Planning and Financing Energy Efficient Infrastructure in Appalachia

Final Report

With Academic Partners:

Regional Research Institute, West Virginia University
Virginia Polytechnic Institute and State University

December 30, 2011

Prepared for the Appalachian Regional Commission under Contract CO-16504-09

Table of Contents

List of Figures

List of Tables

Executive Summary

This report "*Planning and Financing Energy-Efficient Infrastructure in Appalachia," (2011)* was prepared by The Cadmus Group, Inc.[1] under contract to the Appalachian Regional Commission (ARC). The goal of the study is a practical framework to help local governments within the Appalachian Region assess, plan, and finance energy efficiency infrastructure and facility improvements.

Chapter 1 identifies institutions and the tools they offer for *implementing* energy and water efficiency. To select the ones most valuable for local governments, tools had to meet four criteria: longevity (established track record and adequate future funding); credible content evolving in response to user needs; customer assistance and partnership potential; and low- or no-cost status. Each of these criteria is explained more fully at the beginning of the chapter.

Chapter 2 provides examples of eight energy conservation measures (ECMs)—with documented costs and financial returns—being implemented in or near the Appalachian Region. Cost savings for each ECM are also extrapolated to reflect potential savings across the Appalachian Region if local governments adopted, to some degree, each ECM.

Chapter 3 presents case studies of Appalachian counties that are pursuing energy-efficient infrastructure, and assesses their performance using the assessment framework introduced in Chapter 2.

Chapter 4 introduces a self-assessment system—a framework of performance measures—for use by county or municipal governments, to assist them in identifying, implementing, and assessing progress towards energy-efficiency goals. This framework encourages local governments to:

- Develop and promote a culture of energy efficiency and sustainability, within government and as public discourse
- Assess energy use and retrofit the existing building stock
- Implement efficient water and wastewater infrastructure, including stormwater control and low-impact development
- Include renewables as part of their energy planning
- Strive for high-performance and high-profile new construction
- Lead by example through development of policies encouraging efficiency in all sectors.

Using this framework, Chapter 4 assesses the performance of the four case study counties from Chapter 3.

Chapter 5 discusses partnership and financing opportunities, and provides conclusions and recommendations that include the following observations.

Energy efficiency is a source of wealth. If applied across the Appalachian Region, the energy conservation measures described in this report could result in significant wealth, with positive consequences:

- Cost savings, used to fund further local government operations and services, is a measure of higher performance, and signals accountability to taxpayers. Case study Calhoun County, AL is an example of the cost savings and voter satisfaction available as the result of implementing simple energy-efficient building retrofits.
- Energy savings equal carbon emissions savings. As a condition of receiving Federal and/or State funding, local governments must increasingly respond to Federal and State mandates that require them to pledge reductions in both energy use and carbon emissions. Case study Hamilton County, TN began to transform itself in response to such Federal mandates.
- Cost savings can create more investment, and more jobs. In some cases, these jobs—such as a local government's choice to hire an energy manager—may be a direct result of savings now reinvested in human "capital." But becoming energy efficient may in the longer term bring previously unimagined sources of employment.

[1] Team members Regional Research Institute, West Virginia University, and Virginia Polytechnic Institute and State University assisted in research conducted for this study.

Key Findings

A number of key insights and recurring themes come from the resource/tools review (Chapter 1) and the literature review (Appendix A). Some of them relate to the strengths and weaknesses of the existing literature and resources. Other insights recognize the challenges in planning and financing energy efficiency efforts in Appalachia. The self-assessment system developed as a result of this study and presented in Chapter 4 is based on these themes and designed to be relevant to counties in the Appalachian Region.

Implementing energy efficient infrastructure in Appalachia

One of the central questions of this study was "**what actions and efforts are best for implementing energy efficient infrastructure in Appalachia?"**

The literature and resource review provided some potential answers to this question. Recurring themes from the literature and resources are the following:

- **The importance of benchmarking and measurement in setting performance goals, and in knowing what to retrofit.** Benchmarking energy and water use is the first action step. Metering at the building level yields more detailed, and therefore more useful, data. Measurement can uncover leaks and inefficiencies, and even utility billing errors. Performance goals need to be established, and are more meaningful when energy use can be compared to others' performance; they should be tracked continuously. Though relatively unglamorous, this is the one of the most effective steps towards energy efficiency.
- **The potential of energy efficiency in the water and wastewater sector.** Energy use for water and wastewater treatment can be a large proportion of a county government's operating costs, and is therefore the area of great potential benefit to the community.
- **Looking at the holistic picture yields biggest results**. Pursuing strategies based on the relationship between disciplines and departments—such as acknowledging the impact of stormwater management and waste management on energy use—may lead to even greater and more lasting savings from interacting efficiencies.
- **Collaboration not only across disciplines, but between the public and private sectors**, will benefit both, and encourage public awareness, public discourse, and a lasting culture of energy efficiency.
- **New financing instruments are available, but their availability varies widely, by state and energy supplier.** State energy offices provide varying levels of support for financing. Some utilities offer incentives, rebates, and other programs; others do not. This variation means that local governments must educate themselves not only in the financial instruments available, but also must determine which financing strategy makes the most sense for the retrofits they wish to undertake. Local governments must also gauge what their citizens are willing to sanction as capital expenditures.
- **Cost-benefit analyses are essential tools** of persuasion for policy makers and electorates alike.
- **Leading by example—through pledges, active management, and policy development—**draws a roadmap for carbon emissions reduction activities that businesses and investors can also follow, and is thus likely to encourage private sector participation, increasing county-level carbon emissions reduction. It also signals, to potential investors, the attractive presence of leadership.
- **Resource recovery and locally-appropriate renewables —**such as combined heat and power strategies, biomass power, and biogas installations—are innovations where Appalachia, because of an abundance of natural resources, is particularly well suited to gain competitive advantage.

Chapter 1 and Appendix A elaborate on the strengths of the existing literature and resources. The general weaknesses and gaps noted are presented below. These include gaps in literature and resources and challenges in planning and financing energy-efficient infrastructure in Appalachia.

Gaps in literature and resources

- **Appalachia-specific content**. The greatest overall weakness in the available sources on planning and financing energy-efficient infrastructure is the lack of region-specific content for Appalachia. Many standards, and certainly most green building rating systems, make implicit assumptions; but for the purposes of this ARC study, their assumptions may conflict with human or structural realities in Appalachia. For example, density is considered a goal of sustainable planning. The Leadership in Energy and Environmental Design (LEED®) rating system favors development density and awards significant points for public transportation. Water infrastructure under most energy efficiency standards and planning literature is considered to be centralized. Yet a significant proportion of the population of Appalachia does not have access to centralized water infrastructure, nor to public transportation. As in much of the United States, land use is medium or low, rather than high density.

  Is it possible to have good models for planning and financing energy-efficient infrastructure based on the realities of human settlement and land use in Appalachia? Yes, but they will be unique to the social and economic conditions found in Appalachia: smaller scale, decentralized, and cost-neutral (so that savings cover the costs).

  In this and in other respects, Appalachia is in a favorable position, since these and other attributes of the region can work to the advantage of Appalachian counties now and into the future. Many major U.S. cities are experiencing the deterioration of their centralized water and energy infrastructures. In most major east coast cities, measurable rainfall—in some cases, as little as one-quarter inch per hour—overloads the capacity of centralized urban water systems; this results in sewer overflows that pollute receiving rivers and streams. The electrical grid is unreliable in summer, when loads are high. Why should Appalachia rush to catch up to centralized infrastructure as a model, particularly for water management? Greater energy savings and even greater environmental benefits may exist in implementing decentralized options, including onsite renewables and low-impact development. Appalachia can leapfrog the old way of thinking to the future.

- **Synergistic effects of energy efficiency**. The second weakness is that the literature on energy-efficient infrastructure does not fully consider the synergistic effects on energy efficiency of other sustainable practices. Studies remain siloed for the most part. Energy efficiency is only beginning to partake in the kind of holistic thinking that has made possible, for example, the production of energy from waste, or the redefinition of waste as a resource. (More linkage between disciplines will result in these "paradigm shifts," where what is waste product in one process may become fuel for another.) Much has been written recently about the strong link between energy and water management, and the literature review below reflects that. But energy management in the coming years must explore and take advantage of the energy and cost savings inherent in other building-related choices such as land use and planning, building siting, and materials selection. All of these affect energy efficiency, particularly in low-density Appalachia.

- **Relationship between energy efficiency and environmental contamination**. A third gap is the absence of literature on the relationship between energy efficiency and environmental contamination. Very few are studying this issue. A return to certain "traditional" energy efficiency choices in the region which some are promoting, such as the use of natural ventilation and drinking water wells, may not be possible where contaminants foul the air and groundwater.

- **Financing options.** A fourth weakness in the literature is that while national standards and examples of *planning* energy-efficient infrastructure are strong and varied, a matching variety of creative *financing* models—particularly for local governments—seems lacking. Most innovative financing models are intended to be offered *by* local governments *to* the private sector to leverage funds and spread the risk, and are not available to local governments themselves. To begin to fill this gap, as part of the American Recovery and Reinvestment Act of 2009 (ARRA) projects underway through 2012 the U.S. Department of Energy is gathering the best available information on financing and disseminating it to states and local governments via a dedicated website. Further, as major stakeholders and actors in the energy efficiency marketplace, utilities in the Appalachian Region need to inform local governments and residents as to what and how much they are able to do in financing and promoting energy efficiency. The following chapters discuss several interesting and effective utility-sponsored financing models now available. But it is up to the utilities to offer them, and to be more of an active partner to the local government sector.

Utilities can be either the strong or the weak link in planning and financing energy efficiency in Appalachia.

Challenges in planning and financing energy-efficient infrastructure in Appalachia

Structural challenges represent the constraints that exist because of certain patterns or practices inherent in the area's way of life. Some people call them barriers to energy efficiency and look for "work-arounds" to mitigate their effects. These "structural" challenges exist when planning energy-efficient infrastructure in the region:

- Low-density settlement patterns
- Land and property ownership by corporations (companies who negotiated the mineral rights to or ownership of property that they now lease back to residents)
- Inconsistent leadership on the part of utilities and governments in planning energy-efficient infrastructure
- Lack of creative financing mechanisms to implement infrastructure planning.

For a variety of reasons—including low population density—Appalachia has a lower tax base, and that makes it difficult to invest in the capital improvements needed to capture energy efficiencies. In pockets of the region where companies and corporations have controlled the land and property for generations, the tax base of homeowners and small businesses is even smaller. As a result, revenue to local governments from this potential tax base is diminished. With a higher number of renters, the region must determine how local governments can incentivize energy efficiency in the private sector for renters who may not see the financial benefits.

While the structural challenge of low-density settlement patterns may put stress on regional team building and communications, it represents a tremendous opportunity to adopt decentralized solutions to energy and water management, allowing Appalachia to serve as a model for other rural or low-density areas of the United States.

Inconsistent leadership from the government agencies and utilities is an addressable constraint. One goal of this study is to highlight effective leadership in energy management in the region, so that other counties can learn from their experiences and these leaders can proactively teach others. Good leadership stems from effective citizen groups, local governments, educational institutions, businesses, utilities, and state regulatory institutions.

The county-level case studies included in Chapter 3 identify the variety of organizations and groups essential to the effort of planning and financing energy-efficient infrastructure. They include the general public/residents, the private sector, the public/government sector, the utilities, and community, not-for-profit, and educational institutions. To succeed, they need to understand the ways they can interact to make efficiency possible. Literature on sustainability calls this an "integrated resource management" approach. Establishing such collaboration is necessary not only to implementing energy-efficient infrastructure, but also to maintaining it over time. Collaborative and sustainable stewardship of the built environment in Appalachia is the ultimate goal.

Chapter 1: Review of Existing Energy Management Planning and Financing Tools

Many institutions offer tools for implementing energy and water efficiency. To select the ones most valuable for local governments from among all of them, four criteria informed the choice. The tools presented in this review share the following key characteristics:

- **Longevity.** The tools and resources have an established track record, are well funded, and are likely to be around well into the future.
- **Credible content that evolves in response to user needs.** These tools/resources are not published once and never updated; they are continually being improved. They serve as frameworks that aim to lead the way and provide credible, evolving standards for action. In their development cycle, many of them went through a public review and comment process.
- **Customer assistance and partnership potential.** These tools come with help, often live help. Person-to-person contact and collaboration have been essential ingredients in the successful transformations achieved by local governments to date—for example, those counties chosen as case studies in Chapter 3.
- **No or low-cost.** These resources/tools are either already funded by taxpayer dollars or sponsored by the non-profit sector. As a result, the money local governments might have spent purchasing these tools will instead be available for capital improvements or other uses.

The selected tools and their supporting organizations are grouped by the following themes:

1. Energy and resource efficient buildings
2. Water and wastewater management
3. Green workforce training and resources
4. Financing and support
5. Policy development and lead-by-example frameworks

1. Energy and resource efficient buildings

This discussion describes tools for the following steps on the path to energy efficient buildings:

- Energy measurement
- Building retrofits and renewables
- Holistic frameworks (for maximum efficiencies).

Energy measurement

ENERGY STAR® Portfolio Manager (PM) developed and managed by the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE).
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Measurement and observation are the foundations of any energy management plan promoting efficiency. By identifying buildings that are performing poorly relative to their peers, measurement allows local governments to set priorities and target facilities for retrofits. Measurement underpins informed action. Once a local government commits to efficiency, energy use measurement should always be the next step before building audits and retrofits take place. Knowing the total energy use of public buildings also allows local governments to define meaningful, specific goals to reduce that energy use, whether by a percentage or by a specific measured amount.

Broadly speaking, the energy management process includes the following steps, from EPA's Energy Management Guidelines, www.energystar.gov/index.cfm?c=guidelines.guidelines_index:

- Make the commitment to efficiency
- Assess current performance
- Set goals
- Create an Action Plan for improvements
- Implement the Action Plan
- Evaluate progress toward goals (re-assess performance)
- Celebrate achievements
- Continue improving
- Continue measuring energy use

Key to the success of the energy management process is *continuous tracking of energy consumption*. Of the many programs that track consumption, the federal government, through EPA, sponsors one of the simplest and most widely used tools for the commercial and industrial sectors: the no-cost, online **Portfolio Manager (PM**) energy measurement and tracking tool. PM allows users to track energy consumption in buildings. After uploading facility characteristics and utility information, users can see each building's baseline performance, measure progress over time as improvements are implemented, and generate custom reports to evaluate performance. In brief:

- By entering certain building characteristics (such as square footage and hours of operation) and data from their utility bills, PM users track energy and water use for a single building, for one or multiple building meters, or for a portfolio of buildings. When PM users enter energy use data for all of the fuel types within their facilities (electricity, natural gas, propane, even onsite renewables), the program automatically converts the fuel data in its different forms (kilowatt hours for electricity, therms for natural gas, etc.) to a common metric, kBtus, or one-thousand British thermal units. In this way all energy consumption is captured and rolled up into one metric. Outputs demonstrating building energy performance, including costs and greenhouse gas emissions, are available in a variety of formats including graphic or chart form.
- The dataset underlying PM comes from the national Commercial Building Energy Consumption Survey (CBECS), carried out every four to five years by the U.S. Department of Energy (DOE). While other energy tracking programs are available, they are not able to render comparative scores as PM does because they lack the same robust foundational database.
- PM expresses a building's performance as a 1 to 100 score, as compared to other similar buildings, with 50 being the average building. Although the PM score ranks a building or plant against similar ones nationwide, local governments can also use PM to compare like buildings to one another within a county, between neighboring counties, between ARC counties, even across states and regions. That makes PM a powerful tool for information sharing and mutual education across the Appalachian Region.

PM energy performance scores are available for the 15 most common types of buildings in the United States: banks, courthouses, data centers, hospitals, hotels, houses of worship, K-12 schools, municipal wastewater treatment plants, offices, medical offices, residence halls, retail stores, senior care facilities, supermarkets, and warehouses. Buildings that earn a score of 75 or higher are eligible to receive the ENERGY STAR and national recognition for that achievement.

Other space types, not yet eligible to receive a score from 1 to 100, can track their energy use and compare it to other similar buildings by using an ENERGY STAR table of national average energy use metrics by building type. EPA adds new space types as robust data sets become available.

As an existing federal resource already paid for by tax dollars and available online at no cost, the PM tool is supported with regular updates, strong customer service, and training at no cost to users. Its online interface is straightforward and easy to learn. EPA, DOE, and their contractors regularly offer webinars and in-person training sessions for users of all levels. Portfolio Manager is a widely used tool. Through 2010, PM assessed the energy

performance of more than 200,000 buildings—representing about 20 billion square feet, or more than 25% of the total market. The practical results from PM encourage users to make sustained energy tracking an ongoing practice that demonstrates consistent savings from their energy efficiency upgrades.

The noteworthy advantages of Portfolio Manager for the Appalachian Region are:

- PM results are weather-normalized. Since Appalachia spans four climate zones, this is important for comparative reasons.
- At present, PM is the only national energy performance scoring system focused on buildings. It has already been adopted as the state benchmarking tool in Arkansas, Washington, Michigan, Pennsylvania, and West Virginia and its use is mandated in cities like New York, Washington, DC and every city in California. It is required under a Federal Executive Order for all federal buildings. More states, counties, and cities are mandating the use of PM every year. By *benchmarking county and community buildings in PM, local governments in Appalachia will be ahead of the curve and better positioned to take advantage of new opportunities.*
- Local Appalachian jurisdictions with existing MS Excel™ tracking tools can easily export their results to PM and obtain an energy score for comparison purposes. Self-comparison can go only so far. Consider that it is impossible to interpret human blood pressure readings or weight without reference to average numbers and a desirable range. The analogy holds for energy use in buildings: a comparison with others is necessary to understand building performance.
- If a building is a ratable space type, it will get a comparative score to use as a baseline against which to assess progress for years to come.
- Because PM, with its associated EPA resources and training, is a no-cost tool, it is equally accessible to all counties and institutions, regardless of their economic status or wealth.
- PM calculates greenhouse gas emissions deriving from building energy use, which helps governments in Appalachia that must measure energy efficiency savings and GHG emissions reductions to fulfill their reporting responsibilities under the federal Recovery Act and other federally funded programs.
- PM can be configured to group buildings and share data. *In this, Portfolio Manager holds great region-specific promise for Appalachia.* PM could enable a **regional energy use database** in which buildings are aggregated across types and sizes, compared, and the results shared. In an even more ambitious scenario, opportunities for regional financing of energy efficiency could be linked to public sharing of data and resources in this regional PM database. That incentive would break down one of the challenges to sharing data, the fear of public "exposure" of sensitive information. Beyond opportunities for financing, there could be other "rewards" for energy use tracking, including public recognition of the best or most improved performers. Such a database might be achieved as a collaborative effort between ARC and EPA.

For buildings under design, EPA's ENERGY STAR has a tool, Target Finder (http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder) for setting energy use performance targets in new construction. This tool links to Portfolio Manager, thus encouraging energy tracking into the future.

Building retrofits and renewable energy systems

Tracking energy use will identify facilities that are the worst performers, and thus allow local governments and communities to target and prioritize these for energy efficiency upgrades. Indeed, prior to undertaking upgrades, energy use measurement followed by building audits are essential steps in understanding facility weaknesses. When under-performing buildings have been identified and targeted, there are a number of freely-available resources offering guidance on implementing upgrades. In general, local governments should begin with lower-cost energy-efficiency measures, such as lighting upgrades, increased building insulation, and better systems controls, before turning to the costlier, "high profile" retrofits such as the installation of renewable energy systems.

Appalachian Region counties can turn to the practical **ENERGY STAR Building Upgrade Manual,** http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual. It is a guide to planning and implementing specific building strategies and improvements, such as retrocommissioning of building energy

systems (ensuring that systems perform as designed to perform); upgrades in lighting, heating and cooling, and air distribution systems; and supplemental load reduction (from equipment and building envelope efficiencies). As retrofits are completed, users will turn back to Portfolio Manager to regularly track energy use to evaluate the effect of the upgrades on performance. Continual measurement is key to continuous efficiency.

As a guide to prioritizing retrofits, EPA's ENERGY STAR suite of **online calculators**—the *Cash Flow Opportunity Calculator,* the *Financial Value Calculator*, and the *Building Upgrade Value Calculator*—will help local government officials calculate the cost of delaying upgrades, compare estimated cost savings across buildings, and calculate cost savings for a specific project, among other features http://www.energystar.gov/index.cfm?c=assess_value.financial_tools. Regular training webinars are available to help users get the most from these tools.

The National Institute of Building Sciences **Whole Building Design Guide**, at http://www.wbdg.org/ is a comprehensive resource for project management, operations and maintenance, and design guidance. It has information on specific energy efficiency retrofit strategies, such as the implementation of:

- Energy efficient lighting (http://www.wbdg.org/resources/efficientlighting.php)
- Daylighting (http://www.wbdg.org/resources/daylighting.php)
- Energy efficiency master planning (http://www.wbdg.org/resources/emp_hvac.php)
- High performance heating, ventilation, and air conditioning (http://www.wbdg.org/resources/hvac.php)
- High performance building envelope – walls, floors, and roof (http://www.wbdg.org/resources/env_sustainability.php and http://www.wbdg.org/resources/env_hvac_integration.php)
- Natural ventilation (http://www.wbdg.org/resources/naturalventilation.php)
- Operations and maintenance in general (http://www.wbdg.org/resources/sustainableom.php) and for historic structures (http://www.wbdg.org/resources/omhs.php)
- Renewables (http://www.wbdg.org/resources/alternativeenergy.php), such as biomass (http://www.wbdg.org/resources/biomasselectric.php); geothermal systems (http://www.wbdg.org/resources/geothermalheatpumps.php); photovoltaics (http://www.wbdg.org/resources/photovoltaics.php); wind (http://www.wbdg.org/resources/wind.php)

DOE's Net-Zero Energy **Commercial Building Initiative**, at http://www1.eere.energy.gov/buildings/commercial_initiative, has produced a series of free, downloadable how-to guides which detail energy savings strategies, by climate zone, for a variety of building types and sizes, including small, medium, and large office buildings. Their ten-chapter *Sustainable Design Guide* focuses on new construction.

The Collaborative for High Performance Schools (CHPS) is a resource for planning, designing, and operating high performing K-12 schools. CHPS offers a free, downloadable **CHPS Best Practices Manual** (http://www.chps.net/dev/Drupal/node/288), as well as assessment tools and opportunities for recognition.

DOE's Energy Efficiency & Renewable Energy's (EERE) website http://www.eere.energy.gov/ has two broad categories of resources, one for energy efficiency, and one for renewable energy. Local governments should find the link at http://www.eere.energy.gov/topics/government.html most helpful; it contains information on Energy Efficiency and Conservation Block Grant (EECBG) Program (http://www1.eere.energy.gov/wip/eecbg.html), the Solar America Communities Program (http://solaramericacommunities.energy.gov/) , and DOE's Weatherization and Intergovernmental Program (http://www1.eere.energy.gov/wip/), among others.

