2009) NRDC Technical Report *Implementing Watershed-Based Green Infrastructure for Stormwater Management: Case Study in Blacksburg,Virginia (2009)*
Air Quality Trees and other vegetation function to remove pollutants from the air.	Fort Collins, Colorado Action Plan to Reduce Greenhouse Gases, Sec. 8		HARC, City of Houston (Urban Tree projects as credits for State Implementation Plans) Hillsborough County, Florida Environmental Lands Acquisition and Protection Program (provides carbon credit discounts for avoided deforestation)	Chicago Climate Exchange (CCX) North America's only voluntary, legally binding greenhouse gas (GHG) reduction and trading system for emission sources and offset projects in North America and Brazil. First voluntary program in the U.S.
Urban Stormwater Management Natural green drainageways and associated systems create an effective and lower maintenance system for addressing stormwater flows.	*Green Infrastructure Trends in Municipal Wastewater Management*, 32nd Governors' Conference on the Environment (Oct. 2008)	HR 4202, Green Infrastructure for Clean Water Act of 2009, Introduced State of Maryland Storm Water Act of 2007	Sustainable Cities U.K., *Using Green Infrastructure To Alleviate Flood Risk*[23] North Central Texas Council of Governments, integrated Storm Water Management Program (iSWM).	
Urban Heat Island Mitigation Adding green infrastructure (in terms of trees, green roofs and similar systems) helps to reduce the higher temperatures normally created in densely developed areas.	Chicago Green Roof Grants Program Oregon Green Alley Program			
Enhanced Built Infrastructure Green concepts can be integrated into constructed systems, improving their function and creating amenities for residents.	*EcoLogical*, U.S. Dept. of Transportation *A Conceptual Guide to Effective Green Streets Design Solutions*, EPA Green Reserve	Low Impact Development/Green Infrastructure, *Sustainable Community Development Code (2010)*	*Transforming Gray Space Into Green Space – Green Streets and Parking Lots*, ASLA	Green Roads Rating System v.1.0, University of Washington (2010)[24]

Table 3: Trends and Gems for Use of Green Infrastructure

Trends	Gems			
	Programs/Policy	Legislation	Planning/Design	Institutional/Intellectual
Public Health & Safety Natural areas and systems achieve health and safety objectives as well as meet infrastructure functional demands.	*Improving Health in Cities Using Green Infrastructure*, FORUM Journal (Dec. 2009), Newcastle University Maryland's Main Street Clean, Safe & Green Program		*Safe Streets, Livable Streets*, Dumbaugh (2005), Journal of the American Planning Association	*Promoting Ecosystem and Human Health in Urban Areas Using Green Infrastructure – A Literature Review,* Tzoulas, et al.
Economic Drivers Choosing green infrastructure instead of grey adds economic value to a community.	*Economic Stimulus: The Case for Green Infrastructure, Energy Security, and Green Jobs*, Deutsche Bank Nov. 2008[25] Alexandria, VA Eco-City Alexandria		See Oakland County, Michigan's Report on the Economic Value of its Green Infrastructure[26] *Implementing Green Infrastructure: Developing A Winning Strategy to Fund Philadelphia's Ambitious Vision*[27]	*The Economic Value of Green Infrastructure*, Hazel Blears, MP, Communities Secretary (UK) National Green Values Calculator, Center for Neighborhood Technology *Creating Jobs and Stimulating the Economy Through Investment in Green Infrastructure (2008)*, American Rivers and Alliance for Water Efficiency
Social Development Community engagement in green systems offers community-building advantages.	Kansas City's "10,000 Rain Gardens" Program		Portland, Oregon "Grey to Green" Initiative	*Economics and Public Value of Urban Trees*, Urban Agriculture Magazine 13: 31-33 (2004), Dr. Kathleen Wolf
Climate Action Planning Green infrastructure offers advantages in terms of climate change and greenhouse gas reductions.	Fort Collins Local Action Plan to Reduce Greenhouse Gases Charlottesville Comprehensive Plan, Chapter 8 (Climate Action Planning) Florida's Energy and Climate Action Plan (Oct. 18, 2009)	Bill 27: Green Communities Amendments, British Columbia (2008) FL Executive Orders 07- 126/127/128 (2007): 1) Leadership by Example: Immediate Actions to Reduce GHG Emissions from Florida State Government 2) Immediate Actions to Reduce GHG Emissions within Florida 3) Florida Governor's Action Team on Energy and Climate Change. FL HB 697-local government requirements for GHG/ Energy Conservation (2008	Adapting to Climate Change – Green Infrastructure, Australian Institute of Landscape Architects Ada	*Exploring the Role of Green Infrastructure in the Mitigation of Climate Change in the Urban Realm*, Mel, Roe & Davies (2009), Earth and Environmental Science Journal *Greenhouse Gas Reduction and Energy Conservation: Development Impacts Under HB 697 by Paul D'Arelli, Ujjval Vyas, Pierce Jones and Dennis Gilkey [Version 1.0, (Nov. 6, 2009)* *University of Florida Program for Resource Efficient Communities: Land Development and Greenhouse Gas Mitigation Series]*

Table 3: Trends and Gems for Use of Green Infrastructure

Trends	Gems				
	Programs/Policy	Legislation	Planning/Design	Institutional/Intellectual
Multi-Application | Green infrastructure, by its nature, meets multiple objectives and achieves interdisciplinary goals.	Green D.C. Agenda Greenworks Philadelphia Minnesota Metro Greenprint PlaNYC	H.R. 5867 introduced; H.R. 2454 introduced; S. 1733 introduced *City of Redmond, Ord. No. 2447 Green Building and Green Infrastructure Incentive Program (2009)* HCR 31 (2008) State of Delaware Green Infrastructure HB 1379 (2001) State of Maryland to establish Maryland's GreenPrint Program SB399 (2000) Created Georgia's Greenspace Commission and Greenspace Trust Fund	*Blue Cities Guide: Environmentally Sensitive Urban Development*, Boston Foundation / The Cabot Family Charitable Trust Special District Plan, City of Whittier, California Open Space Seattle 2100 *North Texas 2050*, Vision North Texas Partnership	Center for Resource Efficient Communities *Maryland's Green Infrastructure Assessment: Development of A Comprehensive Approach to Land Management*, Weber et al.

435,000 acre metro forest provides $30 million in air quality benefits as well as $624 million in stormwater benefits. Public health studies currently being undertaken in obesity research will ultimately provide significant data for cost/benefit analysis of community greening, greenway implementation and open space improvements.

Urban Forests

Studies demonstrate that strategically planned urban forests, on average, return roughly 21/2 times their total capital and maintenance costs and a host of other benefits, including:

- reduced residential energy costs by as much as a third;
- reduced runoff by an average of 7-9%, and as high as 12-17%[28];
- sequestered carbon and other GHG, with the capacity to intercept particulate pollution at an estimated rate of 9-13%, buffer dust from under-canopy areas by 27-42%, reduce nitrogen oxides by as much as 45% and reduce ozone rates up to 55%[29];
- reduced UV exposure, now acknowledged as a potentially significant risk factor in adult development of skin cancers and eye diseases;
- increased walkable communities and reduced obesity rates among adults;
- reduced accidents by as much as 40% by promoting prudent driving and better road design;
- increased values by 5-9% among treescaped urban residential, commercial and professional properties and professional centers featuring treescapes have less vacancies, turnovers and employee absenteeism and generally command rents higher by 7%, and treescaped commercial/retail districts generate roughly 12% more revenue than their treeless counterparts;
- increased cost savings. For example, a 2007 study by Casey Trees and LimnoTech for the Washington D.C. Water and Sewer Authority (WASA) determined that the agency could save $1.4 to $5.1 million per year, scaled to a Green Build-Out Model of urban tree canopy, green roofs and larger tree boxes in the downtown core.

Use of Incentives and Market Mechanisms

Recognizing the functional potency and economy of green infrastructure systems, tools and practices, some cities have developed incentive options to encourage their adoption. Philadelphia is considering legislation that will allow its stormwater agency to bill customers by the ratio of impervious surface to the total area of the property envelope. In addition, the city may offer tax credits for green infrastructure retrofits, such as installation of a green roof. Modeling its program along the low-impact development (LID)-employment model set by Northeast Ohio's $2 billion, 20-year CSO project, Philadelphia's program will include conversion of municipal courts and lots to pervious pavement, green roofs, and fast-tracking projects that employ LID design elements.

Portland has fostered widespread acceptance and use of

green infrastructure through incentives that include its Grey to Green Program (rebates of up to $5.00 per square foot to add an ecoroof), Treebates to encourage tree planting on private property, bonus floor area to developments that include a green roof, a Downspout Disconnect Program, and an EPA grant-funded program for sustainable, low-impact stormwater management projects.

Chicago Climate Exchange (CCX) operates North America's only cap-and-trade system for all six greenhouse gases, with global affiliates and projects worldwide. CCX Members are leaders in greenhouse gas (GHG) management and represent all sectors of the global economy, as well as public sector innovators. Reductions achieved through CCX are the only reductions made in North America through a legally binding compliance regime, providing independent, third party verification by the Financial Industry Regulatory Authority (FINRA, formerly NASD). CCX emitting Members make a voluntary but legally binding commitment to meet annual GHG emission reduction targets. Those who reduce below the targets have surplus allowances to sell or bank; those who emit above the targets comply by purchasing CCX Carbon Financial Instrument® (CFI®) contracts.

Elsewhere, there is a call to put natural capital in green infrastructure, e.g. urban forests, on equal footing with other municipal capital assets[30] In anticipation of a carbon market expanded to include localized agriculture and urban forests, the Carbon Reserve has developed models and tools for aggregation and verification of these projects in a national cap-and-trade market. Movements to allow urban and open space forests as credits in State Implementation Plans (mandated to comply with federal standards under the Clean Air Act) began in Houston and have been supported in concept by the U.S. Environmental Protection Agency. This becomes even more relevant as increased criteria under the Act will render even more communities non-attainment areas for ozone.

SOLUTIONS AND RECOMMENDATIONS

The Green Infrastructure Sub-Task Force of American Planning Association's (APA) Rebuilding America Task Force believes that green infrastructure must play a central role in efforts to provide the U.S. with the infrastructure to support 21st century urban communities. APA should take the lead in the education, outreach, research and training efforts that will incorporate green infrastructure at all scales of planning.

The Sub-Task Force recommends eight specific actions to invest in green infrastructure to rebuild America's urban areas. Each recommendation is stated and explained briefly below. The first three recommendations address the role of the planning profession in green infrastructure investment. The fourth recommendation is directed both at planners and at the APA. The fifth and sixth recommendations address activities the APA should undertake. The last two recommendations offer policy direction on green infrastructure investment for decision-makers at the local, state and federal level.

1. Planners need to understand and advance the application of green infrastructure approaches to development and redevelopment of the nation's urban areas.

Planning is an integrative discipline. It takes the broad approach, considering all relevant factors, geographical areas and systems. It considers both the short- and long-term view in evaluating alternatives. Until now, the literature and resources on green infrastructure have focused narrowly on individual green systems. The planning profession should lead efforts to integrate green infrastructure system design with the profession's best urban design and development practices. In this way, the relationship between green infrastructure and comprehensive planning and development can be strengthened and more sustainable infrastructure investments can be made.

The design and implementation of green infrastructure requires that we not only plan environmentally, but more essentially, ecologically. The effects of green infrastructure are not only local or regional, but also national and global. Impact analyses must be extended to address the benefits of local green infrastructure investments at all these scales. Green infrastructure should be incorporated extensively in city, county and regional comprehensive plans. Planners should work cooperatively with surrounding governmental and other organizations to design and implement coordinated green infrastructure programs that are deeply integrated with regional ecologies and are also essential and valued parts of the urban fabric. To do this, planners must know more about the potential for urban uses of green infrastructure and must be able to apply this expertise to their own decision-making responsibilities and the policy recommendations they make to others.

2. Planners must take the leadership role in facilitating collaboration across disciplines.

Urban development should also be an integrated process. Traditionally however, design and construction professionals work relatively independently and focus primarily on their own areas of expertise. This lack of collaboration between the various disciplines typically results in under- or over-designed systems. Recently, there has been some movement towards thinking and working more collaboratively across disciplines. The Sub-Task Force believes that planners are uniquely qualified advocates in terms of advancing the interdisciplinary and multi-scale benefits of green infrastructure. Planners are uniquely qualified because green infrastructure projects can be implemented at varying scales (e.g. site, local, regional or greater scale) and may involve diverse jurisdictions (cities, counties, regions, states, special districts and others), and planners are already working at each of these scales and with all of these jurisdictions. Also, planners are the only discipline whose training balances place-based problem-solving with the competing priorities of a long-range, comprehensive perspective. Lastly, planners have special expertise in consensus building and facilitating community engagement, skills necessary when dealing with multi-jurisdictional projects that impact many diverse interests

and have long-term cumulative impacts.

3. Planners should play a central role in communication and education to the broader community about green infrastructure.

The values, beliefs, knowledge and experience of community residents, property owners, elected and appointed officials will shape their interest in, and support for, the use of green infrastructure. Without community support, such new approaches are much less likely to be adopted, or will be adopted much more slowly. Education is badly needed in order to broaden the coalition for green infrastructure. Planners are the professionals in the best position to educate and build support for these initiatives.

4. APA and the U.S. planning community should participate in global discussions and work with global organizations to support investment in green infrastructure.

Green infrastructure, its use and impacts have effects from the molecular level to the global level. APA should work in tandem with the United Nations and other global organizations to both learn from each others' findings and to provide educational resources that can be used worldwide. This collaboration will assist the United Nations as they balance environmental protection, economic growth and social impact globally. It will also take advantage of the APA's global leadership role on planning issues.

5. APA must take the lead on education within the community of planners.

There is a need for widespread education of planners about the concepts, techniques and benefits of green infrastructure. The planning profession does not have an integrated educational program that provides planners with the expertise to connect green infrastructure and sustainability planning to planning tools such as comprehensive plans and implementation ordinances. The architecture and landscape architecture professions have principles, techniques and standards documented in the Green Sites Initiative and the LEED certification program, but these do not address all the issues that are relevant to the planning profession.

Therefore, the Sub-Task Force recommends that APA develop an educational program on the topic of green infrastructure, its benefits and how it fits within the planning and development process. APA is the most appropriate organization to lead the effort creating this program because of its expertise and tradition of high quality, planning–focused educational programs and publications. Specific elements of the educational program should be directed toward planners, developers and builders.

The policies and information for the educational program should focus on:

1. APA guidelines and examples of the integration of green infrastructure considerations into each step of the comprehensive planning and site design process at all scales, including data gathering, goals and objectives, alternatives development and evaluation and implementation programs.
2. APA prototype standards and model zoning, subdivision and stormwater management ordinances.
3. APA guidance on successful projects and effective incentives to implement sustainable design and green infrastructure.

6. APA should take the lead in developing advocacy/education materials targeted specifically at local elected and appointed officials.

It is not enough to just educate planners to understand and advocate for green infrastructure. Local elected and appointed officials play a critical and central role in the planning and development process. They are the decision-makers when adopting comprehensive plans and land use ordinances. They allocate funding for infrastructure improvements and other projects. Their control of the budget directly influences the size and scope of the local planning and development programs. They make the final determination on land use changes and, in some jurisdictions, have authority over development approvals. They have an immense influence in setting the community's agenda.

But these officials also respond to a different set of influences than planners. Therefore, the Sub-Task Force recommends that APA give special attention to developing educational materials targeted specifically at local elected and appointed officials and advocacy tools that will enable planners to engage these officials at their level.

7. Decisions about infrastructure investments need to consider life-cycle costs of the project, including environmental costs.

A fiscally responsible approach to public investment in infrastructure must consider all costs of a project, not just initial construction costs. In many communities, green infrastructure is perceived to be more expensive because the analysis and decision-making has focused just on initial capital costs. When a complete analysis is done, green infrastructure's benefits have been proven to nearly always outweigh its costs. Responsible consideration of infrastructure investment must consider the full range of impacts and benefits that drive long-term planning decisions.

A complete cost assessment must compare project alternatives in terms of their triple-bottom-line, cost avoidance opportunity, and life-cycle cost evaluation. Planners should use this approach for the cost analysis in their own projects and should advocate this policy position for infrastructure investment.

8. Research is needed to document the costs and benefits of green infrastructure compared to traditional infrastructure approaches.

One reason green infrastructure is perceived as less cost-effective by local governments is the lack of quantitative data concerning its costs and benefits, compared with the costs and benefits of conventional infrastructure. This is an often-cited barrier for new

technologies and one that the green building community has also faced as it attempted to mainstream sustainable construction approaches.

There are many examples of green infrastructure but often they are fairly recent or not very well studied. Research is needed to make this information available. Planners and APA, should encourage and contribute to interdisciplinary research efforts that document the costs, benefits, design and results of green infrastructure systems. Planners and APA should also communicate these results through their education and community outreach programs.