Also embedded in the EERE site is the Federal Energy Management Program (FEMP) page, containing many links and how-to resources. For renewable energy systems, http://www1.eere.energy.gov/femp/technologies/renewable_energy.html includes a list of resource maps and screening tools for solar, wind, biomass, and geothermal power available -- see http://www1.eere.energy.gov/femp/technologies/renewable_resourcemaps.html. This includes the **National Renewable Energy Laboratory's dynamic maps and analysis tools**, including current savings to investment ratios with and without incentives, and current payback periods, for photovoltaic systems. For

example, their map of simple payback with incentives (http://www.nrel.gov/gis/images/femp/graphic_pv4_pbincen.jpg) for photovoltaic systems demonstrates that the payback period for photovoltaics in the counties of the southern Appalachia is much better than the national median. The FEMP website includes the **FEMP Operations and Maintenance Best Practices Guide** (http://www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf).

For biomass resources, the **Southeastern Regional Biomass Partnership** at http://www.serbep.org/ contains a comprehensive list of biomass resources links. DOE's EERE website for biomass—http://www1.eere.energy.gov/biomass/—includes a link on financial opportunities. EPA is also a source for programs and incentives for local governments interested in biomass CHP. For information on funding resources, see www.epa.gov/chp/funding/financial.html#tabnav, where EPA keeps a list, by state, of grants, funding, and incentives programs for CHP and biomass projects. For general information on biomass CHP, visit www.epa.gov/chp/basic/biomass_fs.html. In addition, EPA has developed a methodology for monetizing the benefits of CHP, presented in *Environmental Revenue Streams for Combined Heat and Power* (December, 2008), available at www.epa.gov/chp/funding/financial.html#tabnav.

Resources local to Appalachia include **SEDA—Council of Governments Energy Resource Center**: Promoting Efficient Renewable Sustainable Community Energy, http://erc.sedacog.org/. The Energy Resource Center for Central Pennsylvania, dedicated to the development of the region as a center for efficient and renewable energy technology and expertise, provides tips, training, and live support for energy conservation for residential, businesses, agriculture, building trades, schools, and local government. **MACED, the Mountain Association for Community Economic Development**, providing financial capital and expertise to individuals, businesses and communities, http://www.maced.org/E3/E3-ways.htm, offers "Ways to Save at Work," a resource including retrofit calculators for electrical upgrades and more, as well as assistance with financing. **The Kentucky Solar Partnership (KPC),** http://kysolar.org/, has information on installers of solar systems. **The Kentucky Energy Efficiency Program for Schools (KEEPS),** https://louisville.edu/kppc/keeps/toolkit-library/keeps-toolkit-library.html#toolkit-presentations, has presentations on such strategies as thermostat settings adjustment, water heating, and plug load reduction.

Holistic frameworks

As frameworks for the pursuit of sustainability, green building rating systems aim holistically to measure a building's sustainable qualities, including energy efficiency, which is a key component. Green building rating systems also go beyond energy performance to rate other practices that affect energy efficiency, like water and site management. For a region like Appalachia, with considerable surface water and many environmental issues that are bound together inextricably—namely energy efficiency, water management, human health, and environmental quality—rating building performance in a more holistic way makes sense. It can be a considerable force for environmental good as well as for energy-efficient infrastructure. In addition, third-party, comparative ratings can be powerful tools. Public recognition of superior performance confers prestige, enhances reputation, and spurs further achievement—valuable indeed if a county wishes to distinguish itself as a desirable place for investment.

There are two major green building rating systems in use in the United States: Leadership in Energy and Environmental Design (LEED®), administered by the U.S. Green Building Council (USGBC), and Green Globes, administered by the Green Building Initiative (GBI). Of the two, LEED is the most widely known and used. As of September, 2011, in the United States around 150 buildings have been rated in Green Globes and almost 8,000 in LEED. Increasingly, LEED achievement is becoming a mandate in the construction and renovation of public sector buildings. Within the Appalachian Region, the state of Maryland requires all new public buildings to achieve LEED Silver certification, a level beyond the minimum.

As low-cost tools for information and guidance, the LEED Reference Guides are compendiums of best practices. LEED collects many standards and best practices into one place, so that it functions for many as a "one-stop shop" for information on sustainable design and operations. The Reference Guides, developed and sold by the USGBC to assist building owners and designers in their pursuit of LEED, comprises overall information on sustainable building and energy-efficient design. The suite of guides includes the LEED Reference Guide for Building Design and Construction, the LEED Reference Guide for Interior Design and Construction, and the LEED Reference Guide for Existing Buildings: Operations & Maintenance. Common to all are detailed explanations of the importance and benefits of best practices in energy efficiency: commissioning of systems to ensure good performance; minimum and optimized energy performance, which in the Existing Buildings rating system is linked

to EPA's ENERGY STAR Portfolio Manager; and an explanation of the benefits and procedures for measurement and verification and metering. The ten thematic categories within LEED 2012 are as follows: Integrative Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, Performance, Innovation in Design (or Operations, if an existing building), and Regional Priority.

LEED as a holistic system correctly views energy efficiency as one practice among many synergistic practices. Energy efficiency should not be viewed in isolation or pursued as an isolated strategy. Why? Because so many other practices affect it deeply. For example, LEED encourages the building owner to think about how considerations of indoor environmental health can impact energy efficiency retrofits. The counties showcased in Chapter 3 are putting this kind of synergistic thinking into practice.

A further example of a co-dependent practice is stormwater control, which is categorized in the LEED system as a Sustainable Sites (SS) practice, not an Energy & Atmosphere practice. Water/wastewater treatment plants for most municipalities are the greatest energy consumers, accounting for as much as 70% of a local government's electric bills. Stormwater loading to those treatment plants from combined sewers can be a notable percentage of an urban wastewater plant's volume, especially in a region such as Appalachia which has significant rainfall. When a municipality has a plan for reducing stormwater loading to those plants by promoting or incentivizing better methods of site infiltration or treatment, that practice (among the synergies recognized by LEED) translates into significant energy savings. One of the energy conservation measures presented in Chapter 2 covers Low Impact Development strategies for dealing with stormwater through "green" (planted and pervious) rather than "gray" (literally, concrete) infrastructure.

LEED classifies waste management as a Materials & Resources (MR) practice. Recycling, as a strategy to avoid burdens upon municipal landfills, has a number of recognized environmental benefits such as pollution and contaminant reduction. A shorter term benefit for local governments in Appalachia will be that good waste management results in a measurable lowering of carbon emissions, an increasingly key criterion for federal funding. It also may lead to opportunities for methane capture and subsequent energy generation.

For the ten interrelated credit categories (listed above), the LEED Reference Guides contain a wealth of information on each topic area. Because of the weight of the EA credit category, LEED focuses on best practices for energy efficiency improvements. But again, the message of LEED is that for best energy efficiency, one should pursue synergistic practices. Because local governments are the focus of this study's implementation toolkit, that provides a powerful opportunity to encourage multidisciplinary efforts within county government. Breaking down management "silos" may lead to cost savings, as such efforts will help eliminate redundant services, or practices that conflict with and undo one another.

Local governments who wish to take LEED further and certify their buildings using the LEED rating system may experience challenges relating both to costs and to content. Building owners must pay certification fees—linked to a building's square footage—to the Green Building Certification Institute, for LEED review and rating. Because a portion of LEED points relate to population density and the availability of public transportation, Appalachian counties will need strategies to overcome the transportation challenges of the region; Appalachia's rural rather than urban nature makes traditional LEED rewards for settlement density and public transportation harder to achieve. A further general challenge is the need for an informed electorate—public outreach and education on the benefits of green buildings and green building ratings – as well as the need for cost-benefit analyses to persuade voters of the financial benefits of sustainable buildings.

For no-cost, complete guidance on LEED certification for new construction, the **Harvard University Office for Sustainability's Green Building Resource** at http://green.harvard.edu/theresource/new-construction has information on all aspects of the LEED process, from energy modeling to life cycle costing to materials specification to LEED credit roadmaps and credit forms.

Further useful USGBC resources include the following:

- The USGBC keeps a state-by-state database of all buildings certified at all levels in LEED, providing real-world examples of third-party-certified green buildings sortable by location, at http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx?CMSPageID=247 .
- The USGBC has a website for policy and government resources: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1779.

- A LEED pilot program for the Neighborhood Development (ND) rating system, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148, is the first LEED rating system to consider neighborhood wide sustainability and energy efficiency strategies. A review of the LEED-ND pilot sites shows two are in Pittsburgh and one is in Chattanooga http://www.usgbc.org/ShowFile.aspx?DocumentID=3546.
- Of note for counties in Appalachia: participation in USGBC pilot programs often involves waivers of certification fees and access to USGBC internal resources and expertise. Therefore, a county's participation in a LEED pilot program could be a way to make pursuing LEED more affordable for regional institutions.
- State and local USGBC chapters are sources of training, information, and support.

Local and regional USGBC chapters in the Appalachian Region are listed below. As an example of local support, the East Tennessee chapter, headquartered in Chattanooga, links to a local resource, Greenspaces, http://www.greenspaceschattanooga.com/resourcecenter, whose mission is to showcase environmentally smart materials, methods and resources, offer collaborative space for project teams as well as project-specific research with staff. Its goal is to raise awareness and increase green options for commercial and residential developers, contractors, subcontractors, owners, architects, designers, and the public. Greenspaces Chattanooga has its own incentive program, http://www.greenspaceschattanooga.com/incentiveprogram, which offers funds for commercial construction and renovation projects, covering all administrative costs associated with obtaining LEED certification, and dedicated funding for the installation of high profile, very public, exemplary sustainable design features such as green roofs, solar or wind energy generation and geothermal heating.

Table 1: Appalachian Region Chapters of the U.S. Green Building Council

USGBC Chapter	Comments
Alabama *http://www.usgbcofal.org/index.php?option=com_content&task=view&id=12&Itemid=41*	Alabama has four branch chapters. The Birmingham branch has hosted a conference on sustainability, with international speakers, and promotes a sustainable urban plan for Birmingham. North Alabama is another branch chapter in the Appalachian Region. Auburn University has its own chapter.
Georgia *http://www.usgbcga.org/*	Georgia's local chapters focus on Atlanta, Augusta, Central Georgia, Athens, and Savannah.
Kentucky *http://www.usgbckentucky.org/*	Kentucky has one statewide chapter in Louisville, outside the region. The chapter has been active in the push for green schools.
Maryland *http://www.usgbcbalt.org/*	Maryland has two chapters, a Southern Maryland and a Northern Chesapeake Branch.
Mississippi *http://chapters.usgbc.org/mississippi/default.html*	Mississippi has a north and a south branch, with educational sessions geared to the different needs of these two climate regions.
New York *http://www.greenupstateny.org/*	New York's chapters cover New York City and Upstate New York; the later focuses more on the Hudson River Valley than the Appalachian part of the state.

USGBC Chapter	Comments
North Carolina *http://www.usgbc-ptnc.org/*	North Carolina has a Research Triangle chapter *http://www.triangleusgbc.org/* and a Piedmont Triad chapter, but no chapter specific to the western part of the state.
Ohio *http://www.neogreenbuilding.org/index.php; http://www.usgbc-coh.org/*	Ohio has northeast and central chapters, which include Appalachian counties.
Pennsylvania *http://www.gbacpa.org/ http://www.gbapgh.org/content.aspx?ContentID=1*	Pennsylvania has a Central Chapter. The *Pittsburgh Green Building Alliance* is a USGBC affiliate organization with a website providing extensive links and resources.
South Carolina *http://www.usgbcsc.org/index.php?page_id=upstate*	South Carolina has an upstate chapter in Greenville, in the Appalachian Region.
Tennessee *http://chapters.usgbc.org/easttn/*	Tennessee has three distinct chapters: western in Memphis, middle Tennessee, and eastern Tennessee in Chattanooga. The East Tennessee chapter maintains an informative blog, forum discussion, and links to local green resources for property owners, architects, contractors, and developers.
Virginia *http://usgbcswva.org/*	Virginia has a southwest Virginia chapter with a mountain-themed identity and many resource links.
West Virginia *http://usgbcwv.org/About.asp*	West Virginia has a central state chapter, calling itself the newest USBGC Chapter in America, founded in 2009.

Finally, the National Institute of Building Sciences ***Whole Building Design Guide***, at http://www.wbdg.org/ is also a resource for information on holistic practices, including low-impact development strategies (http://www.wbdg.org/resources/lidsitedesign.php).

2. Water and wastewater management

The link between water and energy has been well documented. Energy production requires water; and the business of supplying clean, safe water to a community and treating the water before it is returned to the environment requires energy.

EPA's ENERGY STAR program reports that approximately 3% of U. S. national energy consumption, equivalent to approximately 56 billion kilowatt hours (kWh), is used for drinking water and wastewater services at a cost of $4 billion annually. In some areas of the country, the percentage is much higher because of the need to pump water considerable distances from its source. The National Resources Defense Council (NRDC) estimates that water and wastewater services result in the release of approximately 116 billion pounds of carbon dioxide (CO_2) per year—equivalent to the emissions each year of 10 million cars. Beyond the environmental effects of energy use in the

water-wastewater sector, upgrading centralized water and wastewater treatment facilities to meet demand requires capital investment. The country faces a huge infrastructure gap for water-wastewater totaling into the tens of billions of dollars according to the EPA Gap Analysis Report (EPA 2002).

Financing for energy efficiency improvements is available through federally funded programs such as the clean water state revolving fund (CWSRF) and the drinking water state revolving fund (DWSRF). These programs are administered by the state and have recently received additional funding through the American Reinvestment and Recovery Act of 2009 (ARRA). EPA and other organizations cited in the review below provide benchmarking and energy audit tools free of charge, typically with free training.

Energy efficiency investments in water and wastewater infrastructure often have high rates of return and short payback periods (EPA 2008). For example, based on results of an energy audit, the Gloversville-Johnstown Wastewater Treatment Facility in New York changed out digester gas equipment at a capital cost of $600,000. This change resulted in an annual energy savings of $175,000 and a simple payback period of 3.4 years.[2] The City of Oneida in New York was able to save nearly 635,000 kilowatt-hours (kWh) per year and $88,850 in energy costs by upgrading their aeration system at a cost of $135,000 and payback period of less than two years (Green 2007).

Documented successes, short payback periods, an abundance of publically available tools and resources, and funding availability make investment in energy efficiency in the water and wastewater sector a sensible course of action for Appalachia.

The tools reviewed in this section are organized by improvements in centralized infrastructure, wastewater treatment, water conservation, decentralized water management, and combined heat and power for wastewater treatment plants. In brief:

- A variety of approaches have been successful in achieving energy efficiency goals for water and wastewater. For example, automated operation of water treatment plants can reduce energy by more closely matching inputs to real-time conditions. Replacing standard motor drives (for example, on pumps) with variable frequency drives (VFDs) reduces energy by matching motor speed to load requirements, which allows the system to avoid running at full power unless necessary. Advanced leak detection methods prevent water loss in pressurized drinking water distribution systems. Wastewater utilities using anaerobic digestion to treat solid wastes can recover methane and become energy producers. This view of wastewater as a resource (instead of a burden) to be used for energy production represents cutting-edge thinking in this field.
- Water conservation, as a general rule, has multiple benefits: water is kept in its original ecosystem, and the energy that would have been needed to treat and distribute that water is saved.
- The decentralized water management model where wastewater is treated onsite can eliminate the costly step of conveying wastewater long distances to a centralized facility.

Tools for improving the energy efficiency of centralized water and wastewater infrastructure

A number of technical guidebooks explain how utilities can change equipment or modify operations to save energy. A technical source is "**Energy Conservation in Wastewater Treatment Facilities—Manual of Practice (MOP) 32**," by the Water Environment Research Foundation (WERF 2009). MOP 32 is a peer-reviewed document written by a panel of energy efficiency experts and updated from the previous edition published in 1997. Addressing both water and wastewater facilities, it contains detailed technical guidance on a variety of topics including retrofitting motors, pumps, controls, aeration systems so that they use energy more efficiently.

Specifically for wastewater treatment plants, **"Quality Energy Retrofits for Wastewater Treatment Plants"** by the Electric Power Research Institute (EPRI 1998) offers guidance on the retrofitting process, drives, pumps, and operations. For the drinking water industry, The Water Research Foundation (formerly the American Water Works Association Research Foundation) published a **best practices guide** in 2003, which identified and ranked 18 best practices for saving energy costs based on a survey of 24 utilities (WRF 2003). Best management practices (BMPs) that made it to the top of the list (other than those that involve energy pricing) include matching facility life with equipment life, applying lessons learned from past design and operation, energy audits, and

[2] http://www.nyserda.org/programs/Environment/G-T%20WWTF.pdf

construction review. Additional BMPs include pumping analysis and automated operation using the popular Supervisory Control and Data Acquisition (SCADA) systems.

A useful publication for Appalachia from the Wisconsin Focus on Energy program is the **"Water and Wastewater Energy Practices Guidebook,"** available at http://www.focusonenergy.com/Business/Industrial-Business/Guidebooks/default.aspx. The guidebook is based on site surveys and evaluations of best practices for 85 wastewater treatment plants in Wisconsin. Because much of Wisconsin is rural with relatively small water and wastewater treatment systems, their experiences implementing energy efficiency improvements should be very applicable to Appalachia. In addition to including best practices, this resource gives guidance on establishing an ongoing energy management program. Key steps are to obtain a strong commitment from management, track energy savings performance, form an energy team, develop a long-term energy management plant, and establish a system for continual improvements.

To ensure long-term success, energy efficiency improvements at water and wastewater utilities should be part of a sustainable energy management program. The program should assign a multi-disciplinary team to identify and track energy efficiency goals and should have the full support of utility management. For developing a comprehensive energy management program, EPA's **"Ensuring a Sustainable Future, an Energy Management Guidebook for Wastewater and Water Utilities"** (2008), http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf, provides a step-by-step method based on a "Plan-Do-Check-Act" management system approach to identify, implement, measure, and improve energy efficiency at utilities. It includes case studies of water and wastewater utilities that have already realized benefits using this management approach. Produced by the Office of Water Sustainable Infrastructure initiative, the guidelines are consistent with ENERGY STAR guidelines for energy management http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index, but targeted specifically to water and wastewater utilities. The guidelines also mirror those recommended by the respected Wisconsin Focus on Energy program. EPA Region 9's **website** promotes a similar step-by-step process for improving energy efficiency at http://www.epa.gov/region09/waterinfrastructure/howto.html.

California Flex Your Power **Water/Wastewater Guide 1: Reduce Energy Use in Water and Wastewater Facilities through Conservation and Efficiency Measures**, http://www.fypower.org/pdf/BPG_Water1_Con&Eff.pdf, offers step-by-step procedures for conserving energy at water and wastewater facilities based on the experiences of water and wastewater utilities in the state.

In addition to publishing manuals and guidelines, these three national programs are very active in research, tool development, and providing assistance to the water and wastewater sector:

- Launched in 2005, EPA's **ENERGY STAR water and wastewater focus**, http://www.energystar.gov/index.cfm?c=water.water_wastewater_focus, is a targeted effort to improve energy efficiency in the wastewater industry. Managers of drinking water systems and wastewater treatment plants can now track energy use, energy costs, and associated carbon emissions by using Portfolio Manager, EPA's online energy measurement and tracking tool (discussed in Section 1, energy management). Portfolio Manager also offers wastewater treatment plant managers the capability to compare the energy use of their plants with other peer plants using EPA's energy performance scale. Additional useful links and resources are publicly available at www.energystar.gov/waterwastewater. Through ENERGY STAR, EPA offers regular training on how water systems and wastewater treatment plants can benchmark energy use. See https://energystar.webex.com/mw0305l/mywebex/default.do?siteurl=energystar for a full training schedule.
- U.S. Department of Energy (DOE) **Office of Energy Efficiency and Renewable Energy (EERE) Industrial Technologies Program** http://www1.eere.energy.gov/industry/about/ publishes extensive guidance on motors and pumps, including a software tool that can be used to optimize energy efficiency of all motors at the plant, MotorMaster+ software, available for free download at http://www1.eere.energy.gov/industry/bestpractices/software_motormaster.html)

  MotorMaster+ is a motor selection and management tool that can help managers identify the most efficient action for a given motor repair or change out. It includes a catalog of more than 20,000 low-voltage induction motors. Features include a motor inventory management tool, maintenance tracking capabilities, efficiency analysis, and simple payback and other cost evaluations.

- The **Consortium for Energy Efficiency (CEE) Water-Wastewater focus** http://www.cee1.org/ind/mot-sys/ww/ww.php3 endeavors to improve energy efficiency in the water and wastewater sector by encouraging suppliers of products and services to adopt energy efficiency as a standard industry practice. Toward that end, CEE is working to raise awareness among senior-level decision makers about the benefits of energy efficiency in their facilities. CEE has a resources webpage with links to case studies, reports, tools, and other energy efficiency organizations http://www.cee1.org/ind/mot-sys/ww/resources.php3 .

  CEE is compiling a **motor systems tool kit** to provide a one-stop-shop including both technical tools (software, checklists, guidance, etc.) and promotional tools related to motor efficiency improvements http://www.cee1.org/ind/mot-sys/mot-sys-tools.php3. One frequently cited software included in this toolkit is MotorMaster+ (discussed above). Another popular tool in the CEE motor systems toolkit is the Pump System Assessment Tool (PSAT) http://www.pumpsystemsmatter.org/content_detail.aspx?id=112. Also developed by DOE and available free for download, PSAT uses achievable pump performance data from the Hydraulic Institute Standards and information from the MotorMaster+ database to estimate potential energy savings from the change out of existing pumps with optimal equipment. PSAT also provides an optimization rating so that results can be compared to commercial products.

A vital step to improving energy efficiency at any facility is the energy audit. Although it was published more than 15 years ago, a key reference for the water sector is still the "**Energy Audit Manual for Water/Wastewater Facilities"** (EPRI 1994). This report, available through the CEE website at http://www.cee1.org/ind/mot-sys/ww/epri-audit.pdf , provides guidance on how to conduct a walkthrough and process audits. It provides a list of potential energy conservation measures and tips for developing a successful energy conservation program.

Improving the energy efficiency of wastewater treatment

Energy costs can make up between 30% and 60% of the total operating and maintenance budget at wastewater treatment plants (EPA Sustainable Management Guidebook 2008). Industry experts agree that significant opportunities exist at most plants to reduce energy use and costs. For example, Wisconsin's Focus on Energy was able to reduce the energy use of 85 participating wastewater utilities by 20% to 40%, with some utilities realizing up to 75% reductions (SAIC 2006).

The wastewater treatment process using the largest proportion of energy is aeration. New advances in energy-efficient aeration technology are available for implementation, as noted below. In addition, from the use of aeration improvements to increase energy efficiency, wastewater treatment plants have a unique opportunity to be energy *producers* by capturing and reusing methane gas from sludge treatment processes. More information on methane capture and reuse appears in the CHP section, which follows the discussion of decentralized wastewater systems.

Aeration Improvements. A steady supply of oxygen is needed for microorganisms to break down organic waste in wastewater. The transfer of oxygen from air to wastewater is typically accomplished using either mechanical agitation (mixing) or by bubbling (diffusing) air into the wastewater via submerged diffusers. These processes are relatively energy intensive. Energy use for aeration typically represents the most substantial portion of energy consumed, and the largest operating cost, in a wastewater treatment system. Depending on the treatment process employed, aeration can consume up to 60% of the total electrical power requirements of a wastewater treatment plant (SAIC 2006).

Modern advances in air diffusers have made mechanical mixers much more efficient. Air diffusers are categorized by the size of the bubbles they produce (coarse bubble and fine bubble). Fine bubble diffusers produce numerous, small bubbles into the wastewater being treated. The smaller bubbles result in more surface area exposure in the wastewater liquid (more surface area per unit volume of wastewater). This higher bubble surface area results in a higher oxygen transfer efficiency compared to using coarse bubbles or mechanical aeration. Efficient fine bubble diffusers have demonstrated a reduction of 30% to 40% in the air required compared to coarse bubble diffusers, and the resulting energy savings are on the order of 20%.

In addition to changing the size of the bubble, aeration manufacturers are investigating new ways to design the mechanical aeration equipment to improve energy efficiency. Blowers are the machines that convert kinetic energy into the air pressure that forces oxygen into the wastewater. New "turbo" blowers use advanced bearing design to work at higher speeds with less energy input. These new turbo blowers can reduce energy use in aeration by 15% to 20%. Although experience in the United States with this equipment is minimal, CEE is moving

forward with pilot studies of this technology and exploring ways to promote it in the wastewater industry. More information is at http://www.cee1.org/cee/mtg/06-09mtg/files/WWW1JonesBurgess.pdf.

Tools for Water Conservation

Every drop of drinking water that can be conserved translates directly into energy savings—savings in the energy that would have otherwise been required to withdrawal, purify, distribute, collect, and treat it. About 4% of the nation's electricity is used for supplying potable water, and that is comparable to the electricity used by the entire paper and pulp industry.

Drinking water conservation programs have been around for a long time. National organizations that provide online resources, published materials, and tools for water conservation include:

- **WaterSense®** http://www.epa.gov/watersense/ is an EPA-sponsored partnership program that promotes water efficiency by helping consumers identify water efficiency products. Products that meet criteria for efficiency and performance bear the WaterSense label. The program's website provides links to educational materials for teachers and a simple calculator tool to help consumers gauge how much water they can save by installing a WaterSense labeled product in their home or apartment.
- American Water Works Association (AWWA) **WaterWiser®** www.awwa.org/waterwiser/ is a comprehensive clearinghouse of resources on water conservation, efficiency, and demand management for conservation professionals and the larger water supply community.
- **Alliance for Water Efficiency** www.allianceforwaterefficiency.org is a relatively new organization (founded in 2005) supported by EPA that serves as a national clearinghouse and advocate for water efficiency research, evaluation, and education.

Regional organizations also share their considerable conservation experience and useful tools. **The California Urban Water Conservation Council** (CUWCC) www.cuwcc.org is considered one of the leaders in water conservation practice. CUWCCC is a partnership organization created in 1991 to promote efficient water use statewide. The Council produces several products and Web-based tools that could be adapted to promote water conservation efforts in Appalachia. For example:

- http://www.h2ouse.org is an interactive user-friendly tool that allows consumers to click on an area of the home to find ways to conserve water.
- http://www.cuwcc.org/resource-center/technical-resources/bmp-tools/cost-effectiveness-models.aspx provides links to several spreadsheet-based tools that calculate the cost effectiveness of various water conservation BMPs (e.g., implementation of a leak detection program by a water utility, upgrade to a high-efficiency clothes washer at a residence).

In Georgia several governmental and voluntary institutions have emerged as leaders in water conservation, due to recent extreme drought conditions around Atlanta and downstate. The **Georgia Water Wise Council** http://www.gawp.org/gwwc/ is a partnership between government, education, business, and residents. Its purpose is to promote water conservation statewide. The Council's website includes links to several of its own publications on landscape water management and links to external resources for teachers, landscape professionals, home and garden enthusiasts, and industrial water users. **The Georgia Department of Natural Resources** (DNR) Sustainability Division provides technical assistance in the areas of water conservation and reuse. DNR's water efficiency home page http://p2ad.org/documents/wa_home.html is a compendium of technical publications, brochures, case studies, and calculation spreadsheets for performing various types of water audits (e.g., cooling tower, landscape). The CUWCC in California and the Georgia Water Wise Council are examples of partnership organizations that could potentially be developed to promote water conservation in Appalachia.

Common tools for incentivizing residential water conservation are rebates and/or vouchers for water-saving fixtures and appliances. Rebates provide money to the customer after the purchase is complete, whereas vouchers act like coupons in that they provide a discounted price at the time of purchase. Rebates and vouchers are usually offered at the state, county, or city level by the drinking water utility. Rebate programs have been historically more popular in arid states. WaterSense maintains as list of rebate programs offered by their partners at http://www.epa.gov/watersense/pp/find_rebate.htm.

Beyond everyday consumer use of water, landscape irrigation is a major source of potable water consumption; and there are summaries of conservation guidance available. The **Alliance for Water Efficiency** provides a free online resource library for landscape, irrigation, and outdoor water use at http://www.allianceforwaterefficiency.org/Landscape_and_Irrigation_Library_Content_Listing.aspx. **The Irrigation Association's** webpage http://www.irrigation.org/default.aspx is another valuable resource that contains extensive information and links on efficient irrigation technology. The Association also offers guidance on hiring a contractor, certification information, and tips for efficient irrigation.

Another, perhaps unexpected, large user of potable water is **commercial kitchens**, which for local governments may comprise K-12 school kitchens and office cafeterias. Almost every commercial or institutional kitchen or cafeteria in the country uses pre-rinse spray valves to remove large particles of food from dishware and utensils prior to loading them in the commercial dishwasher, and some use more than one spray valve. According to CEE, dishwashing in commercial kitchens uses approximately *two-thirds* of all water used in the establishment. In many cases, *half* of the dishwashing water is used by the pre-rinse spray valve. A great deal of energy is used to heat that water. For electric water heaters, estimates generally range from about 5 to 10 gallons of water heated per kWh. For gas water heaters, estimates show that just over 2 gallons of hot water can be heated per cubic foot of natural gas.[3] Most standard spray valves flow at around 3 gallons per minute (gpm) or more, and they are used on average 1 to 4 hours per day.[4]

The flow rate of water in energy-efficient models is about half that, at 1.6 gpm or less. These efficient units can save the average small to medium food service operator as much as 150 gallons of hot water per day, translating to both energy and water cost savings. A savings calculator is provided on the **Food Service Technology Center Website** http://www.fishnick.com/saveenergy/tools/watercost/. The California Urban Water Conservation Council's **Phase 1 Rinse & Save Program** began in 2002 and has replaced about 17,000 of the 102,000 hot water pre-rinse spray valves in the state with more efficient units, and other organizations are beginning pilot programs to do likewise. Additional information is available from the **Alliance for Water Efficiency** at http://www.allianceforwaterefficiency.org/Commercial_Food_Service_Introduction.aspx and **CEE** at http://www.cee1.org/com/com-kit/prv-guides.pdf.

Water conservation activities should cover the supply side as well. Supply-side conservation makes sure the treated water reaches its final destination, the customer's tap, efficiently. Water often travels miles from the treatment plant to the customer through a vast network of pipes, valves, hydrants, and pumps. A leak can occur at any point in the system due to pipe corrosion, freeze-thaw cycles, ground settlement, and surface loads. A National Drinking Water Clearinghouse Fact Sheet (2001) reports that 10% to 20% loss of water in distribution systems is normal, but anything higher than 20% should receive priority attention.[5] A new state-of-the-art manual was published by the American Water Works Association and the International Water Association: ***Manual M36 Water Audits and Loss Control Programs*, 3rd Edition** (AWWA 2009). Written for drinking water utilities, the manual contains step-by-step procedures for conducting a water audit of the distribution system and includes spreadsheets and sample calculations for each step. It also provides guidance on leak detection strategies, planning steps to launch a sustained accountability and loss control program, and special guidance for small systems. A link to free water audit software is available at http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47847&navItemNumber=48156

Finally, this review identified two national certification programs in the area of water conservation that local governments could promote to businesses and entrepreneurs in Appalachia.

- The EPA WaterSense program certifies landscape irrigation professionals through WaterSense labeled programs. The program, http://www.epa.gov/watersense/pp/lists/irr_partners.htm, maintains an online list of certified individuals by state, including several states in the Appalachia Region (e.g., Alabama, Georgia, Kentucky, Maryland, North Carolina, Ohio, and West Virginia).
- Originally formed by the Master Plumbers & Mechanical Services Association (MPMSAA) in Australia in 2000 in response to severe drought, GreenPlumbers® USA is now a source of water conservation services and products in the United States. Individuals can become accredited GreenPlumbers by completing a five-part course series on environmental and technical issues including climate change, caring for water

[3] http://www.cee1.org/com/com-kit/prv-guides.pdf
[4] http://www.allianceforwaterefficiency.org/Commercial_Food_Service_Introduction.aspx
[5] http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009_tb/leak_detection_DWFSOM38.pdf

resources, solar hot water, water efficient technologies, and inspection report services. The association lists accredited plumbers at http://www.greenplumbersusa.com/.

Improving efficiency by encouraging decentralized water infrastructure

What does "decentralized wastewater treatment" mean? Decentralized wastewater treatment can be a collection of onsite septic or treatment systems for individual homes, commercial establishments, and industries. The word "decentralized" is also used to describe small, "cluster" systems that treat a very small volume of wastewater—for example, from a residential subdivision. Decentralized treatment can have many advantages over large, centralized collection and treatment systems:

- It focuses on smaller areas, and treats and reuses wastewater close to where it is generated. This eliminates the need for local governments to transport raw wastewater or treated reuse water long distances, saving energy.
- Treatment technologies often make use of the natural environment or natural forces (like gravity) and are thus simple, easier to maintain, and less energy intensive. For example, decentralized treatment can consistently meet groundwater standards for safety using subsurface drip irrigation.
- Decentralized treatment can provide greater opportunity for "green development," such as conservation subdivisions, cluster/village development, preservation of green space, and environmentally responsive land use planning.

In Appalachia, only about half of the households are on a public sewer system. Instead of rushing to install new pipe and treatment capacity to serve the remaining population, why not consider decentralized treatment at onsite or cluster facilities?

To explain the methods and potential benefits of well-managed decentralized treatment EPA established the **National Decentralized Water Resources Capacity Development Project** (NDWRCDP) in 1996. As stated on the website http://www.ndwrcdp.org/:

> *The goal of the NDWRCDP is to . . . address critical information gaps in order to develop the capacity of community leaders, regulators, service providers, and others to respond to the increasing complexities of and expanding need for onsite/decentralized wastewater treatment. The NDWRCDP achieves this by identifying research and development opportunities in the onsite/decentralized wastewater field and then providing funding to support universities, non-profit organizations, and other qualified public and private agencies and institutions to carry out these projects.*

As part of the project, the **Water Environment Research Foundation** (WERF) has completed many technical tasks, including developing guidance for design and operation of decentralized management models.

- A summary of reports generated through NDWRCDP can be found at http://www.ndwrcdp.org/publications/index.htm .
- Links to projects are also included on WERF's decentralized wastewater treatment research area webpage at http://www.werf.org/AM/Template.cfm?Section=Decentralized_Systems.

The key to realizing the benefits of decentralized wastewater systems is *proper management*, including planning, design, construction, operation and maintenance, and adequate user fees. EPA and the Water Environment Research Foundation have published references for management of onsite systems:

- WERF has report on responsible management entities for decentralized treatment: http://www.werf.org/AM/Template.cfm?Section=Decentralized_Systems&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=11214
- EPA has guidebook, voluntary national guidelines, and a booklet for local officials on managing onsite septic systems (and more) http://cfpub.epa.gov/owm/septic/septic.cfm?page_id=268

Other national organizations have emerged in the decentralized wastewater treatment field and provide useful resources on their websites free of charge:

- **The Consortium of Institutes for Decentralized Wastewater Treatment**, http://www.onsiteconsortium.org/tr_entities.html, is a group of educational institutions cooperating on

decentralized wastewater training and research efforts. They offer an educational curriculum, manage an installer training program, and produce technical material such as installation and operations checklists.

- The **Sustainable Water Forum**, hosted by the Coalition for Alternative Wastewater Treatment, http://sustainablewaterforum.org/new.html, supports sustainable water designs and technologies that work with and mimic nature, and result in multiple energy, green space, and other benefits to communities.
- EPA's **septic (onsite) systems website,** http://cfpub.epa.gov/owm/septic/index.cfm, provides guidance manuals and policies, tools and resources, education and outreach materials, and technical information.

As final comment on the applicability to the Appalachian Region, consider EPA's opening statement in its 1997 response to Congress:

> *Adequately managed decentralized wastewater systems are a **cost-effective** and **long-term option** for meeting public health and water quality goals, particularly in less densely populated areas.* (http://www.epa.gov/owm/septic/pubs/septic_rtc_all.pdf , pg i).

Combined Heat and Power for wastewater treatment plants

Many wastewater treatment plants use anaerobic digestion to treat solid wastes. Anaerobic digestion is similar to composting: microorganisms that grow in the absence of oxygen consume solid waste and produce byproducts, namely methane and CO_2. These byproducts, referred to collectively as digester gas, can be captured and used as a source of both energy and heat (also called combined heat and power, or CHP).

CHP is an excellent option for wastewater treatment plants that have, or are planning to install, anaerobic digesters. Digester gas can be used as "free" fuel to generate electricity and power using a turbine, microturbine, fuel cell, or reciprocating engine. The thermal energy produced by the CHP system is then typically used to meet digester heat loads and for space heating. According to EPA, a well-designed CHP system offers many benefits http://www.epa.gov/chp/markets/wastewater.html:

- Produces power at a cost below retail electricity.
- Displaces purchased fuels for thermal needs.
- Qualifies as a renewable fuel for green power programs.
- Enhances power reliability for the plant.
- Offers an opportunity to reduce greenhouse gas and other air emissions.

EPA's Combined Heat and Power Partnership http://www.epa.gov/chp/index.html has the goal of reducing impacts of climate change by encouraging combined heat and power (CHP). Their website includes links to publications, federal initiatives, funding resources, and a strategic markets page for wastewater treatment facilities http://www.epa.gov/chp/markets/wastewater.html

3. Green workforce training and resources

In the pursuit of energy efficient infrastructure, public community colleges can be resources for counties. As centers for workforce training, they can anticipate and even bring growth in green-collar jobs to the region. Easily accessible and affordable for many, these institutions consequently serve a broad segment of the population. The Appalachian Regional Commission's article about community colleges, available at http://www.arc.gov/index.do?nodeId=1357, illustrates that while these two-year institutions do not operate at the same scale as four-year colleges and universities, they have an impact on their communities in sometimes deeper ways. In Appalachia, the ARC report notes the "community college is the one higher education element that is common throughout Appalachia. It's a vehicle that can be used for a lot of things, not just delivering education."

These schools can design and implement programs to teach students field skills applicable to energy-efficient retrofits and the installation and manufacture of renewable energy systems, from solar to biomass. Forward-thinking community colleges across the country are already doing so. Community colleges have the potential not only to educate enrolled students, but to act as gathering places for more general public education and

discussion. They are well positioned to promote public awareness and to encourage a public market for the services of their graduates.

The Community Colleges of Appalachia (CCA), http://ccofappalachia.org/, has a list of member institutions at http://ccofappalachia.org/members.htm. CCA is a voluntary association of public community colleges serving the common interests of member colleges and their communities through programs and services responsive to the cultural, geographic, and economic development challenges facing the region. The proceedings of CCA's 17th Annual Conference, available at http://ccofappalachia.org/conferences.htm, includes a section on developing a workforce in the field of renewable energy. CCA is a resource for training future energy auditors and building retrofit professionals, and ARC can encourage CCA to include these subjects as an educational focus.

A 2011 ARC report, ***Green Schools and Sustainability in Rural Appalachia*** (http://www.arc.gov/assets/research_reports/GreenSchoolsCaseStudies.pdf) highlights six regional case studies of innovative programs in green workforce training. Cleveland State Community College in Cleveland, TN sponsors a program in energy efficient residential construction (EERC). Hocking College in Nelsonville, OH teaches the basics of fuel cell technology assembly, configuration, and troubleshooting for residential, commercial, and industrial power, as well as for vehicles. Appalachian State University in Boone, NC houses the Appalachian Energy Center, which focuses on community outreach and training in energy efficiency and renewables. Lanier Technical College in Oakwood, GA grants a degree in electrical utility technology. Alfred State College in Alfred, NY—one of three technology campuses in the State University of New York system—promotes hands-on learning through on-campus installation of photovoltaic arrays. Frostburg State University in Frostburg, MD offers a Wind and Solar Energy program; this prepares students to sit for the exam certifying their knowledge in the construction and installation of renewable energy systems.

Another best practice example of a community college program outside the region with training in energy efficiency subjects is Lane Community College in Eugene, Oregon (www.lanecc.edu/sustainability/susprog.html). Lane has certificate programs and a well-developed curricula for two specialized Associates degrees in addition to Renewable Energy Technology: *Energy Management Technician,* http://www.lanecc.edu/collegecatalog/documents/CTenergymgmttech.pdf and *Water Conservation Technician,* http://www.lanecc.edu/collegecatalog/documents/CTwaterconservation.pdf.

Going Green: The Vital Role of Community Colleges in Building a Sustainable Future and Green Workforce, http://www.aed.org/Publications/upload/GoingGreen.pdf, **provides** an overview and a comprehensive list of national sources on the subject. Prepared by Mindy Feldbaum and Hollyce States, the study was published by the National Council for Workforce Education and the Academy for Educational Development.

ARC's report ***Green Schools and Sustainability in Appalachia: Case Studies in Rural Practice***, http://www.arc.gov/assets/research_reports/GreenSchoolsCaseStudies.pdf, March, 2011, focuses on six case studies of Appalachian Region colleges and universities providing education and training in sustainable practices. These case studies illustrate the increasing integration of green training into existing curriculums. For local governments in the region, these institutions can be resources for technical advice. Colleges seeking to provide their students with opportunities for hands-on learning may, in turn, want to partner with local governments seeking student interns to help in energy benchmarking, tracking, and assessments.

Several universities in or near the region deserve special mention because of their outreach to Appalachian residents and local governments. They have demonstrated willingness to be collaborators in the public interest. For example, Hale County, Alabama, is one of the poorest counties in Appalachia. The **architecture school of Auburn University in Auburn**, Alabama (just outside the ARC boundaries) sponsors the Rural Studio. The brainchild of a visionary Southern architect and painter, the late Samuel Mockbee, the Rural Studio, http://www.cadc.auburn.edu/soa/rural-studio/Default.aspx, is a design and construction laboratory that puts undergraduate architecture students in the field to live among the residents of Hale County and to build mostly houses. Its abiding goal has been to improve the living conditions in rural Alabama. Since its beginnings in 1974, the Rural Studio has built many houses and small community buildings in Hale County. These have been celebrated both as "style icons" and as affordable housing examples. The challenge of the Rural Studio's 20k Program is to construct a house for $20,000, including materials and labor.

The Rural Studio's structures may not be replicable; they are site-specific to the point of reusing locally "found" materials and objects, and their first goal is not energy efficiency. But the idea of the program is replicable, and counties could add the components of energy efficiency and renewables to it. Field programs like this, sponsored

by relatively wealthy universities that pull in students from across the state, promote new thinking and help to break down the stereotypes about poverty that are so often the enemy of progress.

Some adult workforce training initiatives exist outside the sphere of community colleges. An example from California is the **Rising Sun Energy Center** (www.RisingSunEnergy.org) founded in1994 as a demonstration site and education center for renewable energy and conservation techniques, now headquartered in Berkeley. Its services include adult workforce green job training, specifically a program called Green Energy Training Services, or GETS. The GETS program is a 100-hour training module consisting of classroom, lab, and field training designed to prepare adults with barriers to employment for entry-level jobs in the energy efficiency and building performance industries. GETS defines barriers to employment as some of the following: Recent incarceration, Gang affiliation, Lack of experience, Displaced worker, Chronic welfare recipient, Substance abuser, Veteran.

The goal of the GETS program is to develop the skills, knowledge, and vocabulary to evaluate, record, and fix energy efficiency related problems in residential and small commercial buildings. In addition, participants review basic math concepts as they learn to calculate, assess, and determine energy conservation and utility cost reduction solutions. Thus, GETS combines job training with remedial education, a practical example for Appalachia. Participants also practice completing a residential energy assessment and communicating with customers.

4. Financing and support

The literature review (Appendix A of this study) uncovered a variety of sources addressing energy-related financing in all sectors. Most of the academic works reviewed discuss financial frameworks as a secondary or even tertiary theme, after discussing economic issues generally. The lack of peer-reviewed work specific to the Appalachian Region indicates that Appalachia's challenges offer an opportunity for economists to pose long-term, far-reaching recommendations. Ideally, these recommendations will focus on providing the types of short-term financial solutions that will maximize actual dollars invested and sustain investment over time. Meanwhile, local governments in Appalachia can draw on available state and national resources for advice on grants and financing. In pursuing grants, Appalachian counties may be well served by strategies focusing on innovation and collaboration—with the private sector and with other public sector partners—since federal grant opportunities, such as those from US DOE, favor bold thinking and cross-cutting collaboration. Loans and financing pose another issue for local governments. Counties looking to finance energy efficiency improvements through bonds or loans will need to put the case to their voters, and demonstrate that the potential savings and other benefits make the assumption of debt worthwhile.

Among all local governments, competition for grants remains high. The influx of funding under the American Reinvestment and Recovery Act (ARRA) of 2009 is coming to an end. DOE's Energy Efficiency and Conservation Block Grant (EECBG) program has been the grants-giving vehicle for state and local governments. Concentrating on awards for energy efficiency and renewables projects, the program will continue in a more limited way after ARRA spending ends. EECBG grant allocations (1) favor local governments that collaborate with other local governments and private institutions and (2) reward evidence of a commitment to energy efficiency and conservation (rather than the higher cost strategy of renewables installation) as the first course of action in an energy efficiency strategy. The EECBG program has brought three ideas to the fore, and they constitute an interesting definition of best practices in energy efficiency:

- Energy efficiency/conservation must be first in the loading order of energy practices. Renewables should happen only after energy efficiency is implemented, for two reasons:
  - Energy efficiency is inherently lower cost than renewables;
  - Placing renewables on a building that wastes energy is bad economy, as it subsidizes inefficiency.
- Energy efficiency should be a cross-cutting activity involving many sectors and collaborating institutions; shared resources mean greater savings. ARC as a regional collective has the power to encourage this among local governments, particularly through the Development District Association structure already in place.
- Innovation is to be sought out and rewarded, and part of its definition is that it is replicable in other contexts and is scalable up or down.