REFERENCES

Projects/Case Studies

Urban Stormwater Management

Philadelphia Water Department, www.phillywatersheds.org. Philadelphia's vision plan for green infrastructure focuses on reducing inputs to the combined sewer system through urban greening, green roofs, stream restoration and a stormwater fees program.

Maryland's Storm Water Management Act of 2007, http://www.mde.maryland.gov/programs/waterprograms/sedimentandstormwater/swm2007.asp. The Act requires that Environmental Site Design (ESD), through the use of nonstructural best management practices and other better site design techniques, be implemented to the maximum extent practicable.

Sydney Water www.sydneywater.com.au uses a triple bottom line methodology to evaluate the utility's annual performance, going beyond water delivery to minimizing waste and increasing native vegetation

Urban Heat Island Mitigation

The City of Toronto, www.toronto.ca/greenroofs has evaluated economic benefits of implementing green roofs throughout the city, with stormwater benefits alone measuring over $100 million and used the program to develop a system of green roof incentives.

Enhance Built Infrastructure

Portland's Grey to Green Initiative, www.portlandonline.com established in 2007, sets a 5-year goal to increase green infrastructure elements throughout Portland including 900 Green Streets, 43 acres of Ecoroofs, and over 50,000 new trees.

Alexandria, VA Environmental Action Plan, http://www.alexandriava.gov/uploadedFiles/tes/oeq/Environmental%20Action%20Plan%20Phase%20II%282%29.pdf explains how Alexandria can address climate change, lead the new green economy, and continue its high quality of life.

City of Brockton, Massachusetts. Brockton Brightfields project redeveloped a former manufactured gas plant brownfield site into the largest solar energy system in New England.

Manchester, Connecticut. The Town of Manchester recently worked with its regional council of governments (CRCOG) and the EPA to develop sustainable development guidelines for a vacant shopping center in town. The study, called "From Grey to Green: Sustainable Practices for Redeveloping a Vacant Shopping Center, looks at an greyfield development challenge – that of a five (5) acre center with 90% impervious coverage. http://www.townofmanchester.org/Planning/documents/FinalGreytoGreen.pdf

Stamford, Connecticut. The restructured Mill River project in Stamford recently removed hundred-year-old dams from the river. The project also restores the banks of the river and reduces the flood zone affecting downtown Stamford. At the same time, a private organization has been created to supplement city investments to reopen the riverbanks for recreational use. The ultimate goal of the project is to create a 5 mile linear park that will connect residents of downtown Stamford and neighborhoods on the west and north to Long Island sound and neighborhoods to the south. The project uses green infrastructure to achieve an engineering goal (reducing flooding) while benefitting tens of thousands of urban residents. The organization's website is www.millriverpark.

Green Infrastructure in Public Buildings

Darien Library. The new library in Darien, Connecticut is the first LEED Gold certified library in New England. With a design that blends traditional New England architecture and sustainable features, the building and its site demonstrate the use of green infrastructure in a public facility construction project. The new building is sited on a remediated brownfield. Among its green infrastructure features are on-site water conservation that provides non-potable grey water for use within the building and for irrigation of water efficient landscaping and geothermal wells with heat pumps that provide both heating and cooling using a closed loop technology.

Multi-application

1. Berlin's Biotope Area Factor, http://www.stadtentwicklung.berlin.de /umwelt/landschaftsplanung/index_en.shtml. A comprehensive approach to landscape planning and green infrastructure.
2. Durban's D'MOSS Open Space System, www.un.org/esa/earthsummit/w-durban.htm incorporates social and ecological considerations into planning for a regional green network.
3. Natural Connections, www.greenmapping.org. A regional partnership of the states of Wisconsin, Illinois, Indiana, created to provide interjurisdictional mapping and datasets needed for regional green infrastructure plans.
4. Network of Oregon Watershed Councils, http://oregonwatersheds.org/ A statewide approach to

conservation and planning.

5. The Illinois Green Infrastructure Study: A Report to the Illinois Environmental Protection Agency on the Criteria in Section 15 of Public Act 96-0026, The Illinois Green Infrastructure for Clean Water Act of 2009. http://www.epa.state.il.us/green-infrastructure/docs/draft-final-report.pdf. May 28, 2010
6. Chicago Wilderness, www.chicagowilderness.org, is focused on maintaining biodiversity in 360,000 acres of protected lands, has trained a legion of volunteers in plant identification, invasives removal and fire management.
7. New York City's Plan2030, www.nyc.gov/html/planyc2030 targets air, water, land and climate change variables with a plan to create a more sustainable infrastructure for the metro area.
8. Maryland's Comprehensive Strategy for Reducing its Vulnerability to Climate Change, http://www.mde.maryland.gov/assets/document/air/climatechange/chapter5.pdf. Report lays out specific priority policy recommendations to address short and long term adaptation and response measures that are crucial to Maryland's ability to achieve sustainablility.
9. North Texas 2050, www.visionnorthtexas.org. A regional private-public-academic partnership developed this vision and action package for the Dallas – Fort Worth metropolitan region. Released in 2010, it incorporates green infrastructure recommendations along with policies and action tools for other topics including health, housing and economic development.
10. The Economic Value of Green Infrastructure, Northwest Regional Development Agency, United Kingdom (2009). http://www.nwda.co.uk/PDF/EconomicValueofGreenInfrastructure.pdf
11. Making the Economic Case for Green Infrastructure and Green Development in Oakland County http://www.oakgov.com/peds/assets/docs/es_docs/gi_econ_all.pdf

Websites

Policies, Plans and Regional Information

www.americanforests.org American Forests uses its CITYGreen technology and Urban Forest Ecosystem analysis to map community urban forests and project dollar values for benefits. Also available, Climate Change Calculator to measure impact on CO2 emissions.

"Managing Wet Weather with Green Infrastructure Municipal Handbook," EPA-833-B-08-007 and "Water Quality Scorecard" (Aug 2009), EPA-833-B-09-004 are both available from the EPA website http://www.epa.gov/npdes/greeninfrastructure. Click on the Municipal Handbook link on the sidebar for PDF downloads, including funding options.

ICLEI International Case Study Series lists 100 international case studies featuring urban land use planning and green infrastructure, among other sustainable topics. http://www.iclei.org/index.php?id=1139 http://www.epa.gov/chesapeakebaytmdl/ and http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/cb_tmdl/index.asp Maryland's Chesapeake Bay Phase I Watershed Implementation Plan (WIP) is being developed to restore and protect a healthy Bay for future generations. The six Chesapeake Bay watershed states and the District of Columbia are to submit draft Phase One WIP reports by September 1, 2010 in support of the development of the draft and final Chesapeake Bay Total Maximum Daily Load (Bay TMDL).

http://www.mde.maryland.gov/programs/waterprograms/wetlands_waterways/regulations/lawsandprograms2.asp The Maryland Forest Conservation Act provides guidelines for the amount of forest land retained or planted after the completion of development projects. These guidelines vary for each development site and are based on land-use categories.

http://www.na.fs.fed.us/watershed/publications.shtm Information and references on forests management including best management practices, sustainability and watershed protection

http://www.seattle.gov/ENVIRONMENT/ Office of Sustainability and Environment Home Page. Seattle WA

http://www.greeninfrastructurewiki.com Information on most aspects of green infrastructure

http://www.wa.gov/puget_sound.com. Natural Approaches to Stormwater Management – Low Impact Development in Puget Sound (March 2003).

http://www.epa.gov/npdes/pubs/arid_climates_casestudy.pdf Green Infrastructure in Arid and Semi-Arid Climates

http://www.naturaleconomynorthwest.co.uk resources+reports.php The Economic Value of Green Infrastructure Report

Planning and Design for Sites, Areas & Buildings

«The Practice of Low Impact Development» published by HUD, 2005 is available as a PDF download by going to www.huduser.org, then to research tab, then publications, list by title

«Low Impact Development Design Strategies: An Integrated Design Approach» Prince George's County, Maryland, Department of Environmental Resources, June 1999, available as a PDF download on www.epa.gov/lid/

Sustainable Sites Initiative: "Guidelines and Performance Benchmarks 2009" is available as a PDF download on www.sustainablesites.org, go to the current work tab on top of the home page then under current work go to report where there are instructions for downloading the file.

Sustainability: http://www.sustainablecities.org.uk/water/

surface-water/using-gi/ Leads to a variety of references on sustainability relating to flooding, health, climate change

Green Roadways: http://www.greenroads.us Leads to references on sustainability ratings for new or reconstructed roads

Green Alleys: http://brandavenue.typepad.com/brand_avenue/files/greenalleyhandbook.pdf Establishment of new alley designs that help conserve our resources and improve our environment

Main Streets: http://www.neighborhoodrevitalization.org/Programs/MainStreet/MainStreet.aspx Enhancing the perception of a neighborhood through the principles of Smart Growth and sustainability

Green Buildings: www.usgbc.org. The U.S. Green Building Council was established in 2008 to administer project certifications and professional credentials and certificates within the framework of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Green Building Rating Systems™

Stormwater Management and Green Infrastructure: http://greenvalues.cnt.org/ The Center for Neighborhood Technology maintains this page and provides links to other sustainability topics

Green Infrastructure Digest: http://hpigreen.com Blog published by Hawkins Partners, Inc. with links to projects, policies addressing stormwater management.

Green Roofs: UCF Recommissioning, Green Roofing Technology and Building Science Training Final Report, FSEC-CR-1718-07 (May 18 2007); Florida Solar Energy Center. Prepared for Michael Ohlsen, Florida Energy Office, Florida Department of Environmental Protection.

Green Infrastructure in Town Center Design: The Simsbury CT Town Center consensus Illustrative Plan for the Town Center combines sustainability and New Urbanist principles. The entire charrette final presentation is found at www.simsburycenter.blogsopt.com www.simsbury-ct.gov/charrette . Participants note that they are "happy to praise this great project as it has healed some very deep land use "wounds" re local development issues".

Bibliography – Books and Periodicals

1. Athens, Lucia. 2010. Building an Emerald City: A Guide to Creating Green Building Policies and Programs. Island Press, Washington DC. ISBN-13: 978-1-59726-583-6.
2. Benedict, Mark A. and Edward T. McMahon. 2006. Green Infrastructure: Linking Landscapes and Communities. Island Press, Washington DC. ISBN-1 59726-027-4.
3. D'Arelli Paul, Ujjval Vyas, Pierce Jones and Dennis Gilkey. Greenhouse Gas Reduction and Energy Conservation: Development Impacts Under HB 697 [Version 1.0 November 6, 2009 University of Florida Program for Resource Efficient Communities: Land Development and Greenhouse Gas Mitigation Series]
4. Garde, Ajay. 2009. Sustainable by Design? Insights From U.S. LEED-ND Pilot Projects. Journal of the American Planning Association, Volume 75, Issue 4 September 2009 .
5. Jerke, Dennis, Douglas R. Porter, Terry J. Lasser. 2008. Urban Design and the Bottom Line. ULI Press. Washington DC. ISBN 978-0-87420-996-9.
6. Johnston, Douglas, John B. Braden and Thomas H. Price. 2006. Downstream Economic Benefits of Conservation Development. Journal of Water Resources Planning and Management, Volume 132, Number 1, January 2006, pages 35-43.
7. Leiter, Robert A. FAICP, "Planning and Policies for Sustainable Development in California and the San Diego Region", in Julie Adshead, ed., Green Buildings and the Law, Spon Press, Abington UK, 2010 (forthcoming).
8. MacMullan, Ed and Sarah Reich. 2007. The Economics of Low Impact Development: A Literature Review. ECONorthwest, Eugene OR http://www.epa.gov/region8/ water/stormwater/pdf/ LID_Economics_Literature_Review.pdf
9. Northwest Regional Development Agency. The Economic Value of Green Infrastructure. http://www.nwda.co.uk/PDF/EconomicValueofGreenInfrastructure.pdf
10. Peck, Steven & Goucher, Dayna. 2005. Overview of North American Policy Development and the Policy Development Process. In Greening Rooftops for Sustainable Communities, Washington DC May 4-6 2005. Green Roofs for Healthy Cities, Toronto Canada.
11. Philadelphia Water Department Office of Watersheds, September 2009. Green City Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control. Supplemental Documentation Volume 2: Triple Bottom Line Analysis. www.phillywatersheds.org
12. Slone, Daniel K, and Doris S. Goldstein with W. Andrew Gowder. 2008. A Legal Guide to Urban and Sustainable Development for Planners, Developers and Architects. John Wiley & Sons, Hoboken NJ. ISBN 978-0-470-05329-4.
13. UN-HABITAT (United Nations Human Settlements Programme). 2009. Global Report on Human Settlements 2009: Planning Sustainable Cities. See Chapter 6_ Bridging the Green and Brown Agendas. ISBN: 9781844078998.
14. Urban Watershed Forestry Manual (Parts 1-3), United States Department of Agriculture Forest Service, Northeastern Area State and Private Forestry. NA-TP-04-05 (July 2005)

SECTION 4: WATER AND WASTEWATER INFRASTRUCTURE

INTRODUCTION

It is time for a change to the policies and practices that have guided water and wastewater systems at all levels of government in the United States. Climate change, population growth, and failing water infrastructure provide the impetus for a new water management paradigm for infrastructure. This paradigm rests on four principles: support for the sustainable city; accepting that the future requires fit for purpose water and infrastructure to support that; water pricing that reflects the true environmental and social costs of water; and flexible management and governance structures to permit new ways of planning and operating water infrastructure.

For the last 40 years, water infrastructure systems have been shaped primarily by two significant pieces of federal legislation: the 1972 Clean Water Act and the 1974 Safe Drinking Water Act. These two pieces of legislation resulted in major improvements to the quality of the nation's drinking water and the health of the nation's surface waters. But today a new water management paradigm is required to address the issues of the future which include:

- Aging infrastructure designed for the needs of a previous era, and now approaching the end of its useful life, particularly in the face of new and different pollution challenges;
- Wet city-dry city syndrome as a result of climate change: water supply crises in many areas while others suffer from extreme weather events, flooding and destruction of infrastructure.
- Institutional issues: a proliferation of single purpose service providers with few connections with general purpose government;
- Financing Issues: Conflict over fees raised by traditional water departments and the needs for green infrastructure traditionally funded by decreasing general funds.

This paper will touch on both the existing condition of the infrastructure and the regulatory environment to provide a framework for policy and planning practice recommendations.

THE CHALLENGE

As part of rebuilding America's infrastructure, we are challenged to develop a new paradigm for water/wastewater that integrates water resources with energy, land use, transportation and the ecosystem.

Aging infrastructure, climate change, and population growth are stretching the limits of our existing water supply, sewage systems, and drainage and flood control infrastructure. These forces are depleting and degrading our natural resources.

More is needed than simply replacing or upgrading the performance and efficiency of the individual parts of this infrastructure - change is needed in the fundamental way water and wastewater are integrated with the rest of the urban systems. It's almost impossible to talk about these utilities today without taking a more integrated approach that encompasses stormwater management and flood control, low-impact development, recycling and reuse of wastewater effluent, and the health of urban watersheds and associated ecosystems. The condition of the gray assets is important, but insufficient in characterizing the challenges and needs associated with managing urban water resources.

PHYSICAL INFRASTRUCTURE ISSUES

Traditional water/wastewater infrastructure consists of rapid-conveyance piped systems that deliver potable water and also carry away human and industrial wastes for disposal. This infrastructure includes treatment plants at both ends of the system to purify the water supply and to treat the wastewater before it is released into surface waters. The focus has been on improving both potable and receiving water quality by controlling wastewater contaminants at the end of the pipe. In the case of storm water, water infrastructure includes structures such as dams, drains or other built structures and barriers that reliably and rapidly drain urbanized areas. In many localities, sanitary sewers are combined with storm water sewers which result in discharging contaminants into water bodies during storm events. Even in other areas with combined systems, sewers routinely overflow during storms and contaminant water supplies. Although, the current state of infrastructure varies widely from place to place. Finally, many localities do not adequately maintain their water and sewer infrastructure, choosing to short system maintenance in favor of capacity expansion to accommodate growth.