Under the ARRA, DOE awarded EECBG funds for energy efficiency as formula grants or entitlements, with funds going directly only to those counties large in population (over 200,000) or to the 10 largest counties in the state. This means that most counties in Appalachia have not been eligible for direct funding. Smaller local governments, therefore, seek funds through their State Energy Offices (SEOs), important allies.

SEOs can provide valuable, actionable information and many of them have to capacity to train local governments on issues relating to state laws, codes, standards, and energy-efficient practices and financing. Further, State Energy Offices in Appalachia and nationwide serve an increasingly important *financing* function in promoting energy efficiency at the local government level. Usually the ten largest counties by population within each U.S. state are eligible for DOE formula grants for energy efficiency; the funds come directly from the federal government. Smaller counties, which predominate in Appalachia, must seek energy efficiency grants from their State Energy Offices. In fact, the federal government requires State Energy Offices to share a significant portion of their federal funding with smaller counties. The table below contains information for online resources and personnel contacts for each state in the Appalachian Region.

A review of SEP resources reveals two gaps. First, while state governments are establishing their own internal energy tracking, the number of county governments that have determined a baseline of energy and water usage is unknown. Having baseline data is significant because it allows a region or county to set measurable goals and check progress as efficiency measures are implemented. Additionally, while there is information available on energy-saving practices like rainwater harvesting or waste management, the SEO websites do not usually link to the sources currently considered "beyond energy"; they do not connect practices even in the water and wastewater sector to opportunities for energy savings. The existence of these gaps shows the need for research and case studies focusing on county-level reporting and efforts to tie local renewable energy sources to energy efficiency goals, with a focus on how these practices could be scaled up to the state or regional level.

Table 2: Appalachian Region State Energy Office Websites

State Energy Office Website	Overview
Alabama *http://adeca.alabama.gov/Energy/default.aspx*	Alabama's site includes resources for a variety of energy efficiency and renewable programs listed by theme (from biomass to energy assurance), as well as links to ENERGY STAR and federal funding opportunities. It also includes an online grant resources center "available to assist users in researching, writing, and winning grants."
Georgia *http://www.gefa.org/*	The Georgia Environmental Finance Authority website has helpful tabs: one on Programs and Activities, outlining the variety of its sponsored programs (including water and sewer financing); another on Financing, which summarizes available loans, grants, and tax credits.
Kentucky *http://www.energy.ky.gov/*	Kentucky emphasizes energy independence. The Energy Office has six divisions, one of which is the Energy Efficiency and Conservation Division http://energy.ky.gov/efficiency/Pages/default.aspxoff ers a significant amount of information from and links to the ENERGY STAR program resources. The Division of Renewable Energy, http://energy.ky.gov/renewable/Pages/default.aspx , also provides many helpful links, including to the Kentucky Renewable Energy Consortium and the Kentucky Solar Partnership.

State Energy Office Website	Overview
Maryland *http://www.energy.state.md.us/*	Maryland has an information-rich website covering the private and public sectors, including a site for local governments, http://www.energy.state.md.us/Govt/index.html, containing information on available grants and links to state-vetted energy services companies for energy performance contracting. See http://www.energy.state.md.us/incentives/allprograms/epc/index.asp.
Mississippi *http://www.mississippi.org/index.php?id=4*	Mississippi's energy office website has informational tabs on Energy Services; Education and Awareness; Commercial and Institutional Buildings; Residential; Renewable and Clean Energy; and Financial Tools. Of special note to counties: Section 31-7-14 of the Mississippi Code allows local governing authorities and school districts to lease-purchase energy efficiency services and/or equipment for up to ten (10) years. Through this program, which aims to reduce origination fees and streamline the funding process, public entities have access to pre-arranged, tax-exempt lease-purchase financing. The State's Energy Division can select a third-party financier to fund energy projects such as lighting, boilers, cooling systems, energy management systems, and windows. More information is available at http://www.mississippi.org/energy/financial-tools/energy-efficiency-lease-program-for-public-facilities-and-private-nonprofit-hospitals.html.
New York *http://www.nyserda.org/*	NYSERDA's website holds information on everything from energy prices to financial incentive programs for the water/wastewater sector. Their section for local governments at http://www.nyserda.org/municipalities/default.asp, has links to programs providing energy audits and technical assistance, as well as financial incentive programs for new and existing buildings, including renewable systems installation.
North Carolina *http://www.energync.net/*	North Carolina's website has a page for local governments at http://www.nccommerce.com/energy/government-nfps with contact information for further assistance.
Ohio http://www.development.ohio.gov/Energy/	The Ohio Energy Resources Division, part of the Ohio Department of Development, works to serve both the private and public sectors. The Resources Division link is http://development.ohio.gov/Energy/default.htm.

State Energy Office Website	Overview
Pennsylvania http://www.portal.state.pa.us/portal/server.pt/community/pa_state_energy_program/10396	The state website provides local governments with a useful additional link to further tools and resources: http://www.portal.state.pa.us/portal/server.pt/community/local_government/10404/tools_and_resources/552386
South Carolina *http://www.energy.sc.gov/*	South Carolina's site has a public institutions link, at http://www.energy.sc.gov/index.aspx?m=7. Their page on financing energy projects covers performance contracting, a lease-purchase program, and South Carolina's revolving loan program, Conserfund, which will lend 100% of project costs at an annual interest rate of 2%. Borrowers may leverage up to $500,000 per fiscal year. See http://www.energy.sc.gov/index.aspx?m=7&t=48&h=180.
Tennessee http://www.tn.gov/ecd/CD_office_energy_division.html	Tennessee's Energy Division website focuses on attracting private enterprise investment by touting the state's efforts in biofuel technology, solar power, and electric vehicles.
Virginia *http://www.dmme.virginia.gov/divisionenergy.shtml*	The Division of Energy website, at http://www.dmme.virginia.gov/divisionenergy.shtml, links to information on alternative energy, renewables, the Commonwealth's energy-related programs, and ENERGY STAR resources.
West Virginia *http://www.energywv.org/community/eep.html*	West Virginia's website sorts information by theme -- energy efficiency, fossil energy, renewable energy, alternative fuels – as well as links to events such as energy summits. For example, the link on wind power yields maps of the wind class regions in the state detailing wind resources at 30, 50, 70, and 100 meters (http://wvcommerce.org/energy/renewable_energy/wind.aspx).

National resources for local governments can be found on DOE's **Office of Energy Efficiency and Renewables (EERE)** website, http://www1.eere.energy.gov/financing/. The site contains a listing of EERE funding opportunities, as well as links to financing resources. Given the recent funding provided through the Recovery Act, and distributed through the Energy Efficiency and Conservation Block Grant (EECBG) program, local and state governments are now also able to access resources and expert advisors on financing options.

On the DOE website, **The *Clean Energy Finance Guide for Residential and Commercial Building Improvements,* *Third Edition,*** is designed to help state, local, and tribal governments use federal funds to create financing programs that support energy efficiency and renewable energy upgrades. Funds include those from the DOE State Energy Program (SEP), Energy Efficiency and Conservation Block Grant (EECBG) Program, and the American Recovery and Reinvestment Act: http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/building_improvements_finance_guide.html.

EERE's Solution Center at http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/financingprograms.html contains links and resources for specific financing program types. The website presents and discusses the advantages and

disadvantages of each program type. Promising options for county governments to use in funding their own energy efficiency improvements include:

- State and municipal revolving loans, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/revolvingloanfunds.html, loan funds managed by the local government, where loan repayments recapitalize the fund to allow additional lending on an ongoing basis.
- Third party loans, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/thirdpartyloans.html, administered by a third party -- usually a bank or other financial institution – for energy efficiency or renewable energy improvements.
- Energy savings performance contracting, http://www1.eere.energy.gov/wip/solutioncenter/buildings/performance_contracting.html, contracting programs offered by energy services companies, where energy savings, verified by measurement and verification review, pay for the cost of capital improvements.
- On-bill repayment, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/onbillrepayment.html , relies on utilities to take on the role of financing entity; savings are directly paired with repayment, on the same bill.
- Power purchase agreements, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/ppa.html, for the installation of renewable energy systems, where the utility funds, installs, and owns the system, and the buyer purchases, at favorable rates, a long-term contract for the energy produced from the system.
- Qualified Energy Conservation Bonds, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/qecb.html, a debt instrument that enables qualified local government issuers to borrow money to fund energy conservation projects, and among the lowest-cost public financing tools because the U.S. Department of Treasury subsidizes the issuer's borrowing costs.

Local non-profits are additional sources of financing and technical assistance. **The Mountain Association for Community Economic Development (MACED)**, http://www.maced.org/ (accessed July 25, 2011), is a Kentucky-based non-profit organization that offers technical assistance to mountain towns in regions of Kentucky and Central Appalachia. MACED focuses on business and community development, providing energy efficiency outreach and tools, microloans for energy efficiency retrofits, and a solar capacity calculator for Kentucky.

SEDA-COG's Energy Resource Center, http://erc.sedacog.org/, provides guidance for energy conservation within various sectors in the central Pennsylvania region that the organization serves. The Center's website is tailored to a regional audience, including local governments, homeowners, business leaders, industry groups, schools, and non-profits. It provides specific information on how to finance energy savings. Replicating this type of resource throughout Appalachia would be a valuable tool in the implementation of local and regional energy plans.

Financing water management improvements

A number of federal programs offer funding opportunities for energy-efficient and decentralized water infrastructure. The most noteworthy, **the Clean Water State Revolving Fund** (CWSRF), may offer the greatest potential for assistance in the Appalachian Region. An EPA-sponsored program, CWSRF provides funding for innovative approaches to water management including decentralized wastewater projects, Smart Growth initiatives, low-impact development (LID) systems, and water conservation. Acting as banks, the CWSRF monies in each state provide capital for local programs to finance low- or no-interest loans for systems installations, retrofits and upgrades, and administrative costs. Funds are repaid over terms as long as 20 years and used to finance future projects. Though CWSRF had seen relatively small increases and even decreases in its operational allocation, the Recovery Act of 2009 provided an additional $4 billion in funding.

Additional funding opportunities might supplement CWSRF monies to promote the integration of decentralized infrastructure. The **Drinking Water State Revolving Fund** (DWSRF) recently began funding source water

protection projects. This could potentially include the construction and installation of infrastructure for wastewater and decentralized stormwater management. **Economic Development Administration (EDA) grants** offered by the U.S. Department of Commerce expressly provide funding to economic revitalization projects. Similarly, the U.S. Department of Housing and Urban Development's **Community Development Block Grant (CDBG)** can be used for water infrastructure if applied as a supplement to economic development efforts.

While DWSRF, EDA and CDBG monies are limited in scope to public projects, other programs specifically promote the private projects. **Water and Waste Disposal Loans and Grants**, available through the U.S. Department of Agriculture's Rural Utilities Service (RUS), seek to provide assistance to homeowners for the installation of treatment facilities on their property. RUS funding is available to residents in towns of less than 10,000 people and can be applied toward wastewater treatment and stormwater management facilities.

In general, trend-setting examples in the water-wastewater field are few but growing. More local research is needed to assess the viability of various financing mechanisms to promote energy efficiency and renewable energy at the local level. Municipalities and counties around the country have implemented a number of different financing options with returns on the investment, often paid for through a combination of loans and long-term utility bill savings. [Further assessment is needed to evaluate the success of current options in use, such as performance contracting, tax-exempt lease-purchase agreements, and revolving loan funds. The current infusion of ARRA funding has spawned research, analysis, case studies, and lessons learned from various financing options chosen for energy projects across different states and sectors. DOE will be posting this information on its website as it becomes available.

The role of utilities in financing

While people tend to think of utility companies in terms of monthly bills, transmission lines, electric/water meters, and power plants, utilities can also provide services such as performance contracting and demand side management (DSM) incentives to their customers to help reduce energy and water consumption. DSM focuses on planning and implementing activities that incite customers to modify their patterns of energy consumption. DSM involves several different techniques. Some programs emphasize the power of information by educating customers on ways to weatherize their facilities, improve lighting, and upgrade heating and cooling equipment. Another tactic involves the creation of rebates or low-interest loans linked to DSM to help pay for energy efficiency improvements. Not only do utility companies have the capacity to offer such services, utilities are essential in creating widespread policies and programs focused on efficiency. They also hold the key to facilitating the financing of such programs through mechanisms such as on-bill financing.

On-bill financing and its implementation in states like Kansas and Massachusetts is the subject of a useful white paper from September, 2009 from the National Small Business Association. Entitled ***On-Bill Financing: Helping Small Business Reduce Emissions and Energy Use While Improving Profitability***, it discusses in a helpful step-by-step manner how on-bill financing works as well as its advantages, such as easing of cash flow because no upfront capital is required (a recent NSBA study found that nationwide 52% of small businesses see cash flow as the primary barrier to investing in energy efficiency). Importantly, the study outlines two major barriers. The first is that state regulatory commissions usually impose caps on loan programs. This study suggests some possible solutions, including suggestions for matching funds. Secondly, default risk makes lenders and state utility commissions understandably nervous; they seek to define who will bear the risk for potential loan defaults. Studies of programs in operation (and these are few, as this is a new mechanism) suggest that this is a misplaced fear. The experience of the longest-running on-bill financing program, that of the Connecticut utility United Illuminating, is that since the inception of the program in 2000 default rates have been less than 1%, typically on the order of one to three defaults per year out of a total of 3,400 loans made. The white paper includes a state-by-state appendix of projected monthly and annual utility savings (electricity and natural gas) for small businesses that implement energy efficiency measures (based on the experience of states using on-bill financing). An average 25% savings is projected. For a small business in Tennessee this means yearly savings of over $4,700; for a small business in Alabama, yearly savings of over $5,300; and for a small business in New York State, the savings approach $7,000 per year. The NSBA study is available at http://www.naseo.org/news/newsletter/documents/2009-11-11-On-Bill_financing_for_NSBA.pdf.

A resource for understanding the range of existing incentive programs utilities offer is the **Database of State Incentives for Renewables & Efficiency** (**DSIRE)**. DSIRE is a national database with regionally applicable content. Sponsored by DOE and managed by the North Carolina Solar Center, in their words, DSIRE is the "national go-to resource . . . a comprehensive source of information on state, local, utility, and federal incentives

and policies that promote renewable energy and energy efficiency." It is particularly useful, and fits the criteria of this review, because it is a continuously updated database containing information on federal, state, local, and utility incentives and policies to promote energy efficiency and renewable energy. It allows local governments (both in the Appalachian Region and around the country) to investigate the incentive programs available in their states, whether sponsored by utilities, state agencies, or non-profits.

Each of the DSIRE links below contains a list of available incentives/policies (at the state level) for renewables and efficiency measures. From each link, there is an option to filter by sector. DSIRE's links contain a great variety of resources to support energy efficiency planning and financing in all target sectors: commercial, industrial, governmental, non-profit and institutional, and residential.

For example, the link for Kentucky reveals a listing for and a further link to the Mountain Association for Community Economic Development's (MACED) Energy Efficient Enterprise Loan Program, which provides micro ($10,000), small ($35,000), and large (up to $300,000) loans to qualified borrowers in the commercial, industrial, non-profit, schools, local government, installer/contractor, and institutional sectors to purchase a wide variety of equipment and upgrades, including energy efficiency and renewable energy technologies. The aim is "to finance energy efficiency projects that maintain a positive cash flow due to the resulting energy savings." The link to Ohio leads to information from Duke Energy on their commercial and residential energy efficiency incentive programs. The link to Mississippi reveals a production incentives program from the Tennessee Valley Authority for the installation, by homeowners and businesses, of renewable generation systems from qualifying resources (solar, wind, low-impact hydropower, and biomass); TVA will purchase 100% of the output from qualifying systems at a premium per kilowatt-hour (kWh) on top of the retail electricity rate.

Table 3: Appalachian Region State DSIRE URLs

State	Link to Resources for Energy Efficiency and Renewable Energy
Alabama	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=AL
Georgia	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=AL
Kentucky	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=KY
Maryland	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=MD
Mississippi	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=MS
New York	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=NY
North Carolina	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=NC
Ohio	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=OH
Pennsylvania	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=PA
South Carolina	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=SC
Tennessee	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=TN
Virginia	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=VA
West Virginia	www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=WV

5. Policy development and lead-by-example frameworks

While national examples exist for Appalachia to follow, much work is needed to assist the region's jurisdictions in setting relevant policy goals and creating long-term energy strategies. More region-specific policy assessment is needed to supplement existing resources. At the same time, research alone will not be enough to improve the existing regulatory landscape. Increased quantification of the benefits from relatively new regulatory mechanisms, such as required point-of-sale energy audits and disclosure, will assist in promoting the replication of effective measures. Targeted analysis of regulatory barriers and challenges unique to Appalachia can promote solutions and progress on the policy front, especially if the writing is specifically tailored to public sector decision-makers.

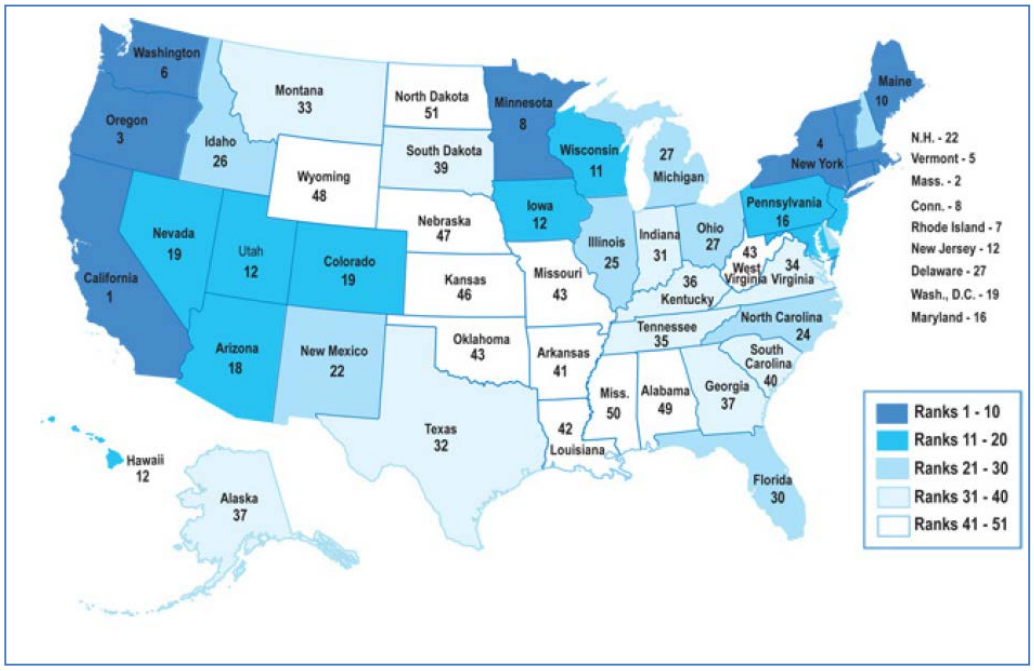
Practical guidance for policy implementation at the local government scale will also be particularly critical to regional energy efforts in coming years.

The ACEEE Scorecard

When considering the expansion of public sector energy efficiency programs in Appalachia, it is important to note issues of implementation and maintenance. State or local governments must have the capacity (financially and politically) to uphold the programs, as well as the leadership to do so. The American Council for an Energy-Efficient Economy's (ACEEE) *2010 State Energy Efficiency Scorecard* (http://www.aceee.org/sites/default/files/publications/researchreports/e107.pdf) provides an extensive analysis of efficiency program implementation and the subsequent success of the programs in each state.

The regional picture depicted in this scorecard shows that many states in the Appalachian Region lag behind other parts of the country in terms of their energy efficiency.

Figure 1: Map of 2010 ACEEE Energy Efficiency Scorecard Rankings



Source: ACEEE 2010 State Energy Efficiency Scorecard

ACEEE awarded states up to a total of 50 points based on six categories: utility and public benefits efficiency programs and policies (20 points); transportation (8 points); building energy codes (7 points); combined heat and power (5 points); appliance efficiency standards (3 points); and State Government Incentives (7 points).

Table 4: 2010 ACEEE Energy Efficiency Scorecard Rankings for Appalachian States

State	Utility / public benefits efficiency programs / policies (20 points)	Transport (8 pts)	Bldg Energy Codes (7 pts)	CHP (5 pts)	Appliance Efficiency standards (3 pts)	State Govt Incentives (Lead by Example) (7 pts)	TOTAL Points 50 max	Ranking among 51 States/DC
NY	12	5	6.5	5	1.5	4.5	34.5	4
MD	6	5	5.5	3	0.5	4	24	16
PA	4.5	4	6	5	0	4.5	24	16
NC	5	0	5	5	0	5	20	24
OH	4.5	0	3.5	5	0	4.5	17.5	27
VA	1.5	1	6.5	0	0	2.5	11.5	34
TN	1.5	2	2	1	0	4.5	11	35
KY	3.5	0	4	1	0	4.5	10.5	36
GA	1.5	1	4.5	0	0	3	10	37
SC	1.5	1	3	1	0	2	8.5	40
WV	0	0	3	1	0	2	6	43
AL	0	0	0	1	0	2	3	49
MS	0	0	0	1	0	1	2	50

Source: ACEEE 2010 State Energy Efficiency Scorecard

ACEEE aggregates information at the state rather than the county level. Four of the states with counties in the Appalachian Region— North Carolina (24), Pennsylvania (16), Maryland (16), and New York (4)—ranked in the top half, and nine states with Appalachian counties ranked in the bottom half.

The ACEEE report also breaks out finer results by category. The 20-point category of "Utility and Public Benefits Programs and Policies" includes these key metrics: electricity program spending, electricity savings, gas program spending, targets (energy efficiency resource standards), and utility incentives and removal of disincentives. West Virginia, Alabama, and Mississippi have a score of 0 in all these subcategories. Tennessee, South Carolina, Georgia, and Virginia have a total score of 1.5; Kentucky, 3.5; Pennsylvania and Ohio, 4.5; North Carolina, 5; Maryland, 6. Only New York State was a relative leader, with 12 out of 20 possible points distributed across the sub-categories.

The ACEEE report contains additional information helpful to understanding the effects of state regulations on local practices. For example, one of its charts shows states that have "decoupled" utility sales from revenues, thus removing the disincentives for utilities to reward customers for energy efficiency. Of the Appalachian States, ACEEE cites New York, North Carolina, Kentucky, Virginia, South Carolina, Georgia, and Ohio as having utilities offering performance incentives of any kind for energy efficiency; the Appalachian States where decoupling has occurred for both electricity and natural gas are New York, North Carolina, and Maryland.