Capacity of Existing Systems and Climate Change

About 75 percent of American households are connected to a central water and sewer system an asset valued at about 1/10th of the US GDP.. Many existing centralized systems are experiencing capacity issues from population growth and development in both the urban and surrounding areas. The population of the United States is projected to increase by two-thirds between 2000 and 2050, from 280 million to 420 million people (U. S. Census 2004). Most of the population growth is projected to be in the west and south in areas already impacted by water availability, areas already urbanized, or on the periphery of urban areas. Forty of the 3,100 counties in the U.S. are projected to experience one-third of the growth. (Burchell, Lowenstein et al. 2002)

Average household income is also projected to increase. Historically, increased incomes have also resulted in increased water consumption and therefore also the need for wastewater collection and treatment. Infill development in large urban areas is being actively promoted by many local officials as a result of the smart growth movement and also concern about reducing carbon emissions. Increased central city urban development will result in increased demand for water and wastewater treatment. The Water Environment Federation (WEF), the professional organization for wastewater operations, is concerned about the more "intense" solids, and the propensity for clogging the existing gravity pipes, often with slopes of four percent or less. For many urban areas with aging facilities, increased development densities may also trigger thresholds for new capital construction and expanded facilities (Meck

2002). While many older urban centers have in the past served larger populations on existing systems, in many instances, the capacity in those systems has been used by suburban flows passing through older networks and/or by infiltration into older pipes. It is not a safe assumption that older systems with long underutilized hydraulic capacity can now accommodate rates of flows seen in the past without major renovations and upgrades. Water and wastewater capacity is understood differently in different regions of the nation and measures of capacity change over time. Low flow devices, gray water usage, conservation, and changing federal requirements make the job of providers more complex. Aging sewage collection systems are also impacted by increased infiltration and inflow both from groundwater and from inappropriate connections as roof and yard drains.

Water and wastewater facilities are the first major infrastructure system to be forced to adapt to the impact of climate change. Global warming has altered the world's hydrological cycles causing changes in traditional precipitation patterns and increases in the frequency and severity of droughts and floods and threats to coastal aquifers. Traditional sources of water are becoming more expensive to access and becoming more erratic in their availability. The existing water/wastewater service model was developed during an era of low energy costs for collection, pumping, transport and treatment (Lettinga et al, 2007). Some view water as the new oil. (Hermanowicz, 2009) Many states have suffered severe droughts in the past ten years.

Many existing treatment plants and parts of collection systems will be subject to rising water levels in the next 50 years because of climate change (Gleick, 2006, 2009). The use of energy to treat water and wastewater and to transport water long distances produces carbon emissions which further exacerbates weather patterns and causes water shortages. Extreme weather events result in the need for more energy, which in turn result in demand or need for additional power plants that require more water. Drought conditions in France in 2004, for example put a nuclear power plant off line for four months, and a similar threat occurred in the southeast U.S. in 2008.

Flood control management infrastructure and practices will be stressed to the maximum by sea level rise due to the melting of the glaciers, and thermal expansion of the volume of the sea, along with the increased frequency and magnitude of extreme events such as hurricanes and other types of storms. Many U.S. cities are built in delta and wetland areas, or alongside of waterways that will be negatively impacted. For example, the Dade County/Miami region is currently mobilized to prepare an adaption plan as a result of predictions that water levels from both Lake Okeechobee and the Atlantic Ocean will inundate Miami Beach and the western portion of Miami itself.

One water expert predicts that climate change will have the following water related impacts by 2100: with a few exceptions, all mountain glaciers will be gone; downhill skiing in resorts will be mostly gone, the Everglades that were saved by restoring their natural flows will be lost by the rising seas and floods from increased precipitation and increased intensity of storms will continue to be the leading cause of death worldwide (Gleick, Peter, The 15th Abel Wolman Distinguished Lecture, the U.S. National Research Council, National Academy of Sciences, Washington, DC, April 23, 2008).

POLLUTION PROBLEMS

Since the 1970's, there has been some improvement in the water quality of many receiving bodys. Still vast areas of the ocean on the east and west coasts have dead zones, where the local flora and fauna have died off due to the discharge from wastewater treatment plants and agricultural runoff into rivers and streams.

Storm Water Pollution

Stormwater runoff is the major cause of pollution for the 40 percent of water bodies in the U.S. that have quality problems. When left uncontrolled, this water pollution can result in the destruction of fish, wildlife, and aquatic life habitats; a loss in aesthetic value; and threats to public health due to contaminated food, drinking water supplies, and recreational waterways. Secondly, uncontrolled stormwater runoff can cause flooding, threats to structures, and the erosion of waterways and ultimately create additional infrastructure needs for the construction and maintenance of these structures.

Sediments and solids constitute the largest volume of pollutant loads to surface waters in urban areas. These contaminants include such things as sediment from development and new construction; oil, grease, and toxic chemicals from automobiles; nutrients and pesticides from lawns and gardens; road salts from de-icing; traces of caffeine, birth control pills and other pharmaceuticals. Although wastewater treatment facilities easily remove biodegradable organic matter; particulates, and some nutrients, are unable to be removed due to a significant amount of trace constituents.

EPA has established a total maximum daily load (TMDL—a kind of performance measure) for wastewater treatment plants and for non-point run off, many treatment plants are not meeting present standards or will not meet future standards. Some wastewater treatment plants located near environmentally sensitive water bodies are required to implement advanced wastewater treatment systems at great expense. Even more of the deterioration is attributable to non-point sources, both urban and rural. Local jurisdictions are adopting stormwater quality management regulations. Initially, these regulations have focused on mitigation for new impervious surfaces in new development. However, significant improvements to water quality, especially for small urbanized watersheds, will require changes to existing land use policies.

Untreated Combined System and Sanitary System Overflows

Untreated wastewater overflows from the current system are a concern for both combined and separate systems. As wastewater infrastructure ages and reaches design hydraulic capacity, the frequency of overflow events increases, resulting in the release of untreated wastewater into urban areas and adjacent water bodies. Overflows regularly result in the closure of beaches

in coastal areas, and can create situations of defacto indirect potable reuse when released into surface water supplies. While combined and sanitary sewer overflows has become subject to greater regulatory scrutiny in recent years, the exfiltration of untreated wastewater from collection systems has been largely ignored. In older cities, this polluted runoff is often released directly into the water without any form of treatment.

Emerging Contaminants and Phosphorus Depletion

Not only does the current water infrastructure system still release nitrogen and phosphorus into the receiving bodies, with the negative outcomes noted above, the loss of phosphorus and the lack of reuse of other valuable nutrients in the waste stream are also of concern. Sewage contains significant amounts of nitrogen and phosphorus, and about 80 percent of that comes from municipal sewage.

Chemicals from industrial and commercial uses such as dry cleaners, gas stations and agricultural uses are being detected in water supply wells. When a well becomes contaminated by such chemicals, it is typically taken out of production. The purveyor must find an alternate water source often at high cost in terms of infrastructure or environmental impact. Vast amounts of money are spent on studying, modeling, and characterizing the contaminant plume, as well as actual clean-up costs.

INSTITUTIONAL CONTEXT

Water and wastewater service is overwhelmingly a local, decentralized operation by utility departments, municipal organizations and special districts. This is in contrast to transportation where 60% of funding is provided by state and federal sources; as well as telecommunications and energy, which are privately funded and provided. Even when the water and wastewater districts or departments are organizationally located within the general purpose government, infrastructure planning is usually separate from land use planning. Joint investment planning for land use and water/wastewater is rare, but a best practice. Indeed, there are many different agencies providing direct survey as well a plethora of regulators in the larger water industry.

Water Providers

In contrast to many other countries, water provision in the United States is provided by a decentralized system of multiple agencies both public and private. (Association of California Water Agencies, Water District Organization (2001 2001 [accessed Feb. 20, 2002]); available from www.acwanet.com/generalinfo/waterfacts/waterdistricts.asp.)

Of the 170,000 public drinking water systems in the U.S., only 54,000 serve more than 25 people a day all year round. (U. S. Environmental Protection Agency, The Clean Water and Drinking Water Infrastructure Gap Analysis, 2002.) 93 percent of water systems serve less than 10,000 people; 7 percent of the systems serve 81 percent of U.S. customers. In sheer numbers, most water supply systems are privately owned - 53 percent of systems nationwide in 1994. However private systems are usually small, and altogether they only serve 18 percent of total U.S. population. Public ownership dominates the provision of water in the U.S., although there is a continuing interest in privatization.

A water agency can be a retailer, wholesaler or a combination of the two. Many of the large western water districts are wholesalers, meaning they purchase water from the federal and state government and sell it to local entities such as cities, smaller water districts, or private water companies. Some systems integrate state or federal government agencies, water districts, jurisdictions and even private companies in the "supply chain."

The governance structure of the public systems varies. Many water agencies are subdivisions of city or county government, especially true in large cities. The city or county may also be served by a regional water provider, which is usually an independent special district with elected officials. Special districts are a common arrangement in areas where multiple general purpose governments share a water supply system. Seventy-five percent of the cities have a single provider, while most counties have multiple water districts and agencies. (Ellen Hanak and Antonina Simeti, Water Supply and Growth in California: A Survey of City and County Land-Use Planners,San Francisco: Public Policy Institute of California, 2004)

These complex jurisdictional arrangements are often a result of historical arrangements and can be difficult to sort out. Once a local entity has water rights, infrastructure, and a governing structure, it may be difficult to combine or incorporate the small district into a larger agency.

Wastewater Operators

In 1990, there were 40,266 wastewater treatment plants in the United States treating 35,300 million gallons per day. (U.S. Geological Survey, Wastewater Treatment Water Use (2001), http://ga.water.usgs.gov/edu/wuwww.html) This includes small, onsite treatment processes. There are 16,024 publicly owned wastewater treatment facilities currently in operation, serving about 72 percent of the U.S. The remainder of the population is not connected to centralized treatment facilities and instead is served by on-site facilities such as septic systems. Currently, 9,388 facilities provide secondary treatment, 4,428 facilities provide advanced treatment, and 2,032 facilities do not discharge into the surface water.

There are 176 facilities that provide a treatment level that is less than secondary (these include facilities with ocean discharge waivers, and treatment facilities discharging to other facilities meeting secondary treatment or better. Almost three quarters of the wastewater facilities serve places with less than 10,000 people. In 1970, roughly 85 million people were served by municipal wastewater systems with sewage treatment, and only 30 percent of U.S. surface water was safe for swimming. In 1996, 173 million people were served by sewage treatment plants, and over 65 percent of surface water is safe to swim in. In addition, pollution from sewage is down by 40 percent. (U. S. Environmental Protection Agency. Facilities Database (Needs Survey)-Frequently Asked Questions (2001), www.epa.gov/

owmitnet/faqwfd.html.)

Wastewater pipes are often the responsibility of the local general purpose government. Some wastewater treatment plants are operated by the local water or sewer district or department, while many others are separate.

Rural Areas and Small Community Systems

In isolated rural areas and small community systems where growth and change may not be a significant issue, questions of adequate water quality and the relation between water service and wastewater disposal may be of concern. As drinking water standards increase, non-point source pollution from septic systems and agricultural runoff becomes more of a challenge. Overuse of groundwater can be a problem. In the west, drought and wildfires have caused low water flows and increased concentrations of pollutants in surface water sources. This has impacted small systems already struggling with limited financial, technical and managerial capacities. Small systems do not have the economies of scale that larger utilities have for treatment, source development and capital financing, and some violate drinking water standards.

Relationship of Water Agencies and Land Use Planning

Water agencies of all types (supply, waste, storm and flood management) are usually quite separate from local general purpose governments which have the responsibility for planning for future development. However, water projects can be a key determinant of growth. As a result, water providers often find themselves debating issues of land use and growth, not exclusively water. Integration of land use and water use planning is likely to be an increasingly important issue, particularly in water short areas where drought cycles and imported water is of concern.

In addition, today's customers and elected public officials want a more environmentally sensitive and open planning process for water and wastewater than was the norm in the 1970's. They want water and wastewater management systems to support overall community goals and to coordinate with land use planning, as well as EPA's triple bottom line. This is particularly true where new development requires expansion of existing centralized facilities that are now surrounded by development. (Maddaus and Maddaus, 2002) Although forward thinking utilities are now making water demand projections based on local land use categories, this is in the beginning stages, and frequently local governments are not actively otherwide involved despite their ability to reduce water consumption through local land use plans, development regulations, and building codes.

In addition, local governments typically plan for future population growth in 20 year increments. Water projects are usually planned 20 to 30 years in advance of need, sometimes longer. Climate change is now making some planners look to a 90 to 100 year time horizon.

FINANCING WATER INFRASTRUCTURE

Capital investment in water infrastructure in the United States has been substantial in the last 120 years. Given the expected life of these systems, many are due for replacement or major rehabilitation. The older cast iron and even wooden pipes installed in the late 1800's have a life expectancy of 120 years, while those installed in the 1920's will last 100 years and those laid in the post World War II boom, the bulk of the pipes, have a life of 75 years. It is anticipated that over the next twenty-five years most water and wastewater pipes, particularly in older urban centers, will need to be replaced. Many treatment plants were built or renovated with federal funds provided by the Clean Water Act beginning in 1972. Most of these will need replacement or major renovations within the next 25 years (U. S. Environment Protection Agency 2002).

Many utilities face increased demand for capital funds over a very short period of time. Estimates of the need range from $500 to $900 billion for capital costs alone and nearly $1.2 trillion (2001 dollars) over a twenty year period when financing costs are included (U. S. General Accounting Office 2004, American Water Works Association, 2003). This translates into annual needs of $25 to $60 billion (2001 dollars) which is more than the current annual rate of capital expenditures for both replacement and new service at about $22 billion. Many industry experts feel that the low estimate is not realistic and that the entire system will need replacement. The local rate increases needed to accommodate this spending range from 14 percent to 800 percent (Kirk 2002). This large capital expenditure (about 1/10th of the yearly GDP) argues for looking for new technologies and service mechanisms.

Strategic business planning by some utilities and the water and wastewater industry has gone beyond typical financial planning efforts to address the near and long-term capital deficiencies. These strategic planning efforts are now evaluating opportunities to improve operating margins by providing new revenue-generating services or by identifying opportunities for greater efficiency in the delivery of existing services in addition to raising user rates and fees.

Federal Funding Programs

Federal assistance is primarily in the form of loans for construction. The Clean Water State Revolving Loan Fund and Safe Drinking Water Revolving Loan Fund were capitalized with federal funds in all 50 states. The states make the loans, and as the money is paid back, new loans are made to others. The funds were initiated in the 1970's and 1980's when over $60 billion was allocated to construct publicly owned and operated wastewater treatment plants. In 1998, the program had over $26 billion in assets and $3 billion distributed in new loans each year. A new infusion of funds came through American Recovery and Reinvestment Act (ARRA), however these came with an emphasis on loans rather than grants. In addition to the loans, EPA has a smaller amount of money for grants to state, municipal and non-profit agencies for research, training and demonstrations of new technologies to prevent water pollution. (Wastewater Primer)

The Department of Housing and Urban Development is intending to offer funding under its Sustainable Communities Planning Grant Program for sustainable development

programs which will include water infrastructure. $100,000,000 is being proposed under this program. Other Federal-based financing sources for small water systems to seek include CDBG, U.S. Department of Agriculture Rural Development Administration grants and loans for communities under 10,000 population, and regionally-based loan and grant programs may also be available. The Bureau of Reclamation has historically funded large scale desalination and water recycling projects in the far west. The Army Corps Engineers and FEMA are two other sources of grant money related to water.

State Programs

Many states issue general obligation bonds for large scale water infrastructure projects that go beyond the capacity of a local or regional effort. These must be paid back with taxpayer general fund revenues. Maryland, Oregon, and Washington, for example, have used the revolving loan fund structure for years to pay for needed wastewater upgrades, water supply systems, and for remediation of failing septic systems. In 2004, Maryland passed a Chesapeake Bay Nutrient Reduction Program which billed homeowners on public sewer systems additional monies to cover the cost of enhanced nutrient reduction on the 64 largest WWTPs in the state. Additional nutrient loadings from all other WWTPs have been capped based on projected 2020 flow or existing capacity whichever is lower. The cap may only be removed if these systems also implement enhanced nutrient reduction technologies, but State assistance through the Nutrient Reduction Program will not be available for that purpose.

Local Funding

Water and wastewater infrastructure funding is primarily a local matter. Nationally, over 80 percent of both maintenance and capital is funded either with on-going service fees paid for by the customer (rate-payers), sometimes supplemented with development fees for new construction (also called connection fees or system development charges) that are integrated into the price of the development. Many local agencies issue revenue bonds and certificates of participation backed by rates.

Locally, jurisdictions have been experiencing "mission creep". As general fund dollars become scarcer, rate-based entities are being asked to broaden their missions. An example is the City of Phoenix in Arizona collects a $2.00 fee on the water bill for jail housing costs. Additionally, rate-payer dollars are used to purchase property to protect habitat, to fund incentive programs for people to develop rain gardens and eco-roofs, and to replace culverts for fish passage. There is debate in the field about the extent to which this is appropriate.

In larger service areas, water and wastewater generally have an advantage over some of the other infrastructure areas because they are rate-payer funded. In small service areas, the cost of system improvements like new treatment plants can be a very heavy burden to spread over just a few rate-payers. Keeping rate-payers informed/educated, and doing a good job delivering services makes them more willing to support increased rates.