Regulatory frameworks

This resource review captured a number of high-quality resources related to energy regulation. The **DSIRE website** features tools that allow comparative state-by-state analysis, including assessments of energy code status. This source might be particularly useful as a tool for research on best practices in regulatory reform and public sector programming. Another valuable resource cited previously is **USGBC's database** of LEED public policies at the local, state, and federal level. The database is continually updated and currently contains summaries of LEED-related initiatives in state and local governments. The USGBC LEED public policy database might be used not only to assess the state of green building regulation in the region, but to draw on nationally recognized leadership examples while drafting new policies. The development of an Appalachian Region-wide standard for LEED certification, for example, would be a unique regulatory initiative.

Building codes and standards

Building code stringency varies widely within Appalachian states. While many statewide codes are exceeded by local jurisdiction and county regulations, it is still possible that municipal energy requirements contain outdated standards. In Mississippi, for example, the state commercial and residential codes are based on ASHRAE Standard 90-1975, reflecting minimum requirements that are nearly three and a half decades old. Experience shows there is a correlation between the adoption of more stringent energy codes and reduced energy consumption. According to DOE's Building Energy Codes University, "research shows that if the 2006 International Energy Conservation Code® (IECC) . . . were upgraded to be 30 to 50 percent more stringent, adopted among states, and effectively implemented, significant benefits would be gained in terms of energy consumption, cost savings, and CO2 emissions reduction"—saving as much as $4 billion dollars for U.S. building owners by 2015.[6]

Table 5: Commercial and Residential Code Stringency Based Various Standards

State	Residential Code Stringency	Mandatory Adoption by County/Jurisdiction?	Commercial Code Stringency	Mandatory Adoption by County/Jurisdiction?
Alabama	AL Energy and Residential Energy Code	Mandatory	AL Energy and Residential Energy Code; 2006 IECC applies to public sector	Mandatory
Georgia	2009 IECC	Mandatory	ASHRAE 90.1-2007	Mandatory
Kentucky	2006 IRC	Mandatory	2009 IECC	Mandatory
Maryland	2009 IECC	Mandatory	2009 IECC	Mandatory
Mississippi	MS energy code based on ASHRAE 90-1975	Voluntary	ASHRAE 90-1975 applies to public sector and high-rises	Mandatory only for public buildings and high-rises
New York	2009 IECC	Mandatory adoption of 2009 IECC or more stringent standard	2009 IECC	Mandatory adoption of 2009 IECC or more stringent standard
North Carolina	2009 NC Building Code	Mandatory	2009 NC Building Code	Mandatory
Ohio	2006 IECC	Mandatory	2006 IECC	Mandatory
Pennsylvania	2009 IECC	Mandatory	2009 IECC	Mandatory
South Carolina	2006 IECC	Voluntary	2006 IECC	Voluntary
Tennessee	2006 IECC	Voluntary	2006 IECC	Voluntary
Virginia	2009 IECC	Mandatory	2009 IECC	Mandatory
West Virginia	2003 IECC	Voluntary	2003 IECC	Voluntary

Source: http://www.energycodes.gov/states/

DOE's "Status of State Energy Codes," Building Codes Energy Program, http://www.energycodes.gov/about/, contains up-to-date information on commercial and residential energy codes for each U.S. state and territory. Users can view maps to compare energy code stringency across states and access code analysis documents.

[6] http://www.energycodes.gov/becu/documents/BECU_Codes_101_Intro.pdf.

Zoning codes

Planning and zoning regulations help determine the potential for energy efficiency in communities. A forward-thinking set of policies lays the foundation for maximizing energy and resource potential; improving access, mobility, and livability; and reducing greenhouse gas emissions. Ideally, jurisdictions implement zoning codes that are both responsive to current priorities and adaptive to future needs. Against a backdrop of rising concern over climate change, economic turmoil, and energy issues, many local governments are recognizing the growing need for new zoning regulations that remove barriers to energy efficiency and sustainability.

A few examples are emerging within Appalachia. In 2006, the City of Pittsburgh enacted an amendment to award **Sustainable Development Bonuses**, allowing any building achieving LEED certification to exceed mandated zoning densities by up to 20%. Chattanooga, TN, has begun discussing **green zoning** principles under its 2009 Climate Action Plan. These are first or partial steps to more fully developed green zoning plans, which are broad in scope, covering issues of density, land use, tree cover, water management, transportation, and more. Adoption of such plans requires public involvement and comment.

The Philadelphia Zoning Code Commission (ZCC) recently undertook an effort to produce a New Zoning Code (http://www.zoningmatters.org/files/Best_Practices_Report.pdf) with help from a third-party consultant and input from the community. Along with an assessment of existing code and recommendations for improvement, the ZCC's **New Philadelphia Zoning Code Best Practices Report**, released June 2009, identified a series of recommendations in a number of categories, including sustainability. The best practices mentioned include the changing of zoning rules to promote transit-oriented development, renewable energy generation, water conservation, and urban food production. Specific techniques include the allowance of rain barrels or solar photovoltaic panels within certain setbacks and the explicit permitting of green roofs within certain zoning districts. The ZCC also addressed the need for improved building energy conservation. The September 2009 Detailed Recommendations for a New Zoning Code include a provision for floor area incentives based on energy performance.

Similar zoning code revisions are currently underway in Washington, DC, https://www.communicationsmgr.com/projects/1355/docs/TF%20Sustainability%20recs%20-%20%283-9-09%29.pdf and Salt Lake City, UT, http://www.slcgov.com/slcgreen/code/. In both cities, sustainable zoning has become a prominent theme, with significant input coming from a growing community of green professionals and concerned citizens. Reports discussing these efforts are listed in Appendix A.

Developing public policy

The University of Louisville's Center for Environmental Policy and Management sponsors a website, ***Climate Change Economics,*** which aims to offer access to objective analyses of the options facing the United States, and to equip policymakers and researchers at every level of government with a clearinghouse of resources and tools. Their library of resources includes diverse subjects, including risk and uncertainty analysis, state policies, and more: http://climatechangeecon.net/index.php?option=com_mtree&task=listcats&cat_id=43&Itemid=15

Best practices public policy examples

The Appalachian Region can draw lessons from numerous examples of best practices from peers across the country. These leadership examples, many of which occur at the local level, demonstrate the success of small but scalable projects and their impact, not only on resource and energy flows, but also in terms of creating social change in communities, cities, and regions. Below are examples of public programs and projects that have advanced energy efficiency through regulatory, financial, and other mechanisms.

Boston Green Building Credits. Boston has implemented a green building policy which requires all new construction and major renovation projects over 50,000 square feet to achieve an equivalent of LEED Certified according to the LEED for New Construction Green Building Rating System. The city created a unique set of "Boston Green Building Credits" to promote development that is responsive to local priorities and conditions. Projects can pursue traditional LEED credits or the Boston Green Building Credits in pursuit of the 26 points necessary to meet the LEED Certified equivalent. Found in Appendix A of Article 37 of the Boston Zoning Code, the Boston Green Building Credits include credits in four categories, including Modern Grid, Historic Preservation, Groundwater Recharge, and Modern Mobility.

The City of Boston also uses GIS databases in interesting and productive ways: http://gis.cityofboston.gov/SolarBoston/. Within this site, tools allow users to select a building and calculate its solar energy production potential. It is also an example of guidance that property owners can derive from overlaying layers of spatial information. For example, the City of Boston map of rooftop solar energy production potential can be overlaid on the City of Boston historic preservation map, highlighting where special permission (from Historic Preservation Boards) may be needed to install solar panels.

Seattle's Green Factor. Designed to increase the quantity of quality of vegetated areas in Seattle, the Green Factor http://www.seattle.gov/dpd/Permits/GreenFactor/Overview/ was adopted in 2006 as part of the city's Neighborhood District Business Strategy. The Green Factor sets requirements for minimum green space in new developments while providing a degree of flexibility to designers in terms of compliance pathways. The scoring systems used by the program is designed to encourage the use of native, larger, and drought-tolerant plants, pervious paving materials, and additional structural and non-structural best management practices to prevent stormwater runoff. The Green Factor requirements currently apply to new construction projects in commercial and commercial neighborhood zones outside of downtown.

Portland's Proposed "Feebate" System. The City of Portland is currently considering a new incentive to reduce the financial burden of building green. The proposed "feebate" system would assess a fee to buildings constructed just to code while providing a monetary award to high-performance green buildings. The fees and rebates are based on the requirements set forth in LEED; the greater the level of certification, the greater the rebate. Minimum credits in the Water Efficiency (WE) and Energy and Atmosphere (EA) categories would be required for projects to be eligible to collect rebates under the system. If approved, the new regulations will apply to new commercial and multifamily residential development. The policy also proposes that existing commercial and multifamily residential buildings publicly disclose energy consumption data by 2013.

Table 6: Feebate Structure for New Commercial Buildings

Feebate Option	Green Building Standards	Minimum Requirements (LEED Credits)	Reward or fee
Reward	Living Building Challenge	Net-zero energy and water documentation (1 year)	$8.65 – $17.30 / sf
	LEED Platinum	10 energy efficiency 4 water efficiency	$3.46 – $6.92 / sf
	LEED Gold	8 energy 3 water	$1.73 –$3.46 / sf
Waiver	LEED Silver	5 energy 2 water	Not Applicable
Fee	None		(-)$1.73 – (-) $3.46 / sf

Source: City of Portland Bureau of Planning and Sustainability, 2008

Table 7: Feebate Structure for New Multifamily Buildings Less Than 5,000 Square Feet

Feebate Option	Green Building Standards	Minimum Requirements (LEED Credits)	Reward or Fee
Reward*	Living Building Challenge	Net-zero energy and water documentation (1 year)	$2.58 – $5.15 / sf
	LEED Platinum or Earth Advantage**	10 energy efficiency 4 water efficiency	$1.03 – $2.06 / sf
	LEED Gold or Earth Advantage**	8 energy 3 water	$0.51 – $1.03 / sf
Waiver	LEED Silver or Earth Advantage**	5 energy 2 water	Not Applicable
Fee	None		(-) $0.51 – (-)$1.03 / sf

Source: City of Portland Bureau of Planning and Sustainability, 2008

Franklin, Massachusetts, Stormwater Guidelines. In 2001, the town of Franklin, MA, issued a ***Best Development Practices Guidebook*** outlining required water management measures to be included in new development. Projects seeking approval from the Planning Board or Board of Zoning Appeals are required to incorporate one or more best development practices (BDPs) from a checklist included in the Guidebook. Franklin's requirements cover erosion and sedimentation control, stormwater management, and landscape design. With a population of 30,000, Franklin is an example of a non-urban municipality promoting low-impact development. The outcomes of this set of policies for distributed water management have a direct impact on local and regional energy use, especially in terms of energy needed for water treatment and conveyance.

Boulder, Colorado, ClimateSmart Loan Program. Boulder County's ClimateSmart program utilizes Property Assessed Clean Energy (PACE) financing—a model by which up-front funding is loaned to property owners and repaid through an annual property tax surcharge over a period of 15 to 20 years—to offer low-interest loans to homeowners seeking to improve energy efficiency. Up to the entire up-front cost of home improvements is loaned to participating homeowners, which is paid back over a 15-year term. All loan applicants must attend a workshop summarizing a number of retrofit options and highlighting the financing mechanisms in place through the ClimateSmart program. Funding for the program comes from the periodic sale of bonds, and payment is made directly to contractors within seven days of the completion of work. All homeowners are required to sign a utility bill release for gas and electric to improve tracking.

The Babylon Project. Also an example of a PACE financing project, the Town of Babylon, New York, launched The Babylon Project to increase convenience and affordability for homeowners seeking to implement energy efficiency projects. Up-front financing is provided by the program, and property owners use one of two billing mechanisms to pay off projects: a pay-as-you-save addition to monthly utility bills, or a benefit assessment billed similar to a solid waste pickup fee. Initial funding for The Babylon Project was created by leveraging an existing solid waste management fund. The program is revenue neutral and operates without any allocation from the town's general fund.

Wisconsin Focus on Energy Water and Wastewater Program. Found at http://www.focusonenergy.com/Business/Industrial-Business/Wastewater.aspx, Focus on Energy "works with eligible Wisconsin residents and businesses to install cost effective energy efficiency and renewable energy projects. Focus information, resources and financial incentives help to implement projects that otherwise would not be completed, or to complete projects sooner than scheduled. Its efforts help Wisconsin residents and businesses manage rising energy costs, promote in-state economic development, protect our environment, and control the state's growing demand for electricity and natural gas." Focus on Energy is noteworthy as an example of a collaborative effort of a handful of organizations, including the Public Service Commission of Wisconsin, the Statewide Energy Efficiency and Renewable Administration, the Wisconsin Energy Conservation Corporation, the Energy Center of Wisconsin, and fiscal agents and independent evaluators.

Focus on Energy provides support for planning and financing energy-efficient infrastructure on many levels. It develops case studies and fact sheets, prepares technical guidance on implementing energy efficiency improvements, and provides expert support. And, importantly, it offers financial incentives for biogas anaerobic digesters, as well as solar, wind, and biomass combustion energy systems, and it offers financial incentives of up to 30% for the purchase and installation of energy-efficient upgrades.

NYSERDA's Focus on Water and Wastewater. The New York State Energy Research Development Authority (NYSERDA) Focus on Water and Wastewater http://www.nyserda.org/programs/Environment/muniwaterwwt.asp develops best practices fact sheets and technical handbooks and sponsors links to case studies of energy efficiency improvements. NYSERDA also provides cost sharing on a 50:50 basis—up to $50,000 per project—to conduct studies that evaluate equipment, controls, operations, processes, biogas production, and biogas use. The FlexTech Program uses NYSERDA's pre-qualified consultants to provide customized energy evaluations. The Technical Assistance Program allows customers to select their own contractor to undertake the study.

MassDEP Energy Management Pilot. Massachusetts of Department of Environmental Protection (MassDEP) Energy Management Pilot, http://www.mass.gov/dep/water/wastewater/empilot.htm, launched in December 2007. The project is working with seven water treatment and seven wastewater treatment facilities to assess their current energy performance, conduct audits, and evaluate renewable energy generation potential. MassDEP and local strategic partners are working together to assist in implementing efficiency and renewable energy projects that will result in energy savings for all targeted facilities. MassDEP is also currently assisting in the

identification of funding sources through the State Revolving Fund (SRF) and the federal stimulus package under the Recovery Act to complete the pilot project's findings and recommendations for each of the treatment facilities.

Efficiency Vermont. Efficiency Vermont, founded in 1986, is a non-profit organization created by the Vermont Legislature and Vermont Public Services Board to promote energy efficiency. The wastewater treatment home page highlights three completed energy efficiency projects and a best practices guide http://www.efficiencyvermont.com/pages/Business/SavingEnergy/WasteWaterTreatment/. One of the three case study sites, the Essex Junction Wastewater Treatment Facility, installed combined heat and power (CHP) equipment to produce energy onsite. The facility experienced a 36% reduction in energy costs with a payback period for the project of seven years. The facility treats on average 2 million gallons per day (MGD). Additional information on the case study can be found at http://www.northeastchp.org/uploads/Essex%20Junction%20Project%20Profile.pdf.

Palm Desert, California's PACE Financing and Public Outreach. PACE financing, up-front funding is loaned to property owners and repaid through an annual property tax surcharge over a period of 15 to 20 years, experienced a stumbling block in mortgage giant Fannie Mae's concern with potential defaults. While Fannie Mae has declined to underwrite mortgages with PACE assessments in the residential sector, PACE is still viable in the commercial sector. PACE financing arrangements allow property owners to finance renewable generation and energy efficiency improvements through low-interest loans that would be repaid over a period of up to 20 years as an item on the property owner's property tax bill. New buyers would assume the payments; and owners benefit from their facility's increased equity. There is no out-of-pocket expense, and owners are not subject to credit checks. Twenty-seven states have adopted PACE enabling legislation, including, in the Appalachian region, New York, Ohio, Maryland, Virginia, North Carolina, and Georgia.

Palm Desert was the first California town to adopt California Assembly Bill 811 (PACE Programs) for financing energy efficiency improvements after its passage in 2008, making it one of the earliest nationwide adopters of PACE. The city has a model energy management outreach program, publishing an energy newsletter, the *Bright Side*. Language below from the city's website, http://www.ab811.org/, provides an example of salesmanship:

Simply Put:

- *Low interest rate loan (so far at 7% amortized over 20 years) from the City attached to your property that resides within that city's limits and to be paid every six months through / along with your County property tax payment;*
- *Earmarked ONLY for and covers MOST energy efficiencies and renewable energies available to the public;*
- *Requires NO credit check and can pass to new owners of property without future credit checks through title transfer at escrow.*

AB 811 - What's in it for you?

- *You, as the owner of residential or commercial real property, immediately enjoy a greatly reduced electric bill with no out-of-pocket expense to you;*
- *If you sell your home or business, the new buyer can assume the payments, as you benefit from the increased equity at sale;*
- *Loans have a minimum of $5,000 and no maximum limits;*
- *Loans are not subject to credit ratings or credit checks;*
- *The interest rate is fixed at or near 7% and paid bi-annually through your property tax;*
- *Loans can be used on a variety of energy efficiency improvements and the materials and labor required to install them properly, [including] air conditioning and ventilation systems; energy efficient windows, doors and skylights; window films; tankless water heating equipment; white -roofs and coating [and] renewable energy sources [including] natural gas fuel cells; solar systems.*

Chapter 2: Best Practices in Planning and Financing Energy-Efficient Infrastructure—Case Studies in Appalachia

The goal of *Planning and Financing Energy-Efficient Infrastructure in Appalachia* is providing a practical framework to help local governments within the Appalachian Region assess, plan, and finance energy efficiency infrastructure and facility improvements. The foundation of the framework is a set of energy efficient practices and case studies of four Appalachian counties that have implemented such practices. The examples and case studies provide real-world examples of best practices in action that have resulted in quantifiable energy and cost savings, employment and income benefits, and greenhouse gas emissions reductions. We chose the four county case studies for these reasons:

- Their potential for widespread application in the Appalachian Region.
- The presence of existing data on costs and benefits, or the promise of significant cost and environmental benefits.
- The range of effort the best practices require, from those which are easy and immediate to implement, to those that require considerable planning and capital investment.

In this document, we use two methods to discuss a variety of best energy efficiency practices. The first method defines and presents best practices through an examination of eight distinct energy conservation measures, or ECMs. (Our second method, demonstrated in Chapter 3 of this study, presents four larger scale case studies of counties in the region that are pursuing a variety of ECMs and other best practices, thereby experiencing the benefits of the synergies among them and the potential for multiplied benefits.)

The eight distinct ECMS are:

1. Detecting and repairing leaky water supply systems and reducing inflow and infiltration (I&I) into sewer lines.
2. Improving stormwater management practices.
3. Replacing inefficient pumps, motors, and equipment for water/wastewater treatment plants and relying on gravity flow where possible.
4. Using combined heat and power or geothermal energy for public facilities and buildings.
5. Retrofitting HVAC and lighting systems in public buildings with energy-efficient alternatives.
6. Replacing grid-sourced power with community-owned onsite renewable energy.
7. Replacing conventional traffic signals with LED signals.
8. Commissioning building energy systems.

These ECMs vary considerably in scope, cost, and duration of payback period. Some are quickly achievable, relatively simple, non-intrusive, and affordable energy-efficiency retrofit actions. These simple actions can be funded as operating costs rather than capital expenditures, thus avoiding the assumption of debt through loans, bond issuance, performance contracting, or other common means of financing. Other ECMs, like the installation of renewable energy generation systems, are more capital-intense projects, but the amount of the potential savings they hold for county governments is significant over the long term. To finance these capital-intense projects, counties may look to one or a combination of different financing mechanisms outlined in Chapter 1, including federal grants, bond issuance (such as Qualified Clean Energy Conservation Bonds), and lease-purchase agreements.

Method for Extrapolating the Savings to the Region

Assuming that rates of adoption will be more widespread for the simplest retrofits and lower for more capital-intense retrofits, and assuming an electricity rate of $.08 per kWh, for each ECM we sought to extrapolate the combined savings over one year for the Appalachian Region if

- 80% of Appalachia's community water systems install advanced metering technology to identify and repair water infrastructure leaks;
- 50% of Appalachian counties adopted low-impact development practices, such as green roofs, for better energy and stormwater management;

- 60% of Appalachian wastewater plants eligible for aeration control upgrades implement these upgrades;
- 60% of Appalachian counties implemented combined heat and power, from biomass sources, for public facilities;
- 80% of the square footage of all local governmental buildings in Appalachia is retrofitted with energy efficient lighting;
- Fourteen (14) regional digesters for biogas production are constructed throughout the region;
- 80% of all the conventional traffic signals controlled by local governments in the Appalachian Region are replaced with LED traffic signals;
- 80% of the square footage of all local governmental buildings in Appalachia is "commissioned," ensuring that energy and energy efficiency systems—such as heating and air conditioning, ventilation, lighting, and the "weather enclosure" or building "envelope" (roof and exterior walls and their openings)—are operating as they were designed to operate.

Further, we based these extrapolations on a life-cycle cost analysis for each ECM, taking into account the costs to install, operate, and maintain each. We also applied a 7% discount rate to potential savings, in recognition of the concept that money received today and invested so as to provide returns may be worth more than money received in the future.

Eight Energy Conservation Measures–Snapshots of Best Practices

ECM 1—Detecting and repairing leaky water supply systems and reducing inflow and infiltration (I&I) into sewer lines

Description

"Grey" infrastructure is a term increasingly used to describe the grey concrete pipes, tunnels, roads, and man-made structures that supply cities and towns with water, energy, transportation, and more. It is conventional, business-as-usual infrastructure. The term was coined as a way to distinguish conventional infrastructure from "green" infrastructure, which the second ECM case study defines and examines. Each component of grey infrastructure usually has a single purpose, resulting in a proliferation of conduits, some for potable water, some for wastewater. For many local governments, the grey infrastructure of water mains, potable water supply pipes, and sewer systems is 50 to 100 or more years old. Reaching the end of its service life, the system's deterioration makes frequent repairs necessary. Because so much conventional water infrastructure is buried underground, not only is it difficult to access, it may be hard to know where the problem literally lies. Detection and repair are sometimes a matter of trial-and-error, or else the result of educated guesses.

Potable water losses and leaks from existing, aging water infrastructure are a significant concern for all water utilities in the United States. "Non-revenue" water is water that does not reach its ultimate destination (the users), and thus is not capable of being metered and billed. It "vanishes" or disperses during conveyance from the treatment plant to the end-users. Leaks in the distribution network result in a daily loss of an estimated six billion gallons of potable water.[7] These leaks have an associated (or embedded) energy loss because potable water requires substantial energy use to treat and distribute. And leaking or cracked pipes not only cause water outflow, they may cause inflow and infiltration of contaminants from ground sources, compromising water purity. **Detecting and repairing leaky water systems helps prevent potable water contamination as well as water and energy losses.**

[7] Wayne D. Morgan, *Preserving our Vital Resources: How Advanced Leak Detection Technologies Support Water Conservation*, Water Utility Infrastructure Management, March 5, 2010**,** http://www.uimonline.com/index/webapp-stories-action?id=371, accessed June 29, 2011.