Stormwater fees are in their infancy. Many of the major storm water control systems like detention or retention ponds found in large parking lots are paid for by the private sector, either as a direct cost of construction or through development impact fees. (Randolph, Environmental Land Use Planning and Management) Some localities pay all or part of storm water management costs with general funds. Others are establishing stormwater utilities or making it part of the wastewater utility mission. A special assessment may be set up to generate funding only for stormwater management. Users within the district pay a fee for drainage plans, maintenance and upgrading of existing storm drain systems, flood control measures and sometimes capital construction projects. Sewer capacity is sometimes adversely impacted by stormwater runoff when systems are failing or designed to collect both.

In 2003, the American Public Works Association (APWA) estimated that about 500 communities had established a stormwater utility with many concentrated in Florida, Washington, California and Oregon. (John F. Damico and Lamont W. Curtis, Financing Stormwater Utilities, Kansas City, MO, American Public Works Association, 2003.) Some estimate that by 2010 there will be more than 2,500 such entities. (Janice Kaspersen, "The Stormwater Utility: Will It Work in Your Community?" Stormwater, 2000.) The use of a dedicated enterprise or utility supported by fees for stormwater programs is now becoming more accepted throughout the country.

POLICY FRAMEWORK

National Policies

Over the years, EPA's original approach of separate programs for point and non-point sources of pollution, and also for regulating drinking water has evolved into a broader watershed protection approach that looks holistically at the relationship of pollution, clean water, ecosystems, and public health concerns. Despite this evolution, the regulatory framework continues to be shaped by the Clean Water and the Safe Drinking Water Acts.

Clean Water Act: The 1972 Clean Water Act originally authorized the National Pollutant Discharge Elimination System (NPDES) to regulate point source pollution. It requires all facilities that discharge pollutants into U.S. waterways to obtain a permit that regulates both the quantity and concentration of each pollutant. The program mostly focused on wastewater and sewage until it was expanded in 1987 to address non-point pollution. Then, jurisdictions discharging stormwater were required to develop programs addressing stormwater and to apply for an NPDES permit. This was due to the variety and toxicity of substances being swept into rivers, bays and streams by storm water runoff.

The 1972 Act also required all states to specify TMDL's (the Total Maximum Daily Load) for each pollutant for water bodies within their jurisdictions that do not meet quality standards. The regulations were modified in 2000, but Congress prohibited EPA from spending money to implement them. (U. S. Environmental Protection Agency. Overview of Current Total Maximum Daily Load - Tmdl - Program and Regulations, 2004.)

Some states are under court orders to develop TMDLs. Every two years, it is required to perform an updated review of monitored water quality compared to standards. These updates result in new TMDLs for non-compliant water bodies. TMDLs will be extremely costly to implement. They often require land use changes, not just to the regulations for future land use, but changes to existing land uses as well. With private properties involved, it is very difficult to move forward on things like re-grading stream banks, adding shade, removal of invasive plants.

Safe Drinking Water Act (SDWA): Prior to enactment of the SDWA in 1974, only standards for communicable waterborne diseases were in force. The SDWA expanded these standards for drinking water to address both naturally-occurring and man-made contaminants. In general, the SDWA takes a three-prong approach to ensuring water quality by addressing water source protection, water treatment, and water distribution system integrity. The 1986 amendments protect the recharge area of aquifers by setting contaminant limits and by regulating underground injection wells. There is no regulatory standard for single-use wells.

The 1996 amendments expanded the SDWA in a number of ways. They require that all community water systems prepare and distribute annual reports about the water they provide, including information on detected contaminants, possible health effects, and the water's source. Under the amendments, every state must conduct an assessment of its sources of drinking water (rivers, lakes, reservoirs, and wells) to identify significant potential sources of contamination and to determine how susceptible the sources are to these threats.

State and Local Regulations

Many states require the preparation of county or municipal water and sewer plans. Typically these plans are required to address water and wastewater capacity, projections of future flows and population served over a ten year time frame, delineations of areas to be served, a statement of consistency with local comprehensive plans, and a proposed capital program. Infrastructure improvements and expansions must be listed in the water and wastewater plans for funding and construction and operating permits from the state regulatory agencies. However, such standardized planning requirements are not typically required in much of the country. Some states require «consistency» and "concurrency" in development approval processes to match land use growth with available infrastructure such as water, wastewater and roadways.

Five western states have passed state legislation that attempt to directly require demonstration of adequate water supply when approving residential subdivisions. Arizona's law, known as the "Assured Water Supply Program," was passed in 1995 and prohibits all new subdivision in the Phoenix, Tucson and Prescott areas without use of "renewable" (i.e. surface) water. Colorado passed the Subdivision Act of 1972 (SB 35), requiring all counties to adopt subdivision regulations including "adequate evidence that a water supply that is sufficient in terms of quality, quantity, and dependability will be available." Nevada passes the 1973 Subdivision Act NRS 278.335), which requires state-level approval of all tentative subdivision maps for water supply. New Mexico passed the 1995 Subdivision Act (HB 1006), requiring all counties to adopt subdivision rules with water supply requirements meeting certain criteria. (Ellen Hanak and M.K. Browne, «Linking Housing Growth to Water Supply: The American West's New Frontier,» Working Paper, Public Policy Institute of California, 2004.) In 2001, California passed Senate Bills 221 and 610 in 2001, designed to address water supply adequacy for large subdivisions (over 500 units) and other projects at earlier stages of planning. Each of these laws is designed to assure that adequate long-term water supplies exist prior to the approval of new housing projects.

Some states have taken the additional step of requiring that every county and municipality that exercises planning and zoning authority include in their local comprehensive plan a water resources element that identified drinking water and other water resources adequate for the needs of existing and future development proposed in the land use element of the plan, considering available data provided by the state. In Maryland, the element must identify suitable receiving waters and land areas to meet the storm water management and wastewater treatment and disposal needs of existing and future development proposed in the land use element of the plan, considering available data provided by the state. The second part of this requirement also resulted in assessments of non-point contributions to water pollution that would result from future planned growth. In both instances the element must identify potential constraints on planned growth and mitigation measures. In cases where constraints did not exist, the element identified the pattern of land uses that would have the least impact on water resources (MD Department of Planning, ManagingMaryland's growth: The Water Resources Element: Planning for Water Supply and Wastewater and Stormwater Management, June 2007).

Local Government Regulation

Local governments also play a role in regulating water use through their police powers and land use authority. Zoning, development regulations, subdivision standards and building, fire and life safety codes are in the planner's typical tool bag. Other regulatory tools include mandatory no-water days during severe drought, xeroscape landscape, and other general practices.

BASIS OF RECOMMENDATIONS

Traditionally, the provision of water and wastewater services has been the purview of the engineering community and the utilities. It is time for planners to have a voice in decision-making related to water and wastewater. 19th and 20th century utility infrastructure planning focused on the physical assets of water, sewer and stormwater systems. 21st century planning should incorporate an integrated approach that focuses on not only the physical assets themselves, but on the (triple bottom line: social, economic, environmental) environment, conservation principles, efficiency standards, reuse, new technologies and low-impact development (Aspen Institute Energy and Environment Program).

Technological advances now make possible systems where water is recycled, rainwater is harvested, peak storm water flows slowed, and discharges of pollutants to remote receiving waters are significantly reduced or eliminated entirely. These same advances also make it possible to rethink the concept of waste as a resource. Concern about carbon emissions has also focused attention on compact growth and changes to the land-use/transportation/energy nexus. Similarly, improvements in information technology makes possible "intelligent" pipes and real time water consumption data. It also makes possible remote sensing by the water utility of the performance of wastewater and water treatment facilities, which opens the door to decentralized water recycling and wastewater management.

Sustainable Communities and Water Management

A sustainable urban region is defined by some as one where the inflows of materials, water, and energy do not exceed the capacity of its hinterlands. IWA defines a sustainable city with respect to water/wastewater as: «A sustainable city's infrastructure is designed with consideration of environmental impact, inhabited by people dedicated to minimization of required inputs of energy, water and food, and waste output of heat, air pollution, greenhouse gases and water pollution (Novotny, Vladimir, 2010, Cities of the Future: Agenda I - Framework and Footprint Development).

A sustainable city's water infrastructure and building structures contribute to the efficient use of land. Urban (green) infrastructure, resilient, and hydrologically and ecologically functioning landscapes and water resources will constitute one system. This leads to the four principles of a new water management paradigm for the United States noted in the introduction: support of the sustainable city by integrating water planning into the overall development process from the outset; development of a new urban water management paradigm that recognizes all water as "good" water, with the application of fit for purpose water criteria instead of using potable water for all purposes; pricing of water including all social and environmental costs; and innovations in water governance to promote consumer choice (intelligent water systems) and better integration of water planning decisions at the outset of local development plans and individual project development. The planner is critical to implementation of these principles, since although water utilities can do much to "green" centralized water treatment, wastewater development and major regional flood management facilities, local government and planners open a second world of on-site and source specific solutions to water problems.

At the federal and state level, this calls for a rethinking of the current regulations and institutions that regulate water/wastewater/stormwater/flood plain management.

At the local level this translates into local plans, development regulations and project developments that have these characteristics:

- Promote decentralized storm water solutions such as green roofs, walls and more pervious pavements, rainwater harvesting where appropriate instead of large scale storm water retention facilities;
- Promote water recycling including decentralized wastewater treatment facilities such as source control, satellite facilities, natural and high technology solutions;
- Promote nutrient and energy recovery from wastewater and solid waste both centralized and on-site, and insure that water utilities are energy and carbon neutral;
- Develop adaptation plans for existing water and related infrastructure that take into account increased chance of extreme weather events and rising coastal and riverine waters.

All of these actions pre-suppose a close relationship between local general purpose governments and the water agencies; in the instance where water agencies are part of the local general purpose government, more integration between the development department and the water department is required. The following identifies specific recommendations that would implement the above.

POLICY RECOMMENDATIONS

In the early '90s the water and wastewater industries began promoting the concept of integrated resource planning (IRP) which encourages an evaluation of the land use and environmental impacts of centralized versus distributed systems. The concept of the IRP is still relatively new to most wastewater utilities that may still rely on a more traditional master planning process for specific facilities with little community involvement. Specific ways that planners can start to implement the IRP concept are noted in this section.

Require regional water/wastewater/stormwater plans

The federal government should condition any federal funds to urban areas for infrastructure upon having a regional water/wastewater/stormwater plan that is integrated with local land use plans, and that take into account carbon emissions and the energy needs of water/wastewater treatment as well as the water needs for energy production. This could be similar to how federal transportation funds are now conditioned combined with the new requirements that California - SB 375 etc - has to connect transportation/carbon emissions/energy use.

Expand project ranking systems to better incentivize water issues

The green building movement has seen the rise of LEED and other ranking systems for local development approvals at the project or site level. This is expanding to look at the neighborhood and city level. Although points for water conservation are only a small portion compared to energy efficiency, this is likely to change over the coming years. ICLEI for example is developing a sustainability city index (Star index) that greatly expands the attention given to water. IWA has a sustainable performance indicators project underway to be used in the future to «rank» cities with sustainable water infrastructure and programs.

Develop long-term financial planning process

Capital pressures will continue to necessitate long-term financial planning and better collaboration between various professional disciplines. Failure to do so will create a larger investment gap leading to costlier projects, higher rates and capital fees, a reduction of a utility's financial flexibility, and greater chances of overcoming inherent political resistance to new and increased funding sources. Comprehensive planning should achieve the following:

- Link infrastructure funding to all available sources (rates, capital facilities fees, bonds, loans, grants) to effectively meet timing of capital project schedules.
- Improve utility cash flow and liquidity.
- If issuing debt for capital projects, meet target financial ratios to improve credit ratings resulting in lower issuance costs.
- Utilize comprehensive capital planning processes such as asset management and newer technologies such as condition assessment to accurately prioritize capital replacement activities at time of projected asset failure.
- Develop pro-active community outreach programs and processes to educate all stakeholders for full understanding of utility needs and actions.

Design utility rates to promote sustainability

Utility rate and capital fee structures should be developed according to established standards for revenue generation, cost allocation, design and implementation, and follow the principle of full social cost recovery. Rates and fees should be linked to cost of service principles and designed proportionately to demand, i.e. those who cause a greater demand on a water/wastewater system should pay higher rates and fees. Pricing policies should encourage resource conservation while demonstrating the true value of the resource. These policies may include tiered (inclining block) water rates, seasonal rates, marginal cost pricing for additional water supply development, incorporation of price elasticity of demand in the rate setting process and other innovating pricing techniques. Equity issues should also be addressed for low income families.

Planners can promote creative rate and fee structures that place the financing and funding burden more on the high or excessive users of water and wastewater systems. For example, many Southwestern communities have adopted, or are considering water budget-based rate structures. This type of rate structure rewards water users who stay within their pre-defined, individualized consumption tiers. Those customers who exceed their efficient allotments pay a significantly higher marginal rate for each unit of water above the established threshold. Agencies that have adopted this type of rate structure have experienced up to 30% annual reductions in water use. In addition to water conservation, this pricing approach has the added benefit of reducing wastewater effluent flow.

Facilitate opportunities for utilities to provide innovative water services

For water and wastewater providers, most future capital funding will continue to be rate-payers and the development community. However, there are other funding options available as well as innovative ideas to address the funding gap. Some agencies are finding a tremendous amount of success in improving the bottom line which will in turn allow utilities to shift rate and other revenues from operations to capital investment. Specific examples include reducing system losses, expanding into new lines of business that provide net revenues to the bottom line, and increasing rates of collections for utility billings. Other examples of successful alternative funding opportunities include 1) the sale of recycled water to regional businesses such as golf courses, ski resort areas for snow-making, nurseries and to agencies that operate parks and maintain street landscaping, 2) the use of more renewable energy through own-source electricity generation, and 3) the sale of composted soil amendment products to reduce solids handling costs.

Discourage one-size fits all solutions and advocate local level regulatory flexibility

What institutional mechanisms can be put in place to provide real assurance that permitting processes can be streamlined, that regulatory flexibility is actually in place to reduce costs for urban retrofit? Is off site mitigation possible, and what are the inter-jurisdictional and institutional constraints that would make off site mitigation less viable?

Federal, State and even local policy makers need to move away from one-size fits all for mandates. For example, in Portland, Oregon the water bureau is under a mandate to treat for cryptosporidium for which there is no evidence of it being in Portland's water source. This mandate will cost $100 million. Other urban systems treat for it, so Portland must do so also.

Continue to promote smart growth practices

Local policy makers can decide where and, just as importantly, when to expand municipal wastewater service which is an important determinant of whether growth is compact or not. Today, tighter land use patterns (smart growth) are desired to mitigate climate change, to reduce water demand. The local general purpose government has a variety of mechanisms to insure that sewers are promote smart growth, including approval of land use and building permits. Local policy makers can affect utility decisions to oversize for future growth and promote, instead, water recycling and water conservation measures.

Promote integrated solutions

Planners can conduct, and utilize research. The water, wastewater and flood plain management organizations regularly conduct research, but it is focused primarily on technical engineering concerns. APA should encourage research that is interdisciplinary and promotes governance structures, programs and tools that look at infrastructure more holistically.

For example, the federal government could fund research into the development of an asset management system that jointly maximizes sewer/water pipe infrastructure and street condition rather than leaving this to local communities to fund. This could

facilitate the development of decentralized wastewater treatment and water recycling during street reconstruction projects.

On a more immediate level, APA and other organizations could survey for best practices at the state/region and city/county level for sustainable water and wastewater infrastructure? The federal government could fund some research into new ways of encouraging institutional changes between water utilities and land use agencies. APWA and other organizations have identified many "best practices" around the country.

Advocate for performance measures

Most waste9water operators have some idea of infiltration and inflow conditions. In some areas (e.g., Chesapeake Bay and Puget Sound regions), the traditional methods of measuring available capacity through hydraulic capacity have been replaced by measures that focus on performance. How a system meets the nutrient reduction standards or other NPDES permit requirements is of equal importance when a system connection is being contemplated. Some areas have regulations and procedures that restrict new connections to wastewater systems after reaching a percent of rated capacity in the system (e.g., Maryland 80%, Washington State 85%). The NEST project being promoted by the federal government is trying to establish a national sustainable data collection system and they are beginning with water. This should provide both local and national indicators that can be used by local planners.

Statewide or watershed wide water strategies

Planners can build relationships with agencies that specialize in watershed planning and tap the extensive resources. The watershed program uses a «watershed approach», or a systems approach, whenever possible to address problems or to restore or protect resources. In the United States, the Natural Resources Conservation Service (NRCS) and the United States Environmental Protection Agency (EPA) are responsible for work on the federal level. The NRCS is typically involved with the planning and continued monitoring of environmental improvement projects, while the EPA is generally responsible for compliance of several environmental laws such as the Clean Water Act. Assistance with watershed protection is also provided on a state level through Soil and Water conservation districts and other state-operated departments (e.g., departments of natural resources, departments of agriculture). Beyond governmental support, other organizations and companies exist that provide support in various manners with the goal of watershed protection in mind as well.