Example Project: American Water—Connellsville, Pennsylvania, Advanced Metering Infrastructure Pilot Project

Project Summary. American Water is the largest private water services provider in North America, responsible for the maintenance of 45,000 miles of water main.[8] Looking to reduce the impacts of water losses, American Water devised a pilot study, conducted in the Appalachian Region in 2005, in Connellsville, Fayette County, Pennsylvania. Using fairly inexpensive, maintenance-free technology (powered by batteries with a 10-year life), the company put acoustic sensors on 500 Connellsville water meters, which were part of its Advanced Metered Infrastructure (AMI). AMI is "smart metering" for water; it involves two-way communication between water meters and a computer network, which records consumption data at regular intervals. The acoustic monitors, known as continuous acoustic monitoring (CAM) technologies, are like a mini-sonar system; CAM works with the AMI smart meters to detect leaks quickly:

Project: American Water – Connellsville Pilot
Cost to implement: $165,000
Cost savings: $250,000 annually
Estimated payback period: 6 to 8 months

"[When] CAM sonically detects the sound of water escaping a pipe, sophisticated vendor software displayed via a website interprets changes and the magnitude of sounds to rank the possible source locations and to identify the exact location of the leak. The leak can then be repaired, or the infrastructure replaced, as required. In the end, using these technologies to find leaks and better record water usage improves customer service, conserves water, and keeps rates down." [9]

Project Cost Savings and Payback Period. According to Dr. Marc LeChevallier of American Water,

"Within the first six months of monitoring, the study [the AMI pilot project] detected 46 leaks, representing 50% of the annual non-revenue water loss. As a result, total non-revenue water decreased by 15% (from 25% of total water to less than 10% of total water)—an annual reduction of $250,000 in purchased water expense, representing an estimated payback period of six to eight months."[10]

Rapid leak detection is also a preventative measure and, as such, affords longer term savings not quantified here. Rapid repair is likely to reduce overall repair costs as well as collateral damage.

The success of the Connellsville pilot has resulted in American Water's widespread adoption of smart metering throughout its service territory. The technology is inexpensive, and its automated nature reduces reliance on roving human meter readers; but a few barriers to widespread adoption do exist. The success of smart water meters relies on frequent interpretation of results, corrective action undertaken based on gathered data, and sufficient bandwidth to enable wireless communication. For local governments that can commit to the technology, the cost savings and rapid payback period make smart water metering a compelling strategy for efficiency.

Extrapolation of cost savings to the region

To reduce non-revenue water, American Water installed five hundred (500) meters with acoustic monitoring. Connellsville is a small city with a population just over 9,000. A 2005 study by the University of North Carolina[11] identifies around 1100 water systems in Appalachia that serve cities and towns in Connellsville's size category, with populations ranging from 3,300 to 100,000. This analysis assumes installations similar in scale and technology to the Connellsville pilot in around 80% of these community water systems, amounting to 880 total installations in Appalachia. The calculations below assume a more conservative payback period of 9 months, rather than the 6 to 8 months cited by American Water. Results are as follows, representing a potential source of considerable savings, with rapid payback, for municipal water authorities:

[8] David Hughes, *Infrastructure Integrity*, http://www.wwdmag.com/Infrastructure-Integrity-article11480, accessed June 29, 2011.
[9] Morgan, op.cit.
[10] Dr. Mark W. LeChevallier, Use of Available Information on Intrusion to Characterize Distribution System Problems, http://www.epa.gov/ogwdw/disinfection/tcr/pdfs/presentations/meeting_presentation_tcr-revisions_intrusiontocharacterize.pdf, undated presentation, accessed June 29, 2011.
[11] http://www.arc.gov/assets/research_reports/DrinkingWaterandWastewaterInfrastructure.pdf

Table 8: Savings from Water Supply Infrastructure Leak Detection, Repair, and Avoided Water Loss

	Per municipal system	**For Appalachian region**
Capital cost to purchase and install 500 meters per system	($187,500)	($165,000,000)
O+M cost	negligible	
Annual cost savings (annualized over 10 years) from avoided water loss	$231,250	$203,500,000
Payback period	0.75 years	
Return on investment	133%	
Net Present Value, 7% discount rate	**$34,714**	**$30,548,320**
Internal Rate of Return	87%	
Net Present Value, 7% discount rate	$12,277	$10,803,760

Local governments should take note: in North Carolina, the State has made the installation of leak detection devices a precondition of funding for counties seeking state grants for water infrastructure.

ECM 2—Improving stormwater management practices

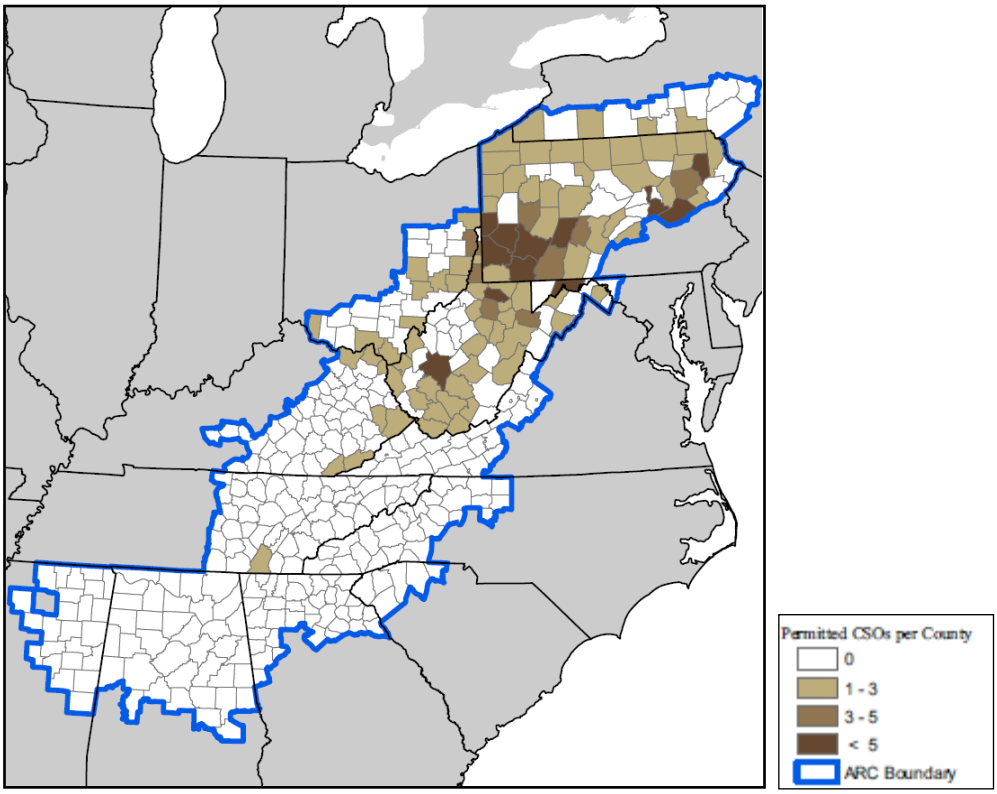
Description

Imagine a site without buildings and cars, without asphalt pavement, without a transformed and re-graded landscape. There, stormwater permeates the ground or runs to a natural swale where it can infiltrate over the next few hours or days, recharging the groundwater table. The leaves and roots of native plants and trees absorb some of the stormwater; vegetation flourishes. Civil engineers call this holistic predevelopment picture "the natural hydrology" or natural water distribution system of the site.

Usually, the post-development scenario is radically different. In a conventionally developed site, buildings and pavement interrupt the natural hydrology. Stormwater has nowhere to accumulate; it sheets off hard surfaces into the public wastewater infrastructure. If a local government has *combined* sewers for stormwater and wastewater from buildings, even during relatively minor storms those sewers overload. The overflow goes directly into adjacent water bodies (rivers, lakes, or streams) wherever municipalities have located their sewer outfalls. The raw, untreated sewage adversely affects aquatic life and human health, given that people often have direct contact with these water bodies while swimming, fishing, and boating. The map below, from the University of North Carolina's Environmental Finance Center, depicts the permitted number of annual combined sewer overflows in Appalachia, and shows the significant presence of combined sewers in Northern and Central Appalachia.[12]

[12] http://www.efc.unc.edu/projects/ARCregional.htm, accessed July 27, 2011. US EPA's CSO website contains a map of US locations with combined sewers, at http://cfpub.epa.gov/npdes/cso/demo.cfm.

Figure 2: Number of EPA Permitted Combined Sewer Overflow Systems per County in the Appalachian Region



Source: North Carolina's Environmental Finance Center

Large volumes of stormwater, when diverted to municipal infrastructure, end up at treatment plants, thus adding to plant loads and energy expenditures. Avoiding such loads means returning, as far as possible, to a natural strategy: onsite infiltration of stormwater.

By encouraging improved stormwater management, a local government saves money in three ways: in water treatment, in pollution fines, and in the decreased need for capital to build new "grey" or concrete infrastructure underground to handle the stormwater runoff. Operations and maintenance (O&M) costs may also be lower for green rather than grey infrastructure.[13]

Stormwater management is the foundation a set of best practices known as low-impact development, or LID. LID encompasses a number of possible design elements: using "rain gardens" (also called bioswales and biofiltration) and green roofs to slow infiltration runoff; reducing -- through increasing landscaping, tree planting, or the installation of pervious pavement -- the area of impervious surfaces to allow for more stormwater filtration and infiltration; and collecting stormwater for reuse. LID practices are part of "green" infrastructure (see p. 3), where natural systems and systems mimicking nature (such as green roofs) become integral to development and reduce or displace reliance on "grey" infrastructure. Grey infrastructure tends to be single purpose (and therefore, some argue, inefficient); green infrastructural ECMs have multiple purposes. Indeed, LID has many synergistic benefits:

- LID practices are not only effective in managing stormwater, but also pleasing to the eye; the result is aesthetic improvement, literal greening, by reintroducing a landscape with greater numbers of plants, grasses, and trees.
- Fewer hard surfaces and more landscape reduce heat island effect. Hard surfaces such as parking lots and building roofs typically absorb the sun's radiation and then radiate that heat outward, raising the ambient temperature of a site (i.e., heat island effect). That makes it more difficult and more expensive to cool buildings in warm weather. LID, however, helps change that dynamic.

[13] Stratus Consulting, *A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds, Boulder, CO*, August 24, 2009.

- More trees and landscape improve air quality as well as watershed health (their roots filter stormwater), reduce carbon dioxide (CO2) emissions, and provide better habitat for birds and aquatic animals downstream.
- With some additional planning at the facility level, reuse of stormwater can permanently reduce potable water use and deliver cost savings. For example, with cisterns or collection tanks in place, municipal buildings can use captured stormwater for non-potable uses such as landscape irrigation. New municipal buildings can incorporate water supply pipes running from stormwater collection tanks to toilet tanks during the design phase and take advantage of free stormwater for toilet flushing.

Example Project: Chattanooga, Tennessee, Low-Impact Development (LID)

Project:
Chattanooga, Tennessee – Low impact development (LID) implementation
Cost to implement:
Varies by site and strategy
Energy cost savings based on population (50% LID implementation):
$3.8 million in $2009 over 40 years
Estimated payback period:
Not calculated

Project Summary. Chattanooga, in Hamilton County, Tennessee, is one of the first cities in the Appalachian Region to base its municipal stormwater fee (or water quality fee) on the amount of a site's impervious surface.

Given its considerable annual rainfall levels (54.5 inches per year), Chattanooga is prone to flooding, erosion from flooding, and contaminant loading in the watershed as a result. The city originally adopted a water quality fee out of necessity to pay for monitoring stormwater runoff and stream sampling required by the 1996 National Pollutant Discharge Elimination System (NPDES) permit. In 2010, Chattanooga decided to tie the user fee rate structure to an "intensity of development" methodology, where the fee is based on the amount of each site's impervious surface. For a site with an impervious area of 100,000 square feet, the stormwater fee is nearly $300 per month.

Using aerial photos to calculate the impervious surface for sites with nonresidential or multifamily residential development, the City cuts the fee in half for those property owners whose facilities provide water quality and water quantity control measures, encouraging innovative runoff reduction measures.[14] Sites that do not discharge to a municipal stormwater drain are exempt. Chattanooga then uses the collected fees to improve stormwater systems, renovate streams, and eliminate sewer discharge. Still, in 2010 the city experienced two "major sewage-contaminated overflows to the Tennessee River,"[15] and Mayor Ron Littlefield has put into place a stormwater permit that requires new development or redevelopments to hold the first inch of rainfall and keep it out of city storm drains. To lead by example, the city also spent $700,000 in 2010 to build a pervious concrete parking lot and rain garden at Chattanooga's Renaissance Park.

[14] Chattanooga Times-Free Press, December 4, 2010, "New Stormwater Permit May Help on Sanctions."
[15] Ibid.

Figure 3: View of Chattanooga, Tennessee's Renaissance Park Rain Garden

Source: http://www.chattanoogan.com/articles/article_173042.asp, accessed August 15, 2011.

Cost Savings and Payback Period. Economists are beginning to quantify the savings that LID practices represent as compared to the kind of conventional infrastructure defined and discussed earlier. The "Stratus Report" prepared for the City of Philadelphia, Pennsylvania, by Stratus Consulting in 2009,[16] bases its comparative estimate of green versus grey infrastructure on an array of monetized benefits associated with green infrastructure, among them being increased property values and increased recreational opportunities. When compared to the costs of constructing a large capacity stormwater tunnel, implementing low-impact development in 50% of the area of Philadelphia would result in more than $2.5 billion in city-wide present value benefits (or reductions in costs) accruing over 40 years.[17] During this 40-year period, energy cost savings would total $33.7 million; greenhouse gas emissions savings (SO_2, NO_x, and CO_2) would be $67.5 million. These estimated savings are from all the benefits cited earlier, including avoided wastewater treatment expense, increased property values, and improved air quality; the Stratus Report includes an explanation of contributing factors and methodology.

How does the Philadelphia benefit analysis apply to Chattanooga? Excluding river area, the land area of Philadelphia and Chattanooga are, at 135 square miles each, almost identical. Chattanooga has a much higher annual rainfall, 54.5 inches, compared to Philadelphia's 41 inches per year. Looking at potential avoided pollution and downstream impacts from combined sewer overflows caused by the rainfall, Chattanooga may have even more to gain from implementing LID, especially considering the value of avoided NPDES fines. As for other variables, such as avoided disruption from the construction of conventional stormwater infrastructure, here the benefits comparison favors Philadelphia as it is a much denser city. Philadelphia's 2009 population was 1.5 million compared to Chattanooga's 167,000, with a higher population density—11,454 people per square mile to Chattanooga's 1,150. Taking the cost savings the Stratus Report attributes to energy savings alone (such as avoided wastewater treatment, energy efficiency from green roofs and shade trees, and the like) and eliminating the non-energy benefits of LID, by implementing green infrastructure over 40 years Philadelphia saves $22.50 in 2009 dollars for each of its 2009 citizens. Translated to Chattanooga's 2009 population, the cumulative savings would be $3.8 million in 2009 dollars over 40 years.

[16] Stratus Consulting, A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds, Boulder, CO, August 24, 2009.
[17] Ibid, p. 5-5.

Extrapolation of cost savings to the region

Green infrastructure and low-impact development (LID) practices include the installation of green roofs and bio-retention swales, tree planting, and the reduction of unnecessary hardscape. By implementing a variety of LID practices, county governments in Appalachia will see general benefits in cost savings from reduced flows to storm sewers during heavy rains and reduced infrastructure maintenance costs. Costs of implementation vary depending on the type of LID practice installed. An analysis of benefits must weigh the long-term benefits of green infrastructure, which may have a higher "first" cost but greatly reduced costs over the life cycle. Many of the environmental benefits of green infrastructure have yet to be monetized fully. Cities and counties in the forefront of its implementation are gathering data on benefits. They are also comparing the life-cycle costs of green infrastructure against the long-term, life-cycle costs of conventional, grey infrastructure – long term costs that may be much higher.

As an example, consider a green infrastructure strategy widely considered to be among the most expensive: green roof installation. Green roofs, known for their multiple benefits, not only help manage stormwater, but improve surrounding air quality as well the energy efficiency of buildings on which they are installed. According to the Green Roof Infrastructure Industry Association's website,

"In summer, depending on the plants and depth of growing medium, green roofs retain 70-90% of the precipitation that falls on them; in winter they retain between 25-40% . . . The greater insulation offered by green roofs can reduce the amount of energy needed to moderate the temperature of a building, as roofs are the sight of the greatest heat loss in the winter and the hottest temperatures in the summer. For example, research published by the National Research Council of Canada found that an extensive green roof reduced the daily energy demand for air conditioning in the summer by over 75%."[18]

The City of Chattanooga, Tennessee has conducted a cost-benefit analysis of green roofs it will install on five municipal buildings.

Table 9: Chattanooga, Tennessee Green Roof Cost-Benefit Analysis

	Sq ft	Cost	Tonnes GHG reduced	$s saved per ton GHG	Estimated annual $ savings	Estimated annual energy savings
Green Roofs		*$10/ft²* $285,980 total				
Bessie Smith Hall trellises	1,500	$15,000	36	$10,406/ton	$3,480	55,176 kWh
City Council	6,300	$63,000	12	$10,500/ton	$1,170	18,558 kWh
City Hall Annex	8,560	$85,600	18	$9,511/ton	$1,590	25,215 kWh
Health & Wellness Center	7,278	$72,780	15	$9,704/ton	$1,353	21,438 kWh
Police Precinct at Farmers Market site	4,960	$49,600	36	$10,277/ton	$3,438	54,495 kWh

Material and installation costs, at $10 per square foot, align with the lower end of green roof cost projections from the University of Wisconsin-Milwaukee for shallow, or extensive, green roofs. This initial cost includes design, permitting, preparatory reroofing, installation, and plant material; the Wisconsin research suggests that O+M costs are required for the first two years only, at $2 per square foot,[19] after which minimal or no maintenance is required. The City of Chattanooga, in the table above, projects additional annual energy savings of 6.12 kWh/sf based on a blend of building types. This kWh savings, multiplied by a $0.08/kWh average energy

[18] http://www.greenroofs.org/index.php/about-green-roofs/2577-aboutgrnroofs

[19] http://www.glwi.freshwater.uwm.edu/research/genomics/ecoli/greenroof/roofinstall.php#costs, accessed August 12, 2011.

price across the region, yields $0.49/sf average annual energy savings. Of further note for our analysis is that the average life span of a green roof is long, projected to be forty years.[20]

Compare these numbers to those associated with the installation or reinstallation of a conventional flat roof. The conventional flat roof has an average life span of only ten years, material and installation costs of $5 per square foot, O+M costs of $0.25/year, and no increased energy savings benefits (and improved occupant comfort) from avoided heating or cooling loads.

Table 10 presents the comparative life-cycle cost analysis of green roofs and conventional flat roofs over a twenty-year period. It demonstrates that although the first cost of green roofs is twice as high as that of conventional flat roofs, the operations and maintenance and energy savings from green roof installation are significant, and offer complete payback over its forty-year lifespan. Not so with the conventional flat roof, which requires significantly more in operations and maintenance costs over the twenty-year period. Over the full forty-year green roof life cycle, comparative savings from green roofs increase even further, because conventional roofs will require replacement three times within those forty years. Note that this life cycle cost analysis does not take into account other factors which, if the benefits were to be monetized, would further favor green roofs; these include reduced environmental impacts through avoided air pollution, reduction of greenhouse gases, reduction of heat island effect, avoided contributions to landfills, and better stormwater management.

Table 10: Comparative Green Roof and Conventional Roof Life Cycle Cost Analysis

	Per county, green roof option	**Per county, conventional flat roof option**	**30,000 sf / green roof installation in half of all Appalachian counties**	**30,000 sf / conventional roof installation in half of all Appalachian counties**
Costs to install 30,000 sf of roofing	($300,000) $10/sf	($150,000) $5/sf	($63,000,000)	($31,500,000)
O+M costs over 20 years	($60,000): $2/sf in years one and two only	($292,500): $0.25/sf and total roof replacement in year eleven	($12,600,000)	($61,425,000)
Annual energy cost savings	$14,700	---	$3,087,000	---
Energy cost savings over twenty years	$294,000	---	$61,740,000	---
Annual costs or savings (annualized over 20 years, taking O+M into account)	$8,700	($14,625)	$1,827,000	($3,071,250)
Total costs or savings over 20 years	$174,000	($292,500)	$36,540,000	($61,425,000)

To speak to the benefits of implementing a larger suite of green infrastructural practices, the cost savings cited in a recent report[21]—on the benefits of a variety of LID practices for the City of Philadelphia—attributes a savings of $.56 per citizen per year to energy savings alone. This savings eliminates non-energy benefits of LID, and thus comes from factors such as avoided wastewater treatment and energy efficiency from green roofs and shade trees. If the population of Appalachia remains around 25,000,000, **annual energy cost savings for 50% implementation would be around $7,000,000 per year for the region.**

[20] http://your.kingcounty.gov/solidwaste/greenbuilding/documents/KCGreenRoofStudy_Final.pdf, page 5.
[21] Stratus Consulting, *A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds*, Boulder, CO, August 24, 2009.

ECM 3—Replacing inefficient pumps, motors, and equipment for water/wastewater treatment plants and relying on gravity flow where possible

Description

There is great savings potential in wastewater treatment plants, one of the most energy-intensive processes in the publicly funded sphere. Community water and wastewater services both consume a significant amount of energy. A New York State 2009 memorandum observes that,

"Energy is consumed in all stages of the water and wastewater treatment, conveyance and collection cycles, and the rate of use is increasing as facilities install new, more energy-intensive technologies to address a variety of issues. However, significant energy efficiency opportunities exist for most, if not all, municipal treatment facilities. Based on a recent survey . . . it is estimated that energy consumption at most municipal treatment facilities could be reduced by 10% to 20%, with opportunities to reduce energy consumption at some facilities by up to 50%."[22]

EPA estimates that **energy costs for water and wastewater treatment and conveyance can be as much as one-third of a municipality's total energy bill; for local governments, targeting wastewater treatment plants for energy audits and retrofits can yield big energy, cost, and carbon emissions savings**.[23]

Delivering dissolved oxygen, a process known as "aeration," drives the biological process that breaks down the waste in wastewater. Oxygen delivery is very energy intensive, using between 25% and 60% of total plant energy.[24] In conventional plants, operators manually monitor the levels of dissolved oxygen by taking readings from the oxidation ditches, and then manually adjust the speed of the motorized rotors that aerate the wastewater in the ditches. Aeration control is a retrofit measure that has wide applicability in wastewater treatment. Substantial savings are possible from implementing two linked improvements:

- Automated, continuous, real-time readings of dissolved oxygen levels.
- Motors equipped with variable frequency drives (VFDs), allowing them to vary speeds instead of always operating at a constant pace, and then synching their speeds to the real-time information from the automated readings.

Example Project: Bartlett, Tennessee, Wastewater Treatment Plant

Project:
Bartlett, Tennessee – Automated wastewater treatment plant aeration controls; variable frequency drive motor speed controls
Cost to install:
$13,500
Cost savings:
22% energy cost savings annually
Estimated payback period:
1.5 years

Project Summary. The Bartlett wastewater treatment plant (just outside the Appalachian Region)[25] treats one million gallons per day (1 MGD), which puts it near the average wastewater plant size in Appalachia (according to EPA's Clean Watersheds Needs Survey database as outlined in Table 11, below.) The plant was retrofitted as part of a demonstration project by the Tennessee Valley Authority (TVA) to assess potential energy savings for wastewater plant upgrades. TVA replaced conventional membrane-dissolved oxygen (DO) probes with newer, easy-to-use optical probes and retrofitted aeration pumps with VFDs. The control of the aeration system was automated based on dissolved oxygen readings. This was a relatively low-

[22] Anne Reynolds, Kathleen O'Connor, Richard Svenson, David Bradley. Memorandum. January 28, 2009. http://www.nysefc.org/docs/smart_growth_draft_final__12-01-08.pdf
[23] USEPA. 2008. Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities, http://www.epa.gov/owm/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf
[24] USEPA. 2010. Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities, available online at http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf
[25] Our search for a representative example for the Appalachian Region led us to case study No. 4 in an EPA report on energy conservation (available online at http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf), a study of a wastewater treatment plant just outside the Appalachian Region in Bartlett, Tennessee.

cost retrofit ($13,500 installation cost, in 2007 dollars) that proved easy to operate and maintain. As a result of this installation,

" . . . One rotor in each of the plant's two oxidation ditches operates continuously at full speed and the second rotor's speed varies, depending upon the DO reading in the oxidation ditch. The VFD controls the second rotor's input electrical power frequency between 60 Hz (at full speed) and 30 Hz (at minimum speed) and rotational speed depending on the input DO reading. The second rotor reaches full speed for only 30 to 45 minutes each day during the peak flow period. The frequency input to the second rotor from the VFD is 30 Hz for much of the day and occasionally the VFD controlled rotor is turned off when the setpoint DO concentration can be maintained exclusively by the primary single, full speed rotor."[26]

Cost Savings and Payback Period. The Bartlett wastewater treatment plant experienced a 13% reduction in kilowatt-hours (kWh) consumed per year, a 39% reduction in peak demand, and a 22% reduction in annual electrical energy costs. Based on annual energy savings of $9,176 and an ECM implementation cost of $13,500, the Bartlett plant retrofit realized a payback in less than 1.5 years.

EPA's case study of the Bartlett plant outlines further potential cost savings beyond the energy costs savings:

- **Labor:** Prior to implementing the aeration system ECM, manual monitoring of the DO concentration in the oxidation ditches required an operator's attention for approximately one hour/day (260 hours per year) at an associated labor cost of $4,680 per year. This requirement has been eliminated by automatic DO monitoring. (Note that, rather than eliminating a job, this allows the operator to do other essential work.)
- **Maintenance:** The Insite IG DO sensor requires no periodic maintenance other than monthly inspection and rinsing with a garden hose and annual calibration. The annual cost associated with this maintenance activity is approximately $200/year.[27]

Extrapolation of cost savings to the region

There are many variables in wastewater plants—size of plant, type of treatment, different treatment components used, and so on. In order to know the regional benefits of an improvement, we first need to know how many plants in the region could use that improvement. To this end, national wastewater plant data from EPA's Clean Watersheds Needs Survey database was gathered and filtered to only include plants in Appalachian counties. Wastewater plants were further filtered to only include plants with recorded flow rates. Potential energy savings from ECM #3 for local governments depend on the size of their treatment plants as measured in daily wastewater flows. Therefore, choosing a representative case study of wastewater treatment plant energy savings for the Appalachian Region requires knowing the average size of Appalachian wastewater plants measured in millions of gallons per day (MGD) of wastewater flows. Table 10 below is a summary of national wastewater plant data from EPA's Clean Watersheds Needs Survey database, filtered to include plants in Appalachian counties, and only those plants with recorded flow rates:

Table 10: Characterization of Wastewater Plants in Appalachia

Size category (flow treated, MGD)	0.001–0.1 MGD	0.101 – 1.0 MGD	1.001 – 10 MGD	10.001 – 100 MGD	More than 100 MGD	TOTAL
Number of wastewater plants in Appalachia	620	936	370	30	1	**1,957**
Average plant flow (MGD /plant)	0.0499	0.378	3.04	22.3	164	
Total flow treated (MGD)	30.94	353.81	1,124.80	669.00	164.00	**2,342.55**
Total annual flow treated in Appalachia (MGD)						**855,029**

Source: Clean Watersheds Needs Survey 2008 (USEPA), http://oaspub.epa.gov/portal/page/portal/CWNS%Reports/download

[26] http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf pp. 160-1, accessed July 5, 2011.

[27] http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf pp. 163-4, accessed July 5, 2011.

Aeration control is a retrofit measure that has wide applicability in wastewater treatment. Further, because aeration—delivering dissolved oxygen—drives a biological process that breaks down waste in wastewater, it is by its nature energy intensive, using between 25 and 60 percent of total plant energy.[28] The Bartlett, TN treatment plant outlined in this case study runs at 1 MGD, which puts it near the average wastewater plant size in our region. After upgrades—replacing conventional membrane dissolved oxygen probes with optical probes; retrofitting aeration pumps with variable speed drives; and automating the aeration system controls based on dissolved oxygen readings—the energy savings for the plant was 13%. If we extrapolate to other plants in the region, the energy cost savings for each 1 MGD of wastewater treated is $307.84, which adds up, over one year, to $112,360 of savings per MG treated. The Net Present Value of energy cost savings per MGD treated is $128.50.

Table 11: Savings for Aeration Controls in Wastewater Treatment

Energy Use (Source: average electricity use for wastewater plants in NY, from NYSERDA http://www.nywea.org/clearwaters/08-1-spring/04-NYSERDA.pdf)	
Average Electricity Consumption per flow (kWh/MG)	1,480
Total Annual kWh for treating wastewater in Appalachia	1.27E+09
Electricity Cost	
Electricity rate ($/kWh)	**$0.08**
Total annual energy cost/MG Treated	**$118.40**
Total Annual kWh for treating wastewater in Appalachia	**1.27E+09**
Total Annual Energy Cost for treating wastewater in Appalachia	**$101,235,467.94**
Aeration Control upgrade costs and savings	
Upgrade costs (Source: Case study No. 4, Bartlett, TN treatment plant http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf)	
Average Plant Flow (MGD)	1.0
Total annual flow treated (MG)	365.0
Total upgrade cost (2007$)	$13,500.00
Incremental operation and maintenance costs*	$ -
Upgrade cost per total annual flow treated ($/MG)	$ 36.99
* O&M costs may actually decrease compared to current aeration control system	
Energy Savings (Source: see previous table)	
Annual Energy Savings (kWh/yr)	71,905.00
Annual energy savings (%)	13%
Annual savings ($)	$5,618.08
Annual Pre-upgrade Energy Cost ($)	$43,216.00
TOTALS	
Percent of plants that can implement improvement	60%
Total MG that can be upgraded to automated control	513,018

[28] EPA Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities (2010), available online at http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf

Life (assume 20 years)	20
Upgrade cost per flow treated ($/MG)	$36.99
Total upgrade cost for plants that can be upgraded ($)	$18,974,622.60
Annualized cost (20 yrs, 7% discount rate)	($1,673,897.33)
Electricity savings from upgrade (%)	13%
Annual electricity savings for plants that can be upgraded (kWh/yr)	9,870,000
Annual cost savings for plants that can be upgraded ($/yr)	$ 7,896,366.50
Total Energy Saved (kWh)	1,974,091,624.75
Energy Saved / MG (kWh)	3,848.00
Cost of Energy Saved	$157,927,329.98
Cost Saved / MG	$307.84
Payback period (years)	2.4
Total NPV	$65,920,927.03
NPV / MG	$128.50

ECM 4—Using combined heat and power (CHP) or geothermal energy for public facilities and buildings

Description

EPA defines CHP as follows: "Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source, such as natural gas, biomass, biogas, coal, waste heat, or oil. CHP is not a single technology, but an **integrated energy system** that can be modified depending upon the needs of the energy end user."[29]

CHP provides:

- **Onsite generation** of electrical and/or mechanical power.
- **Waste-heat recovery** for heating, cooling, dehumidification, or process applications.
- **Seamless system integration** for a variety of technologies, thermal applications, and fuel types into existing building infrastructure.

The benefits of CHP include **savings through avoidance of energy losses** during transmission; **recapture of energy lost** in the generation process; **reduced waste** if burning waste as fuel; **reduction of carbon emissions,** because comparatively less fuel is needed to produce energy output; and **greater energy assurance and reliability**, because of decreased reliance on the power grid. All told, direct and indirect cost savings can be substantial, especially with rising prices for purchased fuel. CHP total system efficiencies are usually between 60% and 80%.[30]

Example Project: Cayuga Nature Center Biomass Combined Heat and Power, Tompkins County, New York

Project Summary. Most long-running CHP examples in the Appalachian Region are industrial rather than public-sector facilities, and most in the region and nationwide involve onsite heat recovery from burning natural gas.

[29] http://www.epa.gov/chp/basic/index.html, accessed July 5, 2011.
[30] http://www.epa.gov/chp/funding/financial.html#tabnav accessed July 5, 2011.

Tompkins County, New York, however, has a demonstration project for biomass heat and power—the Cayuga Nature Center, a public building. The New York State Energy Research and Development Authority (NYSERDA) has funded this project to—

Project:
Cayuga Nature Center, Tompkins County, New York–Biomass CHP
Cost to install:
$155,000
Cost savings:
75% energy cost savings
Estimated payback period:
Nine years simple payback

". . . demonstrate a fully automated, 90% efficient wood-gasification boiler technology that is proven in Europe and adapted for the U.S. market. These systems have emissions that are significantly better [lower] than conventional wood boilers and comparable to typical oil or gas boilers. Mid-sized buildings (10–100,000 sq.ft.) represent 90% of the boiler market in the U.S., and are prime targets for these wood systems, which can achieve rapid paybacks when replacing fossil-fuel boilers."[31]

Biomass is a significant potential fuel source given the forested and agricultural nature of the Appalachian Region. The Appalachian Regional Commission's report *Energizing Appalachia: A Regional Blueprint for Economic and Energy Development* estimates annual Appalachian biomass resources at over 108 million tons.

Biomass ". . . can be derived from many sources and can be used in equally as many ways. Sources of biomass range from forest thinnings and wood waste, to agricultural waste such as manure and corn stover, to methane gas from landfills. Many of these sources are currently produced as waste products from other agricultural or industrial processes, yet there is an increasing degree of research and activity around biomass production exclusively for use as a fuel in the form of dedicated energy crops. Short rotation woody crops including fast-growing willow and poplar species, as well as agricultural commodities such as corn are currently being grown for use as fuel feedstocks in the energy sector."[32]

In terms of the availability of biomass, Tompkins County is typical of the Appalachian region:

"Tompkins County has a land area of about 300,000 acres of which about 40,000 are cultivated and another 20,000 are developed. The remaining 240,000 acres are about two-thirds forested and one-third open land growing grasses, weeds, and brush. Current annual biomass growth on this undeveloped and uncultivated acreage is approximately 160,000 tons, the bulk of which has no commercial value. If harvested, the heating value of this biomass would be equivalent to 20 million gallons of fuel oil, enough to heat every home and business in the county."[33]

At the heart of the Cayuga Nature Center CHP installation is a wood chip-fired boiler; the preexisting propane system is kept as a backup. The boiler can produce 400,000 British thermal units (Btu) per hour from burning chips from adjacent forest brush wastes, more than enough to power the 10,000 square foot Nature Center. Note that this biomass source is brush and forest waste rather than a harvest of old-growth trees; the ecological costs of such deforestation would outweigh the benefits of using biomass as a fuel.

In the case of Cayuga, NYSERDA funded the project to support the evaluation and improvement of biomass-fired heating equipment, promote New York-grown fuels, create new manufacturing jobs, and improve environmental performance of biomass technologies.

Cost Savings and Payback Period. The costs of biomass CHP vary depending on fuel source, location, and technology. One source describes investment costs in this way:

"The investment costs of biomass CHP and power plants with capacities of up to 50 MWe [megawatt, or one million watts, electrical] are between $3,000 and $6,000/kWe (US$2008). The annual operation and maintenance cost (O&M) of the CHP plants is approximately $100/kWe. The incremental investment cost and the annual O&M cost of biomass co-firing in coal-fired power plants are approximately $335/kWe and about $12/kWe, respectively. The investment costs of anaerobic digesters [used to break down animal and crop wastes] with gas-engines for CHP are in the range of $3,000 to $5,000/kWe, with annual O&M cost of about $300/kWe."[34]

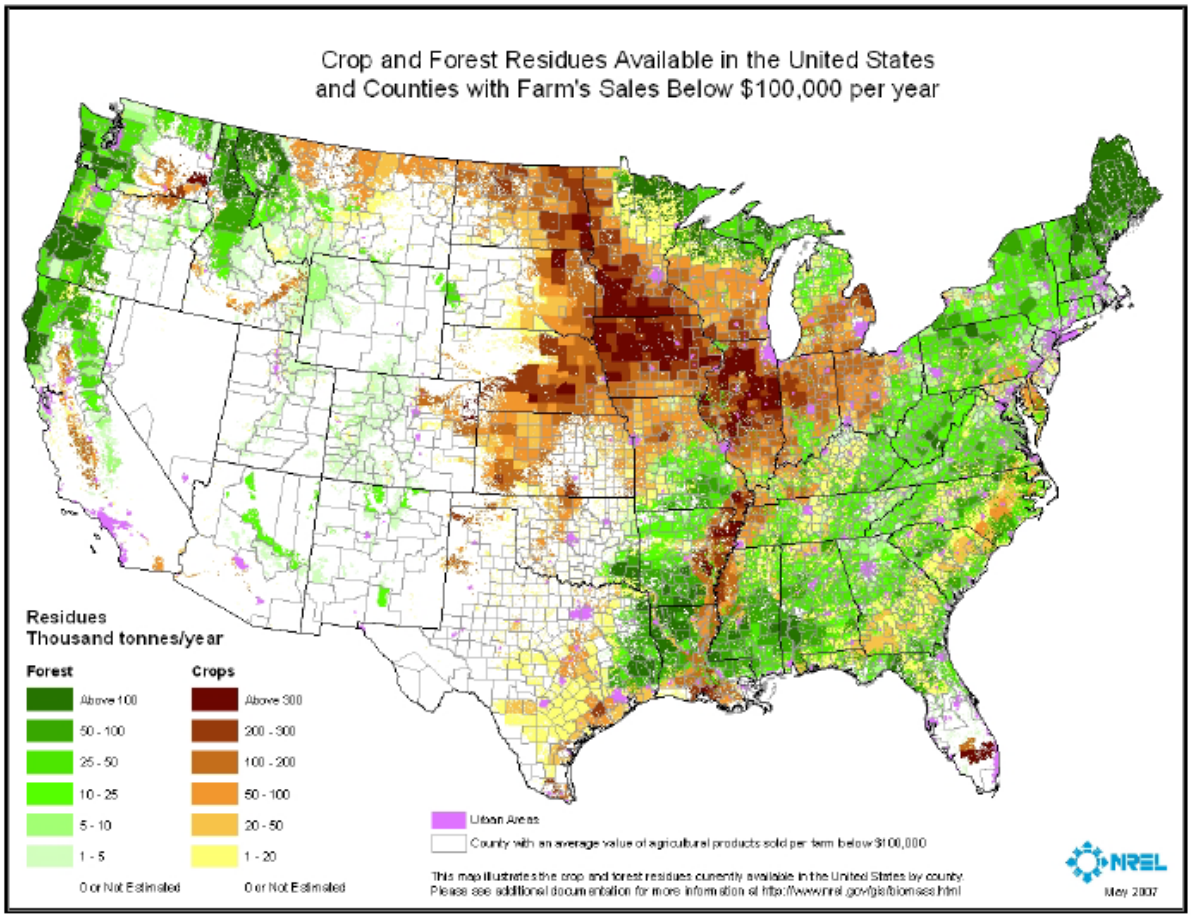
[31] http://tclocal.org/2010/04/funding_and_finagling_the_tran.html accessed July 5, 2011.
[32] http://www.arc.gov/assets/research_reports/EnergizingAppalachiaGlobalChallenges.pdf
[33] http://www.communitybiomassenergy.com/Bioenergy.html
[34] http://iea-etsap.org/web/ThanksDl.asp?file=E05

By contrast, the capital costs of a natural gas power plant are much lower $1,200 per kW for a combined cycle plant.[35] The capital costs of biomass CHP are offset, over time, by fuel cost savings over natural gas. The Cayuga Nature Center anticipates annual fuel cost savings of up to 75% per year over conventional energy sources, or approximately $14,000 per year. The installed system cost was $155,000, with an estimated simple payback period of nine years.[36]

Extrapolation of Savings to the Region

The Cayuga Nature Center in Tompkins County, NY is an example of small-scale biomass combined heat and power (CHP). Onsite generation of heat and electricity in such small-scale plants can make good use of locally available forest or crop residues. A National Renewable Energy Laboratory (NREL) 2008 whitepaper, *Initial Market Assessment for Small-Scale Biomass-Based CHP*,[37] identifies further benefits: the mitigation of forest fires from forest thinning, reduced consequences from fuel price volatility, and lower carbon emissions compared to coal-fired generation. The NREL report includes a map pointing to the significant extent of Appalachia's forest residues.

Figure 4: Crop and Forest Residues in the United States



Source: NREL, *Initial Market Assessment for Small-Scale Biomass-Based CHP*, 2008

Using the Tompkins County example, biomass CHP shows a modest but acceptable return on investment. The return on investment will increase as fuel prices rise. The use of local waste as fuel for onsite energy production is an elegant solution to two problems, the disposal of forest waste and the need for power. As an onsite renewable energy source, biomass CHP may receive a further boost from local utilities willing to provide incentives to those who can generate their own power at times of peak demand.

[35] http://www.fas.org/sgp/crs/misc/RL34746.pdf
[36] http://www.actbioenergy.com/brochure/Containerized%20Wood%20Boiler%20Case%20Study.pdf
[37] http://www.nrel.gov/docs/fy08osti/42046.pdf

Table 11: Combined Heat and Power from Biomass

	Per county facility	Appalachian counties (60% penetration rate—264 counties)
Capital cost to purchase and install	($155,000)	($40,920,000)
O+M cost per year	($1,400)	($369,600)
Annual Cost savings	$12,600	$3,326,400
O+M costs over 20 years	($28,000)	($7,392,000)
Cost savings over twenty years	$252,000	$66,528,000
Payback period	12.3 years	
Return on investment	8%	
Internal rate of return	5%	
Net Present Value, 7% discount rate	$1,800	$475,200

ECM 5—Retrofitting HVAC and lighting systems with energy-efficient alternatives

Description

EPA's ENERGY STAR *Building Upgrade Manual*[38] outlines the savings available from two key energy efficiency retrofits and practices: lighting improvements and heating and cooling upgrades. The Manual characterizes lighting retrofits in this way:

"Lighting consumes close to 35% of the electricity used in commercial buildings in the United States and affects other building systems through its electrical requirements and the waste heat that it produces. Upgrading lighting systems with efficient light sources, fixtures [ballasts], and controls can reduce lighting energy use, improve the visual environment, and affect the sizing of HVAC and electrical systems."[39]

Heating and cooling systems by themselves account for about 25% of a building's energy use,[40] so together lighting and HVAC systems represent more than 50% of a public facility's energy consumption. They offer local governments clear opportunities for cost savings through energy efficiency. The opportunities range from equipment replacement to the relamping of light fixtures with high efficiency bulbs and ballasts. Moreover, for local governments, DOE's Energy's Energy Efficiency Conservation Block Grant (EECBG) Program provides grants for just those types of efficiency retrofits. **If funded by EECBG grant monies, these combined ECMs will provide lasting annual cost savings at low- or nearly no cost to local governments.**

Example Project: Calhoun County, Alabama, Building Lighting and HVAC System Retrofits

Project Summary. Calhoun County, Alabama, adopted energy efficiency as a cost-savings strategy years before the incentives offered to local governments in the Recovery Act of 2009. Calhoun County, which covers about 600 square miles, sits in the northeastern portion of Alabama; the county seat is Anniston, which is also the county's largest city, with 24,000 residents.[41] The county's median household income in 2008 was $39,997, compared to $42,586 for the state of Alabama as a whole; and 17.6% of the population lives below the poverty level. Because it does not take much in by way of taxes, Calhoun County needs to be extremely vigilant about its operating costs.

[38] http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH9_HVAC (Accessed July 5, 2011.)
[39] Ibid, section 6.1.
[40] Ibid., section 9.1.
[41] Calhoun County Chamber of Commerce. About our Communities. http://www.calhounchamber.com/pages/?pageID=37.

County Commissioner Robert D. Downing has been Calhoun's energy efficiency champion. Under his leadership, Calhoun County became the first county in the nation to join the National Association of Counties (NACo's) ENERGY STAR Courthouse Campaign in 2004. NACo and EPA's ENERGY STAR program support county governments in implementing energy efficiency improvements and creating strong, local environmental leadership. After the assessment and planning stages, Calhoun County applied for and received a DOE grant (via the EECBG program) to fund a suite of proposed retrofits.

Project: Calhoun County, Alabama– building upgrades to Courthouse and Admin building
Cost to implement: Negligible if funded by grants; $200,000 if self-funded
Cost savings: $20,000 annually for 110,000 square feet
Estimated payback period: N/A if funded by federal grant; 10 years otherwise

Based on upgrades to the building envelope (increased insulation and window replacements), HVAC, and lighting, the County earned EPA's ENERGY STAR label in 2005 for both the County Courthouse and the Calhoun County Administration Building, the first two public buildings in Alabama to earn the ENERGY STAR.[42] The combination of a successful grant application and creative leveraging of the no-cost tools from the ENERGY STAR program provided savings and national recognition, and helped jumpstart the infrastructure improvements in Calhoun County.

EPA offers local governments (free of charge via its website) Portfolio Manager (PM), the ENERGY STAR measurement and tracking tool, which ranks the efficiency of existing buildings and plants on a scale of 1 to 100, where 50 is a building average. PM aims to make energy benchmarking and sustained energy tracking an habitual practice that can demonstrate consistent cost returns for investing in energy efficiency. If a building is eligible to receive an ENERGY STAR score, local government users enter at least one year of energy bill data, and PM will give a comparative score. Buildings scoring 75 or higher earn the ENERGY STAR.