Advocate for recapitalizing state revolving loan funds

State revolving loan funds for water and wastewater infrastructure are a critical funding source, particularly for small communities. Many small communities are unable to afford the debt service even on the low interest loans available through revolving loan programs. The availability of grants to meet new treatment requirements for water and wastewater systems is needed. Some ARRA funds were directed to states for their revolving loans funds. Most of the ARRA funds were distributed through grants with complex reporting requirements. More money needs to be made available for loans. Reporting requirements should not be so onerous as to become a significant project cost. Also important is the need to build administrative capacity in small communities. Assistance in understanding regulatory requirements, assistance for grant writing or in meeting planning requirements or simplified reporting requirements may make the difference in whether small communities continue to grow in the future.

CONCLUSION

With a trillion dollar plus pool of funding needed to fix and upgrade water and wastewater systems as they age and fail, planners need to be at the table to help pull together all resources necessary for the provision of quality services. Specific recommendations are called out above to guide elected and appointed officials and planning staffs. Teams that are comprised of planners, public works staff, and private enterprise will be key for communities to use resources efficiently and employ innovative solutions to provide long-lasting safe water and wastewater treatment facilities with low-cost maintenance.

APPENDIX

References/Links

U. S. Environmental Protection Agency. Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists and Engineers. Alan Burton and Robert Pitt. (2001). http://unix.eng.ua.edu/~rpitt/Publications/Publications.shtml; Robert Pitt, "Receiving Water Impacts Associated with Urban Runoff," in Handbook of Ecotoxicology, ed. D. Hoffman, et al. (Boca Raton: CRC Press, 2002). http://unix.eng.ua.edu/~rpitt/Publications/Publications.shtml

SECTION 5: TELECOMMUNICATIONS AND TECHNOLOGY INFRASTRUCTURE

INTRODUCTION

1. Telecommunication - Broadband services are considered an essential utility

The Internet has created a new economy, in which goods and services are delivered over broadband infrastructure. Businesses and consumers are adapting new technologies at an exponential rate creating an ever growing demand for broadband networks. Bandwidth hogging applications such as voice over Internet (VOIP), digital imaging, videos, music, gaming, mobile applications and social networking are now integral day-to-day activities in the workplace and the home. Today broadband has become essential infrastructure in the same way that roads are essential infrastructure. Communities without an affordable broadband transport system are going to struggle as the knowledge economy matures.

2. Telecommunication - Broadband infrastructure is typically provided by non-governmental entities

Many communities are worried that the local broadband infrastructure will not be able to meet these demands and that, consequently, their local economies will suffer. Fueling this concern are statistics from the International Telecommunications Union that the U.S. ranks 16th among nations in broadband penetration. (1) Although visionaries are clamoring for gigabit networks, commercial providers, who own the majority of the nation's telecommunication infrastructure are reluctant to invest in this infrastructure without assurances of an adequate return on the network. Many planners are asking if it local, state and the Federal governments need to have a bigger role in planning and deploying telecommunication networks.

3. Federal Communications Commission – National Broadband Plan

In early 2009, Congress directed the Federal Communications Commission (FCC) to develop a National Broadband Plan to ensure every American has "access to broadband capability." In March 2010, the FCC introduced the plan to the public. The plan contains specific recommendations for public policy, incentives and investment as well as outlines six goals to provide a benchmark for achievement over the next decade. Among the goals is to provide 100 mbps to 100 million households, to lead the world in a fast and extensive mobile network, and to provide one gigabit access to anchor institutions such as schools and hospitals. The American Reinvestment and Recovery Act contained funds to map broadband availability in every State to provide baseline information for meeting these goals. (www.broadband.gov).

While the recommendations of this report are consistent with the overall FCC goals, the focus of the this report is more on what practicing planners at the local level can do to promote a robust and affordable broadband network.

Telecommunication Networks - Background

Telecommunication Networks

Broadband falls into two types of connections: wired or wireless.

Wired Connections

Digital Subscriber Line (DSL). DSL is a wireline transmission technology that transmits data faster over traditional copper telephone lines already installed to homes and businesses. DSL-based broadband provides transmission speeds ranging from several hundred Kbps to millions of bits per second (Mbps). The availability and speed of your DSL service may depend on the distance from your home or business to the closest telephone company facility.

Cable Modem. Cable modem service enables cable operators to provide broadband using the same coaxial cables that deliver pictures and sound to your TV set. Transmission speeds vary depending on the type of cable modem, cable network, and traffic load. Speeds are comparable to DSL.

Fiber. Fiber optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers about the diameter of a human hair. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps. The actual speed you experience will vary depending on a variety of factors, such as how close to your computer the service provider brings the fiber and how the service provider configures the service, including the amount of bandwidth used. The same fiber providing your broadband can also simultaneously deliver voice (VoIP) and video services, including video-on-demand.

Broadband over Powerline (BPL). BPL is the delivery of broadband over the existing low- and medium-voltage electric power distribution network. BPL speeds are comparable to DSL and cable modem speeds. BPL can be provided to homes using existing electrical connections and outlets. BPL technology has had limited deployment.

Wireless

As it pertains to wireless internet use, a survey showed that 56% of adult Americans have accessed the internet by wireless means, such as using a laptop, mobile device, game console or MP3 player.[31] As included in the FCC Broadband Plan released in March, Wireless broadband is poised to become a key platform for innovation in the U.S. over the next decade.[32]

Fixed wireless broadband connects a home or business to the Internet using a radio link between the customer's location and the service provider's facility. Current speeds are generally comparable to DSL and cable modem. Wireless broadband Internet access services offered over fixed networks allow consumers to access the Internet from a fixed point while stationary and often require a direct line-of-sight between the

wireless transmitter and receiver. These services have been offered using both licensed spectrum and unlicensed devices. For example, thousands of small Wireless Internet Services Providers (WISPs) provide such wireless broadband at speeds of around one Mbps using unlicensed devices, often in rural areas not served by cable or wireline broadband networks. Wireless Local Area Networks (WLANs) provide wireless broadband access over shorter distances and are often used to extend the reach of a «last-mile» wireline or fixed wireless broadband connection within a home, building, or campus environment. Wi-Fi networks use unlicensed devices and can be designed for private access within a home or business, or be used for public Internet access at «hot spots» such as restaurants, coffee shops, hotels, airports, convention centers, and city parks.

Mobile wireless broadband services are also available from mobile telephone service providers and others. The Pew Internet & American Life Project survey showed 32% of Americans use the internet on a mobile phone. While once thought to be only available to highly mobile customers, this technology continues to grow in popularity. Current speeds are comparable to DSL and cable modems, though planned 3G+ (HSPA+) and 4G (LTE or WiMax) networks will deliver speeds comparable to fiber systems.

Satellite. Just as satellites orbiting the earth provide necessary links for telephone and television service, they can also provide links for broadband. Satellite broadband is another form of wireless broadband, and is also useful for serving remote or sparsely populated areas. Speeds are dependent on a number of items and may be slower than DSL and cable modem, but they are about 10 times faster than the download speed with dial-up Internet access. Service can be disrupted in extreme weather conditions.

Telecommunication/Broadband Applications, Services & Benefits

Increasingly, national governments across the globe are installing broadband for the many public benefits the service will provide to their citizens. Equated to roads and electricity, high-speed internet access is no longer viewed as a luxury for those able to afford it. The question has become, "Can we afford not to provide broadband service in every community?" While cost is one obvious barrier, reviewing the many benefits illustrates the potential for the installation to pay for itself, not just in the long run, but often in as short as a few years.

Stated plainly, broadband is a catalyst for increasing the quality of life within a community. It has the potential to provide better access to services and opportunities for a larger segment of the population. Those without cars, those with physical limitations, and those without access to an educational campus or employment center are all finding broadband to be revolutionary force in their lives. Access to broadband provides opportunities for self-sufficiency in remote areas, smaller rural towns, and low-income areas.

The following list outlines the benefits provided to communities by broadband service:

1. Telecommunication services are available to support an enhanced public service delivery.

The provision of public services can be extremely expensive, even cost-prohibitive, in rural areas. Improved telecommunications and broadband internet access can increase the effectiveness and efficiency of public service delivery. Public websites provide a mechanism to obtain forms and applications, search and apply for employment, and engage in citizen advocacy without traveling to a specific site. Government agencies are able to update information instantly, keeping the public current on information of community importance. In addition, improved communication networks avail themselves to better access to educational tools for K-12 schooling.

From Fire, Police, and EMS services to transportation and utilities, numerous public agencies benefit from the availability of real-time data and are able to respond quicker and more accurately. Systems such as a Geographic Information System (GIS) require the bandwidth capacity of broadband in order to be an effective tool. These systems enable public employees make decisions on-site, conduct research in the field, resolve conflict and avoid issuing violations, and update property records on the spot. In addition, broadband

2. Economic/business development is dependent on the availability of quality telecommunication services.

It is clear that the provision of broadband services will determine which communities remain competitive in the national and world economies. Traditional industry sectors are becoming more technology-focused for the benefits that broadband provides relative to increased efficiency and productivity (= increased profitability). Many of these new jobs focus on creativity and communication and do not necessarily require the manufacturing of a physical product. Increasingly common are real time video surveillance systems which require streaming of live video and high speed broadband connections.

While larger cities typically have more housing, retail, and entertainment options, smaller cities maintain a more affordable cost of living. However, in order to be competitive in attracting and retaining businesses, rural areas need dependable, high speed internet. Studies have shown that economic activity in communities with broadband is significantly higher than those without. Communities with adequate, affordable bandwidth attract companies to areas with an overall lower cost of living. This not only equates to greater employment opportunities, increased Gross State Product and Gross Domestic Product, but increased tax revenue locally. This is one way in which broadband can pay for itself in a relatively short amount of time.

3. Other Community Benefits Associated with Broadband

The government provision of broadband service acts as another provider which increases competition, consumer choice, and the potential for reduced rates in the market place. In addition, this network can serve as a backup grid for existing networks to ensure redundancy in case of outages. Broadband in rural areas would facilitate the creation and support for smart grid technologies to enable improved electric utility efficiency. It would also offer reduced traffic congestion and pollution from smart transportation networking. Overall, it can foster the redevelopment of many economically repressed cities that became obsolete after reduced output from manufacturing sectors of their economy. It can attract new vitality and retain youth within their hometowns.

Some of the other benefits from public system include improved access to home health care and increased prescription ordering for homebound citizens. Studies indicate that the social returns of broadband investment exceed the private returns to companies and consumers. In addition to improved educational opportunities for K-12, broadband services in rural areas provide opportunities to improve technological literacy, bridge the digital divide, and foster economic development opportunities. They allow for more user-friendly government services which enhance participatory democracy by engaging a larger percentage of the population.

CHALLENGES

Underserved areas in rural areas, small towns, lower income urban areas inner-city

According to the United States Department of Agriculture, Economic Research Service, Economic Research Report #78, "Broadband Internet Value for Rural America", August, 2009:

> "Whereas an estimated 55 percent of U.S. adults had broadband access at home in 2008, only 41 percent of adults in rural households had broadband access. Evidence suggests that some of this shortfall in broadband use is involuntary, and may be due to the higher cost of broadband provision or lower returns to broadband investment in sparsely populated areas. …. Analysis suggests that rural economies benefit generally from broadband availability. In comparing counties that had broadband access relatively early(by 2000) with similarly situated counties that had little or no broadband access as of 2000, employment growth was higher and nonfarm private"

Additionally, low-income urban areas are also less likely to subscribe to broadband services. According to a PEW Internet survey from 2009, the percentage of all U.S. adults with broadband at home is 60% for suburban areas, 57% for urban areas, and 38% for rural areas.

Of the 35% of Americans that are not using broadband, the most important reasons, or barriers, include cost (36%), digital literacy (22%), and lack of relevance (19%).[33] If the goal is to provide access to broadband with the intent that people will use its services, then funding programs and marketing/education strategies are needed to overcome these obstacles.

Rural Electric Analogy

There was a time when rural areas were denied electric service because it was too costly to extend power lines to remote areas. Utilities said there was not enough demand to justify the investment. Even when studies indicated there would be profits, electric lines still by-passed rural America for the more profitable urban markets.

Rural areas that were lucky enough to have electricity had service that was often unreliable. Rural America lacked basic modern conveniences like washing machines and radios. They were falling behind the rest of the country. The combined efforts of rural electric coops, municipal electric utilities and the Rural Electrification Act helped fill the gaps.

Fast forward sixty years and the utility has changed, but the issues are the same. Lack of broadband in rural American means Main Street businesses cannot compete with their urban counterparts. Youth leave their hometowns because the better paying jobs are elsewhere. Information and resources that are available on-line are difficult to download in rural areas with slow, unreliable connections. The most recent broadband mapping initiative is meant to map where there are deficiencies and is the first step to develop a plan to overcome them.

Just as the rural electrification was resolved with a combination of Federal policy, public-private partnerships, and local action, the broadband puzzle will require a similar range of solutions.

Telecommunication needs not generally addressed in Comprehensive Plans & Lack of coordination between providers & local governments

Comprehensive planning, community plans, specific plans, etc., generally neglect broadband infrastructure. As an essential service in the 21st century economy, telecommunication needs are typically not addressed in community planning compared with other services as transportation, power, water, wastewater, etc. While many community plans are available for download via broadband connections, there are typically no objectives in the plan itself about such infrastructure being available, the quality of such infrastructure, or the penetration of such infrastructure into the community, to ensure citizenry has access to view such material.[34]

The result of such gaps in establishing an infrastructure policy for broadband services are the disruptions to the community when service providers come to town. Witness the challenge in opening up the rights-of-way within months of a new road improvement or pitting neighbor against neighbor over a zoning permit for a wireless facility.

Ordinances are old and need to be updated - State and local regulations impact the availability of telecommunication services

Regulations and processes are obstacles that deter broadband deployment or investment. Regulations should align with the vision pertaining to broadband deployment and create a broadband-friendly environment to stimulate the build-out of infrastructure. Therefore, regulations should balance all competing priorities, which include:

i. Public process
ii. Value of public space / public space as an asset
iii. Aesthetics
iv. Broadband services

Regulations should therefore be nimble. Planners and policy-makers across the nation are regulating technologies that evolve at light speed compared to the process it takes to develop or modify regulations. Simply put, technologies change faster than the regulations, as evidenced by emergency moratoriums on infrastructure improvements brought as a result of static regulations that were codified to deal with older generation technologies.

How many times over 3-5 year period does a jurisdiction revisit its policies or zoning code on broadband services versus the number of changes in technology in that same time span (e.g. in wireless, over the course of three years we have seen 2G, 3G, 4G and LTE technologies, each with its own radio cabinets and antennas.) Thus, regulations need to allow a predictable process for equipment upgrades that keep up with broadband demand in the marketplace.

Regulations should not favor one technology over another (e.g. home pre-wired for internet connection without consideration of wireless) since there is demand for wired and wireless services.

The regulatory process, fees, etc., should be fair and somewhat predictable. In the absence of a fair and reasonable process, federal or state actions are often taken to mitigate an onerous process in favor of getting broadband infrastructure deployed. Examples include:

i. The FCC issued rules imposing a 90 day limit to states and municipalities to approve or deny collocation (tower sharing) requests, and 150 day limit to act on new tower placement requests.[35]
ii. Michigan established the METRO act and thus implemented a fixed right-of-way fee, standardized application, central authority for fee collection, a 45 day time limit on municipality action on permit, a streamlined process for resolution of disputes, and limits on local regulations for broadband deployment in the rights-of-way.[36]

Reaching out to younger generation in digital age.

While 93% of the 18-29 age group uses the internet, the number drops to 70% for the 50-64 age group.[37] Similar differences are seen between income levels (higher income, higher use of the internet). Strategies to increase demand should be appropriate to the socioeconomic target and focus on the use of multiple technologies (wired and wireless).

Competing globally –Next Generation Broadband

A distinction is often made between "current generation" and "next generation" broadband (commonly referred to as next generation networks or NGN). "Current generation" typically refers to currently deployed cable, DSL, and many wireless systems, while "next generation" refers to dramatically faster download and upload speeds offered by fiber technologies and also potentially by future generations of cable, DSL, and wireless technologies.

The FCC has established the following speed tiers to define broadband. The broadband map being produced by the National Telecommunications Infrastructure Administration will map availability of Basic Broadband. Many economic development and technology professionals are advocating that the U.S. should plan for Tier 7 broadband to be competitive in the global marketplace.

Table 4: FCC Speed Tiers

1st Generation Data	200 kbps to 768 kbps
Basic Broadband Tier 1	768 kbps to 1.5 Mbps
Broadband Tier 2	1.5 Mbps to 3 Mbps
Broadband Tier 3	3 Mbps to 6 Mbps
Broadband Tier 4	6 Mbps to 10 Mbps
Broadband Tier 5	10 Mbps to 25 Mbps
Broadband Tier 6	25 Mbps to 100 Mbps
Broadband Tier 7	Greater than 100 Mbps

Source: FCC Wireless Competition Bureau

Prioritizing public investments in Telecommunication Infrastructure

Long distances and sparsely populated areas, however, delay deployment of advanced technology in rural areas. Since telecommunication providers realize a lower return on investment in rural areas, they focus capital investment in the more profitable urban areas. Consequently, different strategies for attracting broadband investment are required in rural America. Examples of successful strategies include aggregating demand, identifying an anchor tenant, creating telecommunication cooperatives, co-locating equipment and cultivating broadband demand. The appropriate strategy, however, depends on the local market, community leadership, existing opportunities, and potential technology applications.

Local officials must balance investment in broadband with being fiscally responsible and accountable to the entire community. Funds for broadband networks must compete with

other municipal priorities such as roads, water treatment, and public safety. Officials must justify the investment in technology through sound analysis and planning. A planning process can provide information for communities and mobilize constituencies to support creative solutions to improving broadband services. Some questions that communities must answer include:

- Is the private sector meeting local broadband needs and is it possible to adopt policies that will encourage private investment?
- What are the range of goals and applications for the network?
- What technology or network design is best suited to meet the goals that have been established for the network?
- What is the appropriate business model for deploying and operating the network?
- Who are potential partners for deploying, operating and using the network?
- What are the costs at all stages of investing in a broadband network? (Feasibility analysis; build-out; operation .....)
- What is the potential market/revenues for the network?
- Should the city directly compete against the private sector for this market?
- What are potential liabilities and risks in building the network?

Financing Telecommunications - Broadband Investment

The expense of deploying quality broadband services is significant and is effectively no different than deploying other service-related infrastructure (e.g. streets, sewers or electric utility lines). In a private business model, typically there is a minimum return on investment based on the number of subscribers and the revenue per user. Where subscriber numbers are low, then a private business is challenged to build infrastructure when the rate of return is low (or negative). For that reason, it is generally recognized that there is a lack of private financing for network deployment, especially in rural areas.[38] The same is true within underserved urban areas, where public funding is often required.[39] Therefore, it is reasonable to suggest that public and/or public/private funding strategies are necessary to introduce broadband services where they do not exist today. Such strategies should align between federal, state, regional and local efforts.

Beyond deployment, funding will be needed on an on-going basis to maintain and/or expand services, since, like transportation, if you build one lane you eventually need two to keep up with demand. Competition in the digital age will drive expansion of existing networks, both wired and wireless, since speed and network availability are high priorities in delivering broadband services.[40]

Wireless Spectrum

The contribution of wireless services to overall gross domestic product grew over 16% annually from 1992-2007 compared with less than 3% annual growth for the remainder of the economy. Given these growth rates, wireless communications—and mobile broadband in particular—promises to continue to be a significant contributor to U.S. economic growth in the coming decade. Some analysts predict that within five years more users will connect to the Internet via mobile devices than desktop personal computers (PCs).[41]

In the FCC Broadband Plan published in March 2010, and according to Cisco, North American wireless networks carried approximately 17 petabytes per month in 2009, an amount of data equivalent to 1,700 Libraries of Congress. By 2014, Cisco projects wireless networks in North America will carry some 740 petabytes per month, a greater than 40-fold increase. Further, recent survey of 7,000 U.S. adults found that smartphone penetration is now at 33% of mobile subscribers across the four largest wireless operators. Penetration rose steadily over the past several quarters. These new devices drive higher data usage per subscriber, as users engage with data-intensive social networking applications and user-generated video content. Advanced smartphones, such as the iPhone, and devices using the Android operating system consume hundreds of megabytes of data per user per month. Laptops using wireless broadband consume more than a gigabyte per user per month. To put these numbers in perspective, Cisco estimates that smartphones such as the iPhone can generate 30 times more data traffic than a basic feature phone, and that a laptop can generate many times the traffic of a smartphone.

The growth of wireless broadband will be constrained if government does not make spectrum available to enable network expansion and technology upgrades. The progression to 4G technologies may require appropriately sized bands, including larger blocks to accommodate wider channel sizes. That said, innovative technologies are emerging that take advantage of narrower slices of spectrum, and such complementary approaches provide new opportunities for investment and further technological innovation.

Additional spectrum is also required to accommodate multiple providers in a competitive marketplace, including new entrants and small businesses, as well as to enable wireless services to compete with wireline services.

Additionally, experts expect a huge increase in machine-based wireless broadband communications over the next several years, as "smart" devices take advantage of the ubiquitous connectivity afforded by high-speed, low-latency, wireless packet data networks. While many of these devices, like smart meters, are expected to consume relatively small amounts of bandwidth, others, such as wireless-enabled cameras, may make use of embedded video and other media that could substantially increase demand for wireless bandwidth.

Once spectrum is available to a service provider, it can take years for the spectrum to be usable based on the timeframe granted incumbents to vacate use of the same spectrum holding (up to 10 years in some cases). Thus, any effort to make spectrum available should begin now based on the increased demand for spectrum that is forecast within the next 3-5 years (and beyond).

BEST PRACTICES

Wireless applications and infrastructure are providing new platforms for local governments to connect with citizens, provide services, and respond to emergencies. These new approaches include monitoring, detecting and responding to public health threats and management of police, fire, and animal control units.[42] The following are highlights from a few models currently being implemented as cities adopt wireless applications, utilize broadband to support neighborhood revitalization, and define telecommunication growth with strategic planning.

Cities adopt wireless applications

Corpus Christi, Texas adopted a publicly funded model for a citywide network. In contrast to larger cities, whose markets allow for less upfront costs, the city paid for its own infrastructure. The advantage being that Corpus Christi now owns the network and is in complete control of its direction. Forty percent of the bandwidth was dedicated for government functions and the remaining sixty percent was leased to ISPs. According to city officials, the resulting revenue will pay for the startup and maintenance costs, and possibly return a profit that could be used to address other technology needs. The citywide network has already had a significant impact on its building inspection application process. A seven part process that sometimes took up to forty days is now being completed in two to three days. "Now inspectors receive their work orders on Wi-Fi enabled laptops in the morning and drive directly to their first inspection site without stopping at the office. Their laptops are equipped with all necessary documents, a digital camera and Internet access for reference materials. Inspectors go to the inspection sites complete their inspections, take photos, fill out forms, capture signatures from various city approvers and send their information via email to their supervisors, who approves it and posts it to the building division's Web site the same day."

Another model being pursued in some cities is an experimental advertising model. The city contracts a provider to fund, build, and run the network, while the city markets itself as one of the few to offer citywide free service. The idea behind it is a one inch advertising banner that is constantly present at the bottom of the screen for anyone using the network, which provides maximum exposure and visibility for ad clients. The user potentially looks at the ads no matter where he or she travels on the internet. Vendors claim the resulting ad revenue will recoup the city's infrastructure costs and also produce a profit. San Francisco accepted an offer from Google and EarthLink to install and pay for a citywide Wi-Fi infrastructure. Google would provide the free ad-funded service, while EarthLink would contribute the infrastructure and regular fee-based services for those wanting to skip the ads and have a faster connection. "

Philadelphia has opted to offer a citywide network funded completely by private investment. A private company funds, installs, and operates the infrastructure, and gives the city a percentage of the profits. The drawback being that the city can't control the direction of the network outside of what is provided in the contract. The city created and charged its own non-profit, Wireless Philadelphia, to implement the network. They accepted an offer from EarthLink to build the infrastructure for free. Under the contract, EarthLink will be the sole ISP on the network. According to the city, the arrangement shifts the financial burden and risk to a private company, but ensures through strong agreements and the presence of the nonprofit partner that civic, public, and social missions will be achieved. As a middle ground, Milwaukee is combining elements of the Philadelphia plan with aspects of the Corpus Christi model. Midwest Fiber, a private broadband provider is paying to build Milwaukee's network, but only to lease it to several competing ISPs. The city won't pay anything to build the infrastructure but will have several choices from competing service providers.

Neighborhood Revitalization

"Broadband can play a key role in urban revitalization. Not only do the broadband-based benefits apply to blighted urban areas but the introduction of broadband can itself serve as a rallying-point that can directly contribute to the resurgence of previously blighted neighborhoods."

Edgewood Terrace, a residential complex in northeast Washington, D.C. has been a successful use of broadband to uplift a neighborhood. Through a non-profit community development corporation, a strategy was devised to turn the neighborhood around, including broadband connectivity for each residence through a community network known as "EdgeNet." Fully wired community centers in the neighborhood offer classes in career and skill enhancement. Residential broadband enables seniors to have regular checkups via video and to connect to health care providers. Edgewood Terrace has seen significant benefits from CPDC's efforts. Graduates of the IT skills program dramatically increase their incomes, on average jumping from $9,800 to $28,000. School attendance has improved as children take advantage of after school programs and online resources to improve their academic performance. Residents use broadband tools to work together for common goals, creating a safer, more involved community that has seen a decrease in criminal activity and is once again an attractive place to live.[43]

Another project in this trend is the Camfield Estates-MIT Creating Community Connections Project, a partnership between the Camfield Tenants Association (CTA) and the Massachusetts Institute of Technology (MIT), which started in January 2000. Camfield Estates is a 102-unit, predominantly African-American, low- to moderate-income housing development in the South End/Roxbury section of Boston, Massachusetts. The Camfield Estates-MIT project has as one of its goals to establish Camfield Estates as a model for other housing developments across the country as to how individuals, families, and a community can make use of information and communications technology to support their interests and needs.

To achieve this goal, a community technological infrastructure was established at Camfield by offering every family a state-of-the-art computer, software, and a high-speed Internet connection, along with comprehensive courses at the Neighborhood Technology Center, an fifteen-computer

community technology center on the premises. A web-based, community building system, the Creating Community Connections System, was also implemented specifically to create connections between residents, local associations and institutions (e.g., libraries, schools, etc.), and neighborhood businesses. The project combined these elements in an effort to achieve a social and cultural harmony that would integrate both community technology and community building by leveraging assets instead of perceived needs.[44]

Southeast Wisconsin – Regional Telecommunications Plan

Strategic technology planning is still a novelty for most for local governments but increasingly, the viability of a community is linked to its access and use of information and communications technologies. Technology today is as vital to economic growth as transportation and utility systems were in the past.[45]

The Southeast Wisconsin Regional Planning Commission implemented its Telecommunications Planning Program in September 2004.[46] It consists of three network plans: Regional Public Networks Plan, Regional Antenna Site and Related Wireless Infrastructure Plan, and the Comprehensive Regional Wireline-Wireless Telecommunication Network Plan.

Broadband Technology Opportunity Program (BTOP)

The Department of Commerce's National Telecommunications and Information Administration's (NTIA) Broadband Technology Opportunities Program (BTOP), funded by the Recovery Act, provides grants to support the deployment of broadband infrastructure, enhance and expand public computer centers, and encourage sustainable adoption of broadband service. The grants that have been awarded may act as best practice models for investment in broadband and private-public partnerships. The first round of grants was awarded in the spring of 2010. (http://www.ntia.doc.gov/broadbandgrants/)

Google Fiber-to-the- Home Initiative

In February, 2010, Google announced plans to build and test ultra high-speed broadband networks in a small number of trial locations across the United States. The company plans to build a fiber-to-the home network with 1 gigabit per second, to at least 50,000 and potentially up to 500,000 people. Their goal is to experiment with new ways to help make Internet access better and faster for everyone and to promote the following:

- Next generation apps: See what developers and users can do with ultra high-speeds, whether it's creating new bandwidth-intensive «killer apps» and services, or other uses we can't yet imagine.
- New deployment techniques: Test new ways to build fiber networks, and to help inform and support deployments elsewhere.
- Openness and choice: Operate an «open access» network, giving users the choice of multiple service providers.

TechNet

TechNet is the national, bipartisan network of CEOs that promotes the growth of technology industries and the economy by building long-term relationships between technology leaders and policymakers and by advocating a targeted policy agenda. Members include companies in the fields of information technology, e-commerce, clean technology, biotechnology, venture capital and investment banking. TechNet periodically publishes a report summarizing broadband planning activities and best practices in the state. (www.technet.org)

POLICY RECOMMENDATIONS

Federal, state and local policies should promote the vigorous availability of broadband and telecommunication services.

In spring of 2010 the FCC released, "Connecting America – The National Broadband Plan". The plan's recommendations focuses on Federal policy for promoting competitiveness, managing assets such as wireless spectrum, reforming universal service, and examining Federal laws, administrative rules and policies that may create barriers to deployment. State and local governments should undertake a similar process to identify policies and strategies they can adopt to promote the deployment of broadband and telecommunication technologies.

Broadband needs to be part of a suite of services that build community and should be part of a larger community plan.

The availability of advanced broadband technologies is essential to deliver a range of services including:

- Health Care
- Education
- Energy & Environment
- Economic Development
- Local and State Government Services
- Public Safety
- Civic Engagement

Planners should engage stakeholders from all of these areas and involvement them in efforts to plan for telecommunications and broadband services.

Address telecommunication infrastructure in comprehensive plans.

Comprehensive plans should contain an overview of available infrastructure, identify issues and future needs. The plan should contain goals and policies regarding the provision of advanced telecommunications and broadband infrastructure as well as the role of local government in meeting these needs.

Coordinate with public agencies and private industries to cost-effectively deploy telecommunications and broadband infrastructure.

Planners should advocate their communities to give forethought to broadband infrastructure and coordinate with other capital improvements. Examples of coordination include putting conduit in the ground when road projects or water and sewer projects are being designed and identifying sites for towers that encouraging co-location of equipment on public buildings such as courthouses, city halls, and water tanks. Including advanced broadband infrastructure in designs for industrial parks, public housing, educational campuses, and government facilities is a proven strategy for promoting broadband.

Incentives may be necessary to construct broadband infrastructure in certain locations.

Policy makers should recognize the impact of regulations and incentives as it pertains to the location of broadband infrastructure and the availability of telecommunication services. Since much of broadband infrastructure is deployed by private entities, incentives may be necessary to encourage investment to offset negative market forces. Such incentives may include:

- Tax breaks
- Streamline review to encourage speed to market
- Broadband Technology Opportunity Program Grants, State and Local Grants
- Revenue guarantees that address return on investments

Planners should support the use of a planning process to identify the appropriate model for providing advanced telecommunications-broadband infrastructure.

Such models may include aggregating demand, promoting public-private partnerships, or public investments in broadband networks. A planning process that engages all stakeholders, establishes goals and analyzes alternatives will ensure that the local strategy is appropriate for the community and has community support.

Educate planners, public officials and community about benefits of broadband infrastructure and issues related to its deployment.

Planners need to be aware of the importance of planning for broadband infrastructure. In order to incorporate broadband strategies into local plans they need familiarity with how various technologies operate. Understanding broadband applications is essential to working with telecommunications experts that are designing wireless, fiber and cable networks. Planners need access to educational material that can help them navigate these issues. There should be workshops at planning conferences regarding telecommunications planning and university programs should incorporate these concepts into planning curriculum.

Promote the creation of state, regional and local tasks forces to address issues with deploying broadband and promote broadband applications especially as it relates to planning practice.

Many state and localities have created task forces or steering committees for the purpose of promoting broadband applications and technologies. Planners need to be involved in these efforts. Where no task force exists, planners should organize a group to address these issues. Regional planning agencies are often good avenues for bringing interested parties together.

Revamp Universal Service Fund to more effectively provide broadband and telecommunication services to high-cost and under serve areas.

The FCC national broadband plans calls for, "… reform current universal service mechanisms to support deployment of broadband and voice in high-cost areas; and ensure that low-income Americans can afford broadband; and in addition, support efforts to boost adoption and utilization." APA should support these efforts.

SECTION 6: PUBLIC FACILITIES INFRASTRUCTURE

INTRODUCTION

It is well known that communities currently face huge infrastructure backlogs and funding shortfalls. This chapter does not dwell on this significant problem. Rather it focuses on how planners can play a more appropriate and integral role in developing a capital improvement program (CIP).

As one committee member noted, planners are among the best able to bridge and coordinate between comprehensive and strategic plans, finance/budget and line departments, local government officials and the public in terms of developing an implementable CIP. The desired training and tools planners should have to achieve this and different desired levels of involvement are discussed in this chapter.

The remainder of this introduction provides a definition of public facilities as used in this chapter and notes the major constraints of a CIP. Subsequent topics are: current levels of CIP involvement by planners; challenges in developing a meaningful CIP; desired alternatives for planners' roles in preparing a public facility CIP; case study examples; and suggested next steps to enhance the expertise of planners and their increased role in CIP development.

Definition

Since other chapters discuss utilities and transportation, these facilities are not explicitly discussed here. Rather, this chapter includes the facilities normally included under a municipal government CIP such as park and recreation facilities, libraries, public safety facilities and government buildings. In addition to buildings, public facilities could include equipment and rolling stock if it is reflected in the CIP.

A distinction needs to be made between schools, which is included in this chapter, and other public facilities. School districts are usually responsible for planning and building their facilities. In some states, school districts operate financially independent from the local governments in which they are located. However, in many cases the district is dependent on the local government to approve the final budget allocation, but is not dependent on the locality for approval of how the funds are spent. A school district capital facility monetary request can easily equal or exceed the total request of the local government's funding request for all other non-school capital facilities combined.

Constraints

Insufficient funding is a major constraint in providing public facilities. Typically, a locality's operating and capital needs exceed the willingness of elected officials to increase revenue rates (usually taxes) to fully fund the desired budget. The budget that is often first to experience major cuts is the CIP. This requires the governing body to reevaluate priorities within the community. As a result, projects in the CIP keep getting postponed, and in the competition for scarce CIP dollars, existing facilities generally lose out to new facilities to serve growth. It is important to also note that CIP funding needs are often already understated because they do not usually reflect depreciation. Unlike corporate balance sheets, most jurisdictions do not set aside annual CIP monies for infrastructure replacement for facilities that are relatively new.

Another major constraint is *increased levels of service* due to unfunded mandates (e.g., ADA) as well as local decisions. One example of changing levels of service is class size reduction, which has significant capacity and financial implications since the amount of space and cost per student increases. With school costs typically the single largest capital expenditure (for those jurisdictions funding school improvements), this has the potential to dramatically affect capital needs and costs. Another example is the increase in leisure-time participation by residents, which leads to the need for more park and recreation facilities. The list goes on and as a result CIP financial needs increase more.

Among other constraints, particularly given the inability to adequately fund the CIP request, is the *insufficient integration of current land use and/or strategic plans* to appropriately prioritize CIP projects. These are discussed further below.

CURRENT LEVELS OF CIP INVOLVEMENT BY PLANNERS

Before discussing the challenges and desired alternatives for planner participation in preparing a public facility CIP, a brief discussion is provided first on the different levels of planner involvement in the CIP process. Regrettably some planning departments have no role in the CIP process. Noted below are three general levels of CIP involvement for planners.

Minimal. At this level, the planner may be asked to "review" the draft CIP. However, the main responsibility in the preparation and adoption of the CIP is with the budget/finance department. This is a typical approach. For school districts, a demographer or analyst will usually project the increased capacity needs and recommend the location of schools based on attendance zones to the school district budget/finance personnel. There is often little if any interaction with local planning departments.

Moderate. In this level, a planning department is responsible for preparing the CIP, based on a near-term forecast of growth and discussion with respective departments. The planning department is then involved with the budget/finance department to help determine what cuts to make, since the CIP request will likely be in excess of what is eventually recommended to the elected officials (for further cuts before being adopted). This level of responsibility for planning department is far less common than that described above.

Robust. This level of participation is rare since the planning department would be responsible for preparing a CIP that more fully reflects a jurisdiction's planning policies and growth trends. Recommendations would consider various social, economic, environmental and fiscal issues to prioritize capital projects in the CIP. Both a fiscally constrained and unconstrained CIP would be evaluated as part of this robust process.

CHALLENGES

Some of the major challenges for planners—and local governments—facing the implementation of a meaningful public facility CIP are noted below.

Changing Levels of Service (LOS)

Examples of changing levels of service were noted above. It is rare when voters or elected officials are told the actual cost of a proposed LOS change, if the question is even asked. Given the sizable backlog of infrastructure needs that exist in most communities, there should be some discussion of decreasing levels of service across a number of public facility categories. Planners could be a good vehicle for this effort.

Concurrency

Usually a concurrency requirement (sometimes called an Adequate Public Facilities Ordinance (APFO)) relates to adequate capacity for utilities, transportation and/or schools. In some instances, school capacity issues have stopped desired infill even though proposed mid- and high-rise residential development would have had a minimal impact on school capacity. Another example involves road concurrency requirements, which at the adopted level of service have had the unintended consequences of forcing new nonresidential development out to greenfield areas from stagnating infill locations. The various negative costs should be considered in many cases. The true effect on the need for new capital facilities and the underutilization of existing facilities are areas in which planners are well suited and can become more active.

Coordinated Planning

Utility departments, school districts and local governments within the same area frequently have overlapping borders and/or are competing for approval from regional and/or state agencies for scarce dollars. A utility district may want more new development (i.e., users) to help pay for existing capacity while the jurisdiction wants growth in a different area. A school district may not want to redraw boundaries and utilize all unused capacity even though it would help to reduce sprawl, an objective that may be favored by the jurisdiction. Planners need to become more active in dealing with these different entities so that public facilities are more efficiently utilized and planning objectives realized.

Land Use "Cherrypicking"

In some states, nonresidential development generates fiscal surpluses and residential development generates fiscal deficits. That is why a balanced growth land use plan is needed. In some states, retail sales tax is very important and can lead to deal making to attract a good retailer. Without knowing the fiscal impacts of land use decisions, these deals and incentives may lead to worsening fiscal conditions. When planners can show a balanced land use plan that is fiscally sustainable, the "giving away the store" mindset may diminish.

Political Reality

Unfortunately, most elected officials are extremely concerned about the next election, which is usually less than two years away. Consequently, they do not like to raise taxes and therefore the public facility financial shortfalls get worse. It is significant to note that many bond ballot questions that itemize the particular facilities to be funded are often approved by voters. Many attribute this to overall public distrust of how general tax dollars are spent versus voting for a specific set of improvements to be funded with bond proceeds. As part of the CIP process, a dialogue with the public is needed to show how public facility capacity needs and dollar shortfalls are derived and what alternatives there are with fewer dollars (i.e., decreasing levels of service by type of facility). This would enlighten both voters and elected officials and possibly instill more confidence in interested parties. Part of this discussion could include showing how different alternatives affect planning and other objectives. Planners would be a good conduit for this type of activity.

Planner's Expertise

In considering what department is a good vehicle to plan and coordinate future CIPs, the planning department is an excellent candidate. This department should be most aware of current community growth trends and spatial patterns. Planners that are already involved in the comprehensive plan with related community and stakeholder meetings should have a good understanding of the pulse of the community, its diversity as well as needs. Planners should be heavily involved in forecasting the increased demands for service and facilities, hopefully from a spatial perspective. A city manager's office does not usually have the time, mandate, or staff for this. The budget/finance office is mostly concerned with next year's budget and the mechanics of bond issuance. Line departments are geared to their particular service. Unfortunately, most planners have had little or no course work or experience in municipal finance or economic and fiscal analysis. In many jurisdictions, notably in the inter-mountain west, planners are used primarily as project managers, managing current development caseloads. This challenge is addressed below. Whether a school district has a planner on staff or coordinates with the respective jurisdiction(s), the same type of activity should be pursued to present a full picture of alternatives.

Revenue Availability

One of the challenges facing many local governments is the lack of revenue sources dedicated specifically for capital facility needs. Examples of dedicated revenue sources include impact fees, a debt service levy (e.g., property tax increment specifically for debt service) and variations of a local option sales tax. It is important to note the revenue sources/financing mechanisms available to local government vary dramatically from state to state. Too many local governments are unable to adequately fund their CIPs due to a lack of dedicated capital revenue. They are often forced to fund the CIP with transfers from the General Fund based on whatever operating surplus exists in a given year. Furthermore, the use of non-local revenue sources in funding a CIP often requires the involvement of and/or coordination with other non-local stakeholders such as state agencies, which presents additional challenges.

INCREASING PLANNERS' ROLES IN PREPARING A PUBLIC FACILITY CIP THROUGH AN INTEGRATED MODEL

As noted above, in many cases planners have little or no role in preparing a public facility CIP. What is needed is a model that integrates the planning department into the CIP process with other departments within the organization, each performing a specific function. This is a collaborative, integrated approach bringing together the departments that are responsible for planning, financing, and constructing the capital improvements, as well as the departments that are responsible for programming and maintaining the capital assets once they are built.

The three alternatives briefly discussed below identify greater responsibilities for planners in preparing a public CIP. In all cases, ongoing and frequent interaction with line departments—those providing direct service and facilities to residents and businesses—as well as budget/finance departments will be necessary.

Coordinated Inclusive CIP. The planning department's role under this model is to plan the public facility strategy in accordance with comprehensive plan or sub-area plan policies to ensure coordination with a number of items such as land use, comprehensive plan standards, conservation goals, urban design, phasing, and other capital improvements. The planning department may or may not be charged with responsibilities for identifying funding for the capital improvements, and may or may not be the lead department in the process. However, CIP decision-making is typically done by committee, and the planning department plays an important role.

Alternative Growth and Fiscal CIPs. In this alternative, planners would consider more "what ifs" in terms of unconstrained and constrained funding. Alternative development scenarios in terms of type, location and pace of growth would be evaluated. In addition, a fiscal impact analysis calculating the demands for services—including capital facilities—and the resulting revenues as well as capital and operating costs would be conducted and reflected in the CIP. This approach would present funding needs under different scenarios, which could then be refined as the CIP process continued beyond the draft stage. The approach would reflect a more realistic CIP than the other alternative because it would likely force explicit changes to levels of service, growth location and pace, rehabilitation versus new construction, staging, and funding strategies to address funding constraints. At this level of involvement, the planning department would be an important entity in the process. The bottom line would be that unless the CIP is fundable, it will not be implemented.

Matrix Process CIP. The most comprehensive approach would be to include not only the above elements, but add other considerations and criteria in developing the CIP such as: socioeconomic data; major environmental factors; potential for disinvestment, stagnation and/or growth; effect of Transit Oriented Development; incentive zoning; etc. This approach would necessitate more public involvement if qualitative factors such as perceived quality of life, etc., are to be considered. The level of effort by planners in developing "what if" scenarios to formulate the CIP is typically more extensive than the other alternatives discussed but well-suited to a planner's comprehensive view of the community.

Relating to schools, school planners should interact with jurisdictional planners. School planners would then better understand how their recommendations for new schools, expansions and/or rehabs interplay with the jurisdiction's plans. An example of this is Clark County, Washington, where a collaborative planning process has recently been established called the Clark County Quality Schools Program. Under this program, the County and its cities' planning agencies meet regularly with representatives from school districts in the County to discuss planning issues. This pilot program, which was initially funded by the state, has been continued with local funding.

CASE EXAMPLES

Several examples from current practice are noted below. These examples primarily reflect the coordinated CIP approach of the integrated model. The general approach of the three case examples is consistent although the complexities generally increase as the size of the jurisdiction increases and as state regulations vary. For example, the requirements and possibilities in California are different than in Arizona and Maryland. One of the suggested next steps discussed subsequently is to provide additional examples of best practices for planners to increase their roles in developing a public facility CIP.

Case Example 1: Anne Arundel County, Maryland

Overview

Anne Arundel County, Maryland, over 360 years old, is 416 square miles with a 2010 population of approximately 495,000 and a labor force of 273,000. The County serves both the Washington and Baltimore metropolitan areas.

In Maryland today, most of the counties and the City of Baltimore are the principal units of governmental management, with budget control over line departments for virtually all local services including: schools, public utilities, land use, protection of natural environment, open space and recreation, housing, transportation, economic development together with numerous community services including health, fire and police protection, libraries and more.

Anne Arundel County operates under a Charter form of government adopted in the mid-1960s. The Charter lays out the structure of total operations of the county government, in which the elected County Executive is chief executive officer for all line departments. The Charter also grants the county planning and zoning powers and the county code designates the Office of Planning and Zoning to prepare and periodically update a comprehensive plan (General Development Plan) to guide growth and development.

The County has had a General Development Plan (GDP) since 1968 with updates in 1978, 1986, 1997 and most recently in 2009. Historically, the County has revised or amended the GDP to reflect demographic, economic, social and environmental changes that have occurred. In a county with over 500 miles

of shoreline, the protection of shoreline and water quality has become an even greater focus through the years. The 1997 GDP also incorporated policy recommendations that comply with the State of Maryland's Economic Growth, Resource Protection and Planning Act of 1992 and related "Smart Growth" legislation. Subsequent to the adoption of the 1997 plan, the county adopted 16 Small Area Plans (SAPs) which are community based and serve as guides to how individual properties should be used and what facilities may be needed.

The 2009 GDP provides a greater focus on integrating land use planning with water resources planning. In addition, the 2009 GDP includes a "Concurrency Management Plan" to ensure the adequate provision of public facilities. The element analyzes levels of service for facilities, existing and future demand for facilities, long-range capital improvement needs, and potential revenue strategies to fund capital improvements. It is intended to link the GDP with the five-year CIP and annual capital budget.

Under the County Charter, the Office of Planning and Zoning (OPZ), the Department of Public Works and the Budget Office have responsibility for managing the preparation of the annual Capital Improvement Program (CIP), its submission to the County Council, and its eventual adoption of a one-year capital budget and a five-year CIP.

Under Charter authority, a Planning Advisory Board (PAB) of seven local citizens is appointed by the County Executive to review the County's GDP, typically revised and updated on a ten-year cycle, and the capital program and budget prepared by the County's line departments and the Budget Office . The PAB, assisted by OPZ staff, review the capital budget and program for public facilities based upon the County's adopted GDP and Small Area Plans (SAP). The CIP with the PAB's advice contained in an Advisory Letter is then transmitted to the County Council via the County Executive.

This process provides for staff of the Office of Planning and Zoning to review the CIP in the context of the SAPs and the current GDP thus more readily providing for implementation of the plan through the CIP. It also provides review and advice from citizens who have knowledge of the GDP and are charged with linking the two documents.

Anne Arundel County CIP Process

Each department or agency prepares a preliminary capital budget and program (CIP) for areas within its responsibility, e.g., schools by the Board of Education, parks by Recreation and Parks Department, roads by Public Works Department, water and wastewater by the Utilities Department, etc. After costing by the Department of Public Works (DPW), the preliminary requests are presented by the user agencies to the Capital Improvement Oversight Committee (CIOC), an internal committee comprised of the directors of OPZ, DPW, Budget Office and the County Chief Administrative Officer. The Budget Officer and the Chief Administrative Officer revise the preliminary budgets based upon the recommendation of the CIOC and affordability.

The revised CIP is then presented to the PAB by the user agencies and the OPZ staff for their review and recommendations focusing on debt affordability, changes from the previous CIP and how the proposals implement the GDP. The PAB issues a draft Advisory Letter containing their recommendations to the Budget Officer and the County Executive. After state and other funding is known, the County Executive sends a final CIP to the PAB. After consideration of any changes in the CIP, the PAB issues a final Advisory Letter.

The County Executive presents the budget and the CIP, with the PAB Advisory Letter to the County Council during his budget message on May 1. During the County Council's month-long public deliberations, members of the PAB usually make a presentation, highlighting the issues in their Advisory Letter. A final budget and CIP are then adopted at the end of May.

Conclusions

A major strength of the Office of Planning and Zoning is its authority to have impact and access across all departments, creating an opportunity to work with other agencies to plan for the future. Likewise, one of the strengths of the Anne Arundel County CIP process is that it provides for collaboration among departments. This has the potential to be more constructive and far reaching as they work together. The annual planning and budgeting process provides an opportunity to annually assess how effective implementation of the GDP is year after year. The iterative nature of the CIP process allows significant opportunity for collaboration within the county government and for aligning project needs with funding and debt affordability. An added benefit is that the process gives planners an opportunity to provide service and professional advice to the Chief Administrative Officer, the County Executive and the County Council.

The CIP program is closely linked to the GDP through the staff of OPZ and the citizen Planning Advisory Board. This board is able to review and comment on the draft document prior to it being presented at public hearings. The PAB has an opportunity to see the CIP as a whole document weighing the projects in the context of the GDP and the timing and importance of one project with another. This is a clear advantage as public input during the public hearing process tends only to be advocates for or against a particular project without consideration of the CIP as a whole. Some citizens who participate in the public hearings to advocate for particular projects do understand and comment upon the connection between the CIP projects and the GDP.

Case Example 2: Queen Creek, Arizona

Overview

The Town of Queen Creek, Arizona, with a population of approximately 26,000 is a growing suburb of the Phoenix metropolitan area. Since 2000, the Town's population has increased fivefold. Arizona has adopted Growing Smarter statutes that require local communities to include several new elements within the community's general plans. Two of these elements are the "Growth Areas" and "Cost of Development" Elements.

In Queen Creek, the planners are the project managers for creation and implementation of the General Plan. This role

requires the planner to serve as the lead for the organization in outreach to the community on all facets of the General Plan. Planners serve as the key organizational lead to the community and the development community and view all as stakeholders in building the community.

The role of the planner is to assist in identifying areas within the community that will need certain types of infrastructure. For example, a neighborhood meeting may result in a determination that additional trails or parks are needed to link other public infrastructure like schools to the trails system. The planner attempts to capture all those needs, identify those in the General Plan, serve as the lead for developing costs for that infrastructure if the infrastructure is triggered by new development in particular. The planner also plays a fundamental role in developing growth projections by fiscal year in helping to create the 5-year CIP. This involves evaluating the quantity of new housing starts annually and correlating those projections with adopted projections from the development impact fee methodology studies.

Queen Creek CIP Process

The development of the community's CIP starts with the General Plan (referred to as the Comprehensive Plan in other states). The results identified in the General Plan are translated to the 5-year CIP, which is adopted and updated annually by the Town Council. In Arizona, major updates to the General Plan also require a public vote. The process requires the Town Council to ratify the update to the General Plan, including some fairly specific CIP elements that are included in it, and then the plan is scheduled for an election, typically after a period of at least 120 days. Once voters approve the plan, the elements of the plan are considered as part of the annual budgeting process several weeks and months later. All in all, the timing may be 3 years or longer before actual infrastructure is approved (and longer for construction) that citizens desired and provided input on as part of the outreach process and update to the General Plan. Arizona law also requires communities to develop a process for annual "minor and major amendment" updates to the General Plan that are requested by landowners. This annual review can provide assistance in developing modification to the CIP based on development trends and growth nodes.

The actual creation of the final, Town Manager recommended CIP, is managed by the CIP Division, but developed in consultation with the Planner/Project Manager (and many other staff within the organization). Funding for infrastructure is identified by source and project and noted explicitly in the CIP. The timing of the development of the infrastructure is also noted within the CIP. Because Queen Creek relies significantly on development impact fees (ranging from 10 to 25 percent of the annual CIP budget), specific expenditure and detailed accountability is determined and linked with the applicable statutory requirements for expenditure of those funds.

Recognizing the lag in timing during the General Plan update process noted above, Queen Creek still updates its 5-year CIP on an annual basis along with the entire fiscal year budget development process. The General Plan is always considered and it is the planner's role to provide recommendations to the CIP Division and ultimately the Town Manager. The planner's review focuses on growth and development changes occurring relative to implementing the General Plan and changes to the plan that impact the CIP that may be initiated by the private sector as part of the annual "major or minor plan update process."

Conclusions

The significant strength of the Town of Queen Creek process in developing the CIP is that it truly starts with the creation of the General Plan. The public involvement process implemented by the Town (including the 5-year town-initiated major updates) includes open houses, focus groups, web-based and in-person surveys, attendance by planners at community events and gatherings, including the more routine and traditional Planning Commission as well as updates with the Town Council at their normal meeting times. Depending on the schedule and phase of the update to the General Plan, focus groups include various stakeholders affected by the update to the General Plan, not just anonymously selected citizens. For example, because the Town is only at about 40 percent residential build-out, major land developers and owners are asked to participate in a unique "developers focus group." Input by citizens on the final CIP starts with the Council Budget Committee over several meetings. Once the Council Budget Committee finishes their work, a recommendation is presented to the full Council for final approval of the CIP along with the entire fiscal year's budget.

There are challenges to this approach related to citizen engagement in assisting to develop components of the CIP at the General Plan level. Some of the more notable challenges include the staff time to obtain a representative cross-section of the community. This overall citizen involvement process will take 12-18 months. Depending on when the first phase of citizen involvement occurs, if some of the more profound input is taken early in the process, sometimes there is criticism towards the end of the process about the early input being stale. This is often the nature of a dynamic community but this is particularly challenging when planners are working with community groups that desire to have input on specific infrastructure components in the plan, only to find out that it may be well over two years before the final plan is actually ready for consideration within the formal CIP and budget.

Over time Queen Creek has moved towards a committee process, with various disciplines within the organization providing the necessary technical input needed to develop the final CIP for consideration by the Town Council. The planner's role is that of a key member of this committee that provides input on the General Plan status and private development trends within the community.

Case Example 3: City of San Diego, California

Overview

The City of San Diego is large geographically, at approximately 340 square miles. The population is over 1.4 million. Unlike

most states, redevelopment agencies can play important roles in helping to fund capital infrastructure. Also there are many separate districts (e.g., library) with funding capabilities, as a result of Proposition 13 revenue limits.

The City's General Plan establishes citywide policies, but does not direct land use for specific parcels or areas. This level of specificity occurs at the community plan level. The City has 47 Community Plans, which mirror the General Plan elements at the more focused community level. The Community Plans contain land-use policies that affect individual parcels, layout the transportation network, and describe public facility requirements. A program-level Environmental Impact Report is prepared for each Community Plan update as input to the decision-making process. Zoning is reviewed, and if necessary, revised to implement the Community Plan policies each time the plan is updated or amended. Legally, the Community Plans in aggregate comprise a component of the General Plan's Land-Use Element. Each Community Plan has an associated Public Facilities Financing Plan that establishes the nexus relationships and funding mechanisms for community public facilities, including impact fees or facility benefit assessments.

San Diego CIP Process

The City of San Diego's CIP process is a multi-departmental effort with the Planning Department playing an integral role. Elements of the City's General Plan such as the Public Facilities, Services, and Safety Element; Mobility Element; Recreation Element; and Conservation Element provide most of the service standards and policies that guide public facilities and infrastructure. The CIP must be consistent with the General Plan, as certified by the Planning Commission each year.

San Diego's planning department is called the City Planning and Community Investment Department (CPCI), and includes four divisions – Planning (including the Mobility team), Urban Form (which includes parks and open space planning), Economic Development (which manages the Community Development Block Grant program among its many duties), and Redevelopment (which manages the tax increment funds and most of the redevelopment project areas). The Department also contains the Public Facilities Financing Section which is responsible for calculating and maintaining impact fees, facility benefit assessments, development agreements, reimbursement agreements, and other sources of capital funding. The Public Facilities Financing Section also has a planner who serves as a liaison with other departments to coordinate their public facility needs with the community plans and the General Plan. This structure integrates the visioning and policy role of long-range planning with some of the major financing implementation tools.

Other City departments play important roles in the CIP process. For the purposes of the CIP, City departments are divided into three functional groupings: (1) Asset-owning departments, (such as the Park and Recreation, General Services, Storm Water, Library, and Police and Fire departments), (2) Financial Departments (such as Budget, Comptroller, and Debt Management), and (3) Service Departments (such as Engineering and Capital Projects, Development Services, and the City Planning and Community Investment Department (CPCI). The asset-owning departments are responsible for programming and maintaining their respective public facilities, and work with CPCI to develop standards and plan their facilities. CPCI, as a service department, looks to the asset-owning departments as clients, helping them plan and fund their facilities, in accordance with the community plans, the General Plan, and each community's Public Facilities Financing Plan.

The Engineering and Capital Improvements Department (E&CP) is responsible for managing the design and construction of public facilities. They are the lead department for managing the CIP; however, they are not the sole decision-maker. The CIP decision-making process at the staff level is the responsibility of the Capital Improvements Review and Advisory Committee (CIPRAC). It is comprised of the department directors (including the Planning Director), and is chaired by the City's Chief Operating Officer, or designee. CIPRAC meets monthly and provides a high-level, cross-functional review of the CIP prioritization process.

The asset-owning departments propose their CIP projects to the CIPRAC. The Redevelopment Agency may also propose projects funded by tax-increment. CPCI's Facilities Financing Division confirms funding availability from development impact fees, benefit assessment accounts, reimbursement accounts, and other sources. From this "needs" list, a short-list of preliminary priority projects is established and proposed to CIPRAC relative to the projected revenues available. CIPRAC reviews the proposals and votes whether or not to add a project to the fiscal-year CIP based on City Council policies and a scoring system. CIPRAC's recommendations are then presented to the Mayor, who then confirms the recommendations and proposes them to the City Council for adoption as part of the annual budgeting process. The Planning Commission reviews the CIP to determine consistency with the General Plan prior to Council approval.

A CIP allocates projects into three categories reflecting the phases of planning, design, and construction – (1) preliminary design and engineering, (2) final design and engineering, and (3) construction. A project is reviewed and can be recommended for one phase at a time, or any combination of the three phases depending on available resources and priorities. CIPRAC recommends to the Mayor and City Council which CIP projects, and what phase, to implement. If proposed by the Mayor and affirmed by the City Council at a public hearing, the CIP is adopted and its projects are implemented.

Conclusions

The San Diego CIP process includes many participants. The process replaced a less organized approach and 2009 represents the first year the CIRPAC process is fully operational.

A number of CIP evaluation criteria are used to evaluate and prioritize capital projects. Criteria include health and safety, community investment, revitalization opportunities, consistency with the General Plan, regulatory and mandated requirements, and other planning-related criteria.

However, financial criteria are also included, such as funding availability, leveraging of other funds and grants, project readiness, opportunities for economies-of-scale, and availability of funding for ongoing maintenance. The major sources of capital funding are DIFs (development impact fees) and Benefit Assessment Districts. The CIP is dependent on the market which does not necessarily coincide with facility planning expectations and thus leads to a fiscally constrained program.

SUGGESTED RECOMMENDATIONS

Several next steps are suggested and discussed below. They are not meant to be all inclusive, but rather reflect some of the more obvious and immediate efforts that could be undertaken to expand planners' roles in CIP development.

Expand Degree Coursework and Internship Opportunities

As the above discussion has indicated, planners with appropriate training can and should be a vital cog in the CIP process. This necessitates a level of skill regarding demographic forecasting; assessing capital facility levels of service and costs; fiscal analysis; economic analysis; revenue source analysis; sustainable practices; and environmental issue analysis. Few academic programs provide even a basic foundation for many of these categories. Each of these categories does not necessitate one individual course, rather these elements could be integrated together.

In addition, there is an opportunity for universities to do more and partner with local governments more aggressively with internship programs in local planning departments as well as in other related areas that manage the infrastructure development and forecasting programs related to the CIP.

Provide Training Courses

Since many planners do not have the needed experience given their past academic training, APA should provide or facilitate the development of training courses to address these needs. The courses would encompass the categories noted above.

Expand Advocacy Program

APA should develop material that planners can provide to or use in discussions with jurisdictional employees, elected officials and citizens which describe why planners are an important cog in developing meaningful public facility CIPs.

Develop a Best Practices Manual for Planners

A "Best Practices Manual" is needed to provide not only existing case examples, but also to explore desired expanded approaches for planners. The latter would include showing how matrices can be developed to reflect a host of factors which can (and should) be considered in developing meaningful CIPs. This would include examples of how variables can be changed and the potential impact of those changes.

Provide Information on Revenue Alternatives

APA should provide a document that educates planners on the various revenues that may be available for capital facilities. Tradeoffs would be noted. Two members of this committee have worked on a previous similar effort for APA toward this end, which resulted in a succinct written product.

SECTION 7: ENDNOTES

ENDNOTES

1 http://www.infrastructurereportcard.org/

2 "American Planning Association Surface Transportation Policy Guide," 2010, p. 1.

3 "American Planning Association Surface Transportation Policy Guide," 2010, p.11.

4 *APA Policy Guide*, p. 26.

5 HOT lanes are a form of congestion pricing and have variable rates based on the level of congestion or the speed of travel time in the toll lane. HOT lane users are assessed a fee for the convenience of not having to be stuck in traffic congestion. HOT lanes require high-tech infrastructure for monitoring and reporting fees as well as assessing and enforcing fees, which may require a registration process or membership number. (In some cases, HOT lane systems have been criticized from a social justice perspective for resulting in inequitable access to low-income and minority groups).

6 See Barbour, E. and Teitz, M., "Blueprint Planning in California: Forging Consensus on Metropolitan Growth and Development," Occasional Paper, Public Policy Institute of California, San Francisco CA, June 21, 2006.

7 City of San Diego, General Plan, San Diego CA, 2008, p SF-3.

8 City of San Diego, General Plan, San Diego CA, 2008, p SF-24.

9 Power Systems Engineering Research Center, *U.S. Energy Infrastructure Investment: Long-Term Strategic Planning to Inform Policy Development*, March 2009. A PSERC White Paper, downloaded June 28, 2010 from http://www.pserc.wisc.edu/research/white_papers.aspx

10 U.S. Environmental Protection Agency (EPA) at http://cfpub.epa.gov/npdes/greeninfrastructure/information.cfm#glossary

11 "Cost" includes capital, operational and replacement/upgrade costs.

12 The 'butterfly effect' refers to the idea that a seemingly small change in one system, such as a butterfly flapping its wings, could begin a series of reactions that result in a significantly different outcome or future. The concept originated in Ray Bradbury's 1952 short story "A Sound of Thunder" and was reflected in the scientist Edward Lorenz' research on weather.

13 "Health Impact Assessment of Greenspace", http://www.greenspacescotland.org.uk/upload/File/Greenspace%20HIA.pdf

14 Few international agreements with regulatory power exist - two examples are Ramsar (wetlands) and CITES (trade in endangered species).

15 LEED-ND (LEED for Neighborhood Development) is one of a suite of green building standards developed by the US Green Building Council under the Leadership for Energy and Environmental Design initiative.

16 The Sustainable Sites Initiative is the LEED equivalent for projects that do not involve a building. SSI was developed by the American Society of Landscape Architects, National Wildflower Center and the National Resources Defense Council - as of early 2010 it was in the pilot stage.

17 http://olympiawa.gov/community/sustainability/~/media/Files/PublicWorks/Sustainability/SAM2.ashx

18 In a White Paper for the Presidential Climate Action Partnership, the authors recommend adoption of green infrastructure as a federal policy proposal, defining the term as "community forestry, low-impact development, preservation of green space, innovative water/sewer systems, landfill gas recovery, solid waste recycling, urban wildlife corridors, and other local activities that reduce GHG emissions. U.S. Climate Action – From the Ground Up, Federal Policies to Promote Local Government Climate Protection, Ward, Wyman, Brown & Seth (Summer 2008).

19 The U.S. EPA has authorized inclusion of urban greenspace and tree canopy projects as qualifying measures in State Implementation Plans that diagram state strategies for meeting ozone attainment levels under the federal Clean Air Act.

20 Green Infrastructure Statement of Intent, which authorizes EPA awards or recognition grants.

21 Ibid.

22 http://www.phillywatersheds.org/ltcpul

23 http://www.sustainablecities.org.uk/water/surface-water/using-gi/

24 http://www.greenroads.us

25 White Paper available at http://dbadvisors.com/climatechange

26 http://www.oakgov.com/peds/assets/docs/es_docs/gi_econ_impact_sum.pdf

27 http://economyleague.org/files/Implementing_Green_Infrastructure-Final-Report-October_2009.pdf

28 Unmanaged urbanization and the proliferation of impermeable surfaces has made stormwater runoff the nation's top water pollutant, U.S. Public Health Reports, May-June 2002, Volume 117.

29 A 2007 study by the California Air Resources Board and the American Lung Association, concluded that attainment of particulate matter and ozone pollution standards throughout the State would prevent 8,800 premature deaths, and avoid 7,600 hospital visits, 210,000 cases of asthma and other lower respiratory symptoms, 17,000 of acute bronchitis, 4.7 school absences, and 1.4 million missed work days. A 2010 study estimates that air pollution costs across the nation total roughly $50 billion each year.

30 "Planning and Financing Future Urban Forests – a Capital Asset Hybrid Proposal, Kenneth A. Knight, AICP, and the U.S. Forest Service Pacific Southwest Research Station Center for Urban Forest Research, June 17, 2008.

31 John Horrigan, Wireless Internet Use, Pew Internet & American Life Project, July 22, 2009, http://www.pewinternet.org/Reports/2009/12-Wireless-Internet-Use.aspx, accessed March 24, 2010.

32 National Broadband Plan, Chapter 5, Spectrum, http://www.broadband.gov/plan/5-spectrum/, accessed March 26, 2010.

33 Two Studies That Deepen Our Understanding of Barriers to Broadband Adoption as viewed on FCC, March, 2010

34 Comprehensive Plan (2007-2027) - City of Coeur d 'Alene, as visited March 2010

35 FCC Issues Declaratory Ruling Establishing Timeframes for State and Locality Processing of Applications for Wireless Towers , FCC, November, 2009

36 Technet, Top 10 States, viewed March, 2010

37 Pew Internet & American Life Project; Report: Internet, broadband, and cell phone statistics, viewed March, 2010

38 FCC Public Notice, released December 18, 2009

39 Press Release: Commerce Announces Recovery Act Investment in California to Expand Broadband Internet Adoption and Economic Opportunities as viewed March, 2010

40 Broadband, What's Your Need for Speed? as viewed on FCC, March, 2010

41 National Broadband Plan, Chapter 5, Spectrum, http://www.broadband.gov/plan/5-spectrum/, accessed March 26, 2010.

42 Critical Mass: How Digital Technology Will Redefine The Way You Live. Retrieved from www.erepublic.com, 2007

43 Broadband Benefits: Urban Revitalizatioin, retrieved from www.e-NC.org, 2008

44 Community Technology and Community Building, retrieved from www.publicsphereproject.org,

45 A Technology Plan for your City or Region is Essential, retrieved from www.urbaninsight.com, 2008

46 Southeast Wisconsin Regional Telecommunications Plan, retrieved from www. co.washington.wi.us, 2006