Calhoun County's 60,000 square foot Courthouse earned an ENERGY STAR score of 90, putting it in the top 10% of courthouses nationwide; the County Administration Building, at 50,000 square feet, earned a score of 88. Their superior energy performance was the result of high-efficiency window retrofits; replacement of old boiler systems with gas-fired rooftop heat pumps and electric heat pumps; increased insulation in walls, roofs, and attics; and the use of ENERGY STAR qualified appliances and power saver features. Building on that early success, Calhoun County recently received $486,000 in ARRA funding to upgrade the county jail and another county administration building. The project includes lighting upgrades, improved controls, swapping out old showerheads and water heaters, and the installation of solar water heaters.

Cost Savings and Payback Period. For two buildings totaling 110,000 square feet, annual energy use was reduced by 20%, with annual energy savings for Calhoun County of approximately $20,000. Entirely funded by the federal EECBG program, there is no payback period in this case. However, to calculate the payback period in the absence of federal grants, let us assume a total cost for energy efficient retrofits of $1.80 per sf. This amount equals the maximum Federal tax deduction allowed for commercial and public sector buildings under EPAct 2005, where the tax deduction equals the cost of energy efficiency improvements. In the case of Calhoun County, the cost of implementation would therefore be $198,000. Add county administrative costs of $2,000 and the payback period becomes, in the absence of grant monies, 10 years.

Extrapolation of Savings to the Region

Interior lighting retrofits are among the easiest energy efficiency retrofits to implement, the classic "low-hanging fruit." To extrapolate their savings to the region, we looked at four different lighting retrofit scenarios, described in EPA's ENERGY STAR Building Upgrade Manual,[43] one of the sources in our implementation toolkit for energy efficiency. All four retrofit scenarios target that most ubiquitous of institutional lighting fixtures, the linear fluorescent lamp, the "light tubes" found in public buildings and K-12 schools throughout the United States. Conventional fluorescent lights typically have four linear "tubes" per fixture.

[42] Kelly Zonderwyk. *Calhoun County earns ENERGY STAR labels*. County News, Volume 38, No. 11. June 5, 2006.
[43] http://www.energystar.gov/ia/business/EPA_BUM_CH6_Lighting.pdf, page 8 (accessed April 30, 2011).

The first retrofit scenario, Case 1, is simple and initial costs are the least; it involves replacing a light fixture's conventional T12 lamps and magnetic ballasts with thinner, more efficient T8 lamps and electronic ballasts.[44] (T8 lamps and ballasts can fit into fixtures that accommodate T12 fixtures and ballasts—there is no need for replacement of the lamp base.) Case 2 is equally simple, but initial costs are somewhat higher; the swap-out in this case involves higher-cost and higher-performance T8 lamps and ballasts.[45] Case 3 takes the same basic already-installed fluorescent linear fixture, but adds a specular reflector and acrylic prismatic lens to that fixture. The effect of the new reflector and lens will be to get a good deal more light output—so much so that you can now rely on just two linear lamps per fixture rather than four, a move termed "de-lamping." The Case 3 retrofit assumes that two T8 lamps will replace the original T12s. Case 4 takes the de-lamping scenario and combines it with new control mechanisms—specifically, occupancy and daylight sensors. These can register the presence of people and/or sufficient daylight, enabling a lamp to turn itself off when not needed.

To be able to extrapolate the number of lamps involved, we made the following assumptions:

- For overall square footage of space owned and operated by local governments in Appalachia, we used figures from two sources summarized in this study's Chapter 2, the literature review: the 2009 McKinsey and Company report, *Unlocking Energy Efficiency in the U.S. Economy* (Hannah Choi Granade, Jon Creyts, Anton Derkach, Philip Farese, Scott Nyquist, and Ken Ostrowski; final Report, McKinsey & Company, 2009) and the Southeast Energy Efficiency Alliance (SEAA), *Energy Efficiency in Appalachia: How Much More is Available, at What Cost, and by When?* (Appalachian Regional Commission Online Resource Center, 2009). The SEAA report cites a total of 5,000,000,000 square feet of overall commercial space in Appalachia, and commercial space is the sector which includes local governmental buildings. The McKinsey report cites that the proportion of commercial sector buildings that are under governmental ownership is 24%, and that of this 24%, 62% is comprised of buildings belonging to local governments. Thus, our figure for total square footage of Appalachian regional local governmental facilities is 755,402,299.
- Since not all facilities will or spaces will be eligible for retrofits or have linear fluorescent lighting installed in the first place, we assumed a likely implementation rate for 80% of this total square footage; thus, the total Appalachian regional facilities square footage affected becomes 604,321,839.

To know the total square footage is the first step; the next step is to know how many square feet a conventional four-lamp linear fluorescent fixture will illuminate. This figure, derived from our ENERGY STAR sources, is 425.6 square feet illuminated by each four-lamp fixture, the rule-of-thumb for adequate levels of artificial light. This figure allows us to calculate energy needs per square foot of space, and then to derive the savings obtainable by replacing conventional linear fluorescent lamps. For costs to install and savings, we used figures from the EPA's ENERGY STAR Building Upgrade Manual (BUM).

The table below summarizes the potential savings for each retrofit scenario. The savings are impressive, particularly for the Case 3 retrofit involving specular replacement and de-lamping. Case 3 yields the greatest NPV of all four scenarios, $5,617,579,911.17 for the Appalachian Region, with an internal rate of return (IRR) of 79%:

[44] The "T" is the diameter of the lamp: while T8s have a smaller diameter than T 12s, and are thus more energy efficient, the light output is almost identical. Ballasts regulate the flow of current through the lamp. Electronic ballasts, with their embedded circuit boards, operate at higher frequencies than magnetic ballasts, resulting in less flickering and much greater energy efficiency—up to 25% more than magnetic ballasts.

[45] *The Consortium for Energy Efficiency (CEE), a non-profit organization, updates a list of current high-performance T8 lamps, available at* www.cee1.org/com/com-lt/**lamps**-ballasts.xls *(accessed April 30, 2011).*

Table 12: Appalachian Regional Totals, Lighting Retrofit Savings Scenarios

TOTALS	ES-BUM Case 1	ES-BUM Case 2	ES-BUM Case 3	ES-BUM Case 4
Upgrade Cost	$1,165.00	$1,320.00	$1,560.00	$ 2,150.00
Upgrade Cost/SF	($2.74)	($3.10)	($3.67)	($5.05)
TOTAL CAPITAL COSTS	($1,654,217,440.15)	($1,874,306,455.79)	($2,215,089,447.76)	($3,052,847,636.33)
Life (assume 5 yrs)	5	5	5	5
% Savings in Lighting Cost	26%	42%	71%	83%
Reduction in Lighting Cost/SF	$0.63	$1.01	$1.71	$2.00
New Lighting Cost/SF	$1.79	$1.40	$0.70	$0.41
New Lighting Cost	$1,078,895,739.18	$845,620,984.76	$422,810,492.38	$247,854,426.57
New Total Energy Cost	$3,786,549,138.66	$3,553,274,384.24	$3,130,463,891.86	$2,955,507,826.05
Total Annual Savings	$379,071,475.93	$612,346,230.34	$1,035,156,722.72	$1,210,112,788.54
NPV/sf	$0.04	$3.25	$9.30	$9.02
Total NPV	$21,368,611.94	$1,961,224,940.31	$5,617,579,911.17	$5,448,091,168.66
IRR	7%	33%	79%	54%

ECM 6—Replacing grid-sourced power with community-owned onsite renewable energy

Description

Renewable energy sources are not limited to solar and wind power. Waste, rather than a liability, can be a renewable resource for power generation. The Appalachian Region is rich in the agricultural processes that produce a variety of waste products, such as plant waste from crop harvests and manure from livestock. The infrastructure investment needed to take advantage of waste as an energy resource involves anaerobic digesters, which are devices used to break down agricultural waste.

Essentially, anaerobic digesters are insulated tanks, kept in a controlled atmosphere. Introducing micro-organisms (bacteria) into the tanks starts the process. The micro-organisms digest the waste, converting some of it into methane and CO_2 gases. This mixture (50% to 75% methane and 25% to 45% CO^2) is "biogas," used as a fuel for generators that produce electricity. The solids left by the process are organic fertilizers, sterile enough for use on food crops. Waste thus becomes food and fuel, in an elegant regenerative loop. In addition to providing an ongoing source of community-owned renewable energy generation, anaerobic digesters offer additional environmental benefits. The nutrients in animal waste are prevented from going into the local watersheds, and the methane from untreated waste does not go into the atmosphere.

Use of agricultural waste as a renewable energy source is more common in Europe. However, U.S. counties with significant agricultural and livestock production are beginning to explore how to generate power from the biogas produced by anaerobic digesters.

Example Project: Community-owned Anaerobic Digester for Biogas Production, Cayuga County, New York

Project Summary. The Appalachian Region will have its first waste-to-biogas project in Central Pennsylvania's (Bedford County's) Regional Cove Digester by 2013. A non-profit cooperative formed by local stakeholders, community governments, and private agricultural operators,[46] the project anticipates the production of 4.8 megawatts of electricity per year from livestock waste, enough to power 3,000 homes. That will also prevent 26,260 tons of CO_2e emissions per year from fossil-fueled power plants, and 579,000 pounds annually of avoided nitrogen loads to the Chesapeake Bay watershed. The Cove Digester will not be online until late 2012 or 2013.

In Cayuga County, New York, just north of the Appalachian Region, a similar project will be up and running at the end of 2011[47]—the first of its kind in North America. The facility is projected to produce more than 5 million kWh of electricity per year. The anaerobic digesters will process local manure and food waste, avoiding pollution of ground and surface waters and reducing the possibility for pathogens and methane to be released into the environment. The residual solids will be sold as garden compost. A 2010 story in the Syracuse, NY, *Post-Standard* describes both the project and the potential savings:[48]

Project: Cayuga County, New York– regional digester and bioenergy facility

Cost: $3,000,000 without grants (original estimate); $500,000 to $1,500,000 with grants

Cost Savings: $100,000 annually for 1000 cows; approximately $10,000 from the manure of every 100 dairy cows

Estimated payback period: If partly funded by grants, simple payback between 5 and 16 years

"The anaerobic digester will run on cow manure and other waste products like restaurant grease, using microorganisms to break down the biodegradable material in the absence of oxygen. 'The digester, to be built at the county Soil and Water Conservation building in Sennett, will be the first municipal regional digester in the country to use a hydraulic mixing technology to convert animal waste into methane gas and other valuable byproducts,' officials said. The methane gas will be used to generate low-cost electricity. The digester could be producing heat and electricity by year's end for the county's three buildings in Sennett: the Soil and Water Conservation building; the county nursing home; and the sheriff's department and jail. Any leftover power would be sold to New York State Electric & Gas for resale on the power grid. It will produce enough power and heat for this entire county campus. 'It's not a far cry to say the county will save $100,000 a year,' said Ron Podolak, executive director of the county Soil and Water Conservation District. No local tax dollars will be spent on the project. Soil and Water received about $6.2 million in federal stimulus money—nearly double the amount it anticipated—and about $3.5 million in federal and state grants and aid."

Cost Savings and Payback Period. The total project cost of the Cayuga County Soil and Water Conservation District's regional digester/bioenergy facility for agricultural areas in upstate New York is $9.5 million, co-funded by an EPA Clean Water State Revolving Loan Fund (CWSRF) and by NYSERDA, NY State's Department of Agriculture, the U.S. Department of Agriculture (USDA), and DOE. The original cost estimate was $3 million; costs tripled in part because of a more aggressive time frame for design and bidding of contracts, grant restrictions that require the use of American-made parts, and the need for reconstruction of the main building to meet Recovery Act funding regulations.[49]

In terms of available economic analyses, the North American province of Alberta, Canada, has produced a fact sheet and a report which consider the economic feasibility of anaerobic digesters:

"The total capital costs of anaerobic digester plants are high and may range from a few hundred thousand to a few million dollars. However, most of the other waste processing technologies, which may also require a high capital investment, do not generate revenue like a biogas digester plant does.

[46] http://www.covedigester.org/images/finalpp2011.pdf
[47] http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044903.pdf
[48] http://www.syracuse.com/news/index.ssf/2010/04/waste_digester_in_sennett_will.html
[49] http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044903.pdf, page 2.

Some of the feasibility studies in North America on anaerobic digesters concluded that the payback period ranges from 5 to 16 years when operated under optimum and worst conditions, respectively. Government financial incentives for producing green energy can potentially reduce the payback period significantly." [50]

The Alberta report includes tables for the energy generation capacity of various sources of manure, and estimates the annual energy production available from the manure production of 100 cows, as follows:

Table 13: Alberta Report Energy Generation Capacity of Manure

Manure/energy estimation				
Description	Manure quantity as excreted (kg/d)	Biogas production (m^3/d)	Electricity potential kW/year	Energy Potential (GJ/year)
Beef	24.0	1.10	663	3.0
Dairy	62.0	2.01	1,227	5.5
Piglet*	3.5	0.16	98	0.4
Poultry (100 - layer)	8.8	0.85	516	2.3
* Multiply the values by 12 for every so in farrow to finish operation.				
Number of cows	= 100 dairy cows			
Average cost of electricity	= $0.06/kWh			
Average cost of heat	= $5.5/GJ			
Annual electricity potential	= 1,227 kWh (from table above)			
Annual heating potential	= 5.5 GJ			
Savings from electricity	= 100 x $0.06/kWh x 1,227 kWh = **$7,362**			
Savings from gas	= 100 x $5.5/GJ x 5.5 GJ = **$3,025**			
Total annual savings from energy	**=$10,387**			

Source: http://www.thebioenergysite.com/articles/121/economic-feasibility-of-anaerobic digesters

Navaratnasamy, Mahendran and Ike Edeogu and Lawrence Papworth, Prepared for the Agriculture Stewardship Division Alberta Agriculture and Rural Development, August 2008.

The Alberta report cites typical capital costs of a biogas electricity generating plant at $3,700 to $7,000/kWh and typical running costs of a biogas electricity generating plant at $0.02/kWh. It illustrates how to estimate the approximate simple payback period, and concludes that an average simple payback period will be seven years, depending on the extent of maintenance and process-related issues:

[50] http://www.thebioenergysite.com/articles/121/economic-feasibility-of-anaerobic-digesters

Table 14: Alberta Report Cost Estimates

Capital cost (assumes 30 days/year as shutdown for maintenance, 24 hr/day production, and $7,000/kWh capital cost for system)	= $403,200
Operating cost assumed	= $0.02/kWh
Total electricity production from dairies and animal fat	= 463,125 kWh
Operating cost /year	= $0.02kWh/yr x 463,125 kWh **= $9,262.50**
Yearly energy revenue	= $39,392.95
Subtracting operating cost from the yearly revenue	= $39,392.95 - $9,262.50 **= $30,030.45**
Government incentives for renewable energy production (2007-2012)	= $0.06/kWh
Total incentives	= $0.06/kWh x 463,125 kWh **= $27,787.50**
Total yearly revenue	= $30,030.45 + $27,787.50 **= $57,817.95**
The simple payback period	= 403,200/57,787.95 = 6.97 years

Source: http://www.thebioenergysite.com/articles/121/economic-feasibility-of-anaerobic digesters

Navaratnasamy, Mahendran and Ike Edeogu and Lawrence Papworth, Prepared for the Agriculture Stewardship Division Alberta Agriculture and Rural Development, August 2008

Extrapolation of Savings to the Region

Like biomass CHP, the implementation of regional digesters, for energy production from biogas, uses waste as fuel, thus helping to resolve several problems at once: the need for energy, and the need for disposal of animal waste, and the need to mitigate the environmental effects of runoff from animal waste on streams and watersheds. Of all the ECMS discussed here, regional digesters are the most expensive to implement. If, however, the environmental and other costs involved with the disposal of animal waste can be monetized, digesters may prove to provide great savings. As fuel prices rise, large-scale, community-owned biogas generation can provide substantial profits. Finally, as a clean energy source, carbon emissions are lower for this than for more conventional methods of energy generation.

Note that the analysis below includes State or Federal incentives/credits for renewable energy generation, as well as a grant award that offsets a portion of the capital costs. Figures are based on the Alberta, Canada report and Cove Digester project cited above. For purposes of this analysis, we assume the construction of fourteen regional digesters throughout Appalachia.

Table 15: Regional Digester for Biogas Analysis

	Per plant	**Total, 14 Appalachian plants**
Capital and installation costs	($9,500,000)	($133,000,000)
Capital and installation costs after Federal-state grant of $3,500,000	($6,000,000)	($84,000,000)
Energy production per year	5,000,000 kWh	70,000,000 kWh
Annual revenue from energy production ($.08 per kWh)	$400,000	$5,600,000
Annual O+M costs @ $.02/kWh (from Alberta report)	($100,000)	($1,400,000)
Incentives for the production of renewable energy @ $.04/kWh/yr	$200,000	$2,800,000
Annual profit	$500,000	$7,000,000
Return on investment	8.3%	
Payback period	12 years	
Internal rate of return	5%	
Net Present Value, 7% discount rate	$71,429	$1,000,006

ECM 7—Traffic Signal Retrofits

Description

The move away from conventional, incandescent traffic signals towards light-emitting diodes (LEDs) makes sense for several reasons. LEDs confer many benefits, as the Consortium for Energy Efficiency describes:

Traffic signals that use LEDs consume 80-90 percent less energy and generally last 5-7 years, compared to just a year for a comparable incandescent light signal. LED traffic signals also offer significant peak demand savings since they operate 24 hours a day. [51]

Significantly for local governments, LED installation is one of the thirteen activities the US Department of Energy designates as eligible to receive funding under the Energy Efficiency and Conservation Block Grant (EECBG) program.[52] The EECBG program, one of the toolkit resources listed in Chapter 1 of this study, is a source of support for the energy efficiency efforts of state and local governments.

Example Project: LED Traffic Signal Installation, SEDA-Council of Governments (SEDA-COG) of Central Pennsylvania

Project: LED traffic signal installation, central Pennsylvania

Cost per small community: $36,000 to install twelve intersections

Cost Savings: $48,746 annually

Estimated payback period: Nine months

Project Summary. The SEDA-Council of Governments (SEDA-COG) of central Pennsylvania sponsors an Appalachian regional example of an incentive program for the purchase and installation of LED traffic signals.[53] The program is the result of collaboration between three Pennsylvania Local Development Districts, who joined forces to negotiate a bulk purchase of LED components at a 25% discount. In 2007 and 2008, SEDA-COG approached 38 small communities who had not converted to LED signal lights. Joining them together in a consortium enabled not only the bulk purchase of components at a favorable price, but also the provision of installation training and unified project management. For training and management, SEDA-COG leveraged the resources of the Pennsylvania Department of Transportation (PennDOT), an example of fruitful inter-governmental collaboration. According to the SEDA-COG website,

"To support this lighting conversion project, SEDA-COG's Energy Resource Center (1) formed the consortium of signalized municipalities through education and outreach, (2) facilitated intergovernmental cooperation for the procurement of the LED lighting equipment, (3) procured $200,000 in grants to reduce the equipment purchase cost to municipalities and (4) provided overall project management. PennDOT assisted municipalities (1) to identify their LED equipment purchase needs, (2) to compile a master list of LED equipment to be purchased by consortium members and (3) to reduce installation costs by conducting workshops to train municipalities and traffic signal installation contractors about how to install and maintain LED equipment."[54]

Cost savings and payback period. SEDA-COG cites aggregate annual cost savings per municipality of $48,746, with an approximate purchase and installation cost per intersection of $3,000. Assuming that each small community installs LED signals at 12 intersections, with a total cost of $36,000 the project has a payback period of less than 9 months.

Extrapolation of Savings to the Region

For further cost data, we turned to a resource within the Appalachian Region. The New York State Energy Research and Development Administration (NYSERDA)—whose variety of resources, as outlined in the Tompkins County, New York case study of Chapter 3, includes many best practices examples and incentive programs at the

[51] http://www.cee1.org/gov/led/led-main.php3 (accessed April 30, 2011)
[52] http://www.usmayors.org/climateprotection/documents/eecbghandout.pdf (accessed April 30, 2011)
[53] http://erc.sedacog.org/EnergyConservation/LocalGovernment/LEDTrafficSignalProject/tabid/81/Default.aspx (accessed April 30, 2011)
[54] ibid.

state level—offers an LED Traffic Signal Analyzer, and we looked to this tool for information on costs, savings, and other non-quantifiable benefits of LEDs, such as reduced signal failure and improved visibility.[55]

Table 16: Traffic Signal Costs and Savings by Intersection

	Incandescent	LED Traffic Signals	DELTA	% reduction
ASSUMING: 10 bulbs in 1 intersection				
Capital costs		$(2,000.00)	$(2,000.00)	
Implementation costs		$(1,105.00)	$(1,105.00)	
Admin costs	$ -	$ -	$ -	
Annual energy costs	**$(806.79)**	**$ (73.51)**	**$733.28**	**91%**
Annual Tariff costs	$(224.00)	$ (217.00)	$7.00	
Annual O&M costs	$(277.00)	$(248.00)	$29.00	
Total annual costs	$(1,307.79)	$(538.51)	$769.28	
Life Operating Costs	$(20,615.80)	$ (5,810.27)	$14,805.53	
Life maintenance costs	$5,540.00)	$4,960.00)	$580.00	
Total Life Cycle Costs	$26,155.80)	$13,875.27)	$,280.53	
Simple Payback (years)		**-4.04**		
NPV		**$3,772.69**		
IRR		**30%**		
Discount capital rate/cost		7%		
Lifespan in years	1	10		

For our regional extrapolation, and following SEDA-COG's assumptions, we assumed an implementation rate of 80%, and thus calculated overall savings for 8,000 of a total regional number of 10,000 intersections. We also applied SEDA-COG's bulk discount price of 75% of full market value, resulting in total capital and implementation costs of $18,630,000. Here were the overall savings we derived for the Appalachian Region:

Table 17: Appalachian Regional Total, Traffic Signal Retrofit Savings

TOTALS	Incandescent	LED Traffic Signals	DELTA	% reduction
Total Energy Use (kWh)	79,896,000	7,280,000	-72,616,000	91%
Total Annual Energy Cost	**($6,454,318.46)**	**($588,107.52)**	**$,866,210.94**	**91%**
Total Annual Tariff costs	($1,792,000.00)	($1,736,000.00)	$56,000.00	3%
Total Annual O&M costs	($2,216,000.00)	($1,984,000.00)	$232,000.00	10%
Total Annual costs	**($10,462,318.46)**	**($4,308,107.52)**	**$6,154,210.94**	**59%**
Total Life Operating Costs	$164,926,369.28)	$46,482,150.40)	$118,444,218.88	72%
Total Life maintenance costs	($44,320,000.00)	($39,680,000.00)	$,640,000.00	10%
Total Life Cycle Costs	**($209,246,369.28)**	**($104,792,150.40)**	**$104,454,218.88**	**50%**

[55] http://www.lrc.rpi.edu/programs/transportation/led/nystrafficsignals.asp (accessed April 30, 2011)

ECM 8—Commissioning building energy systems.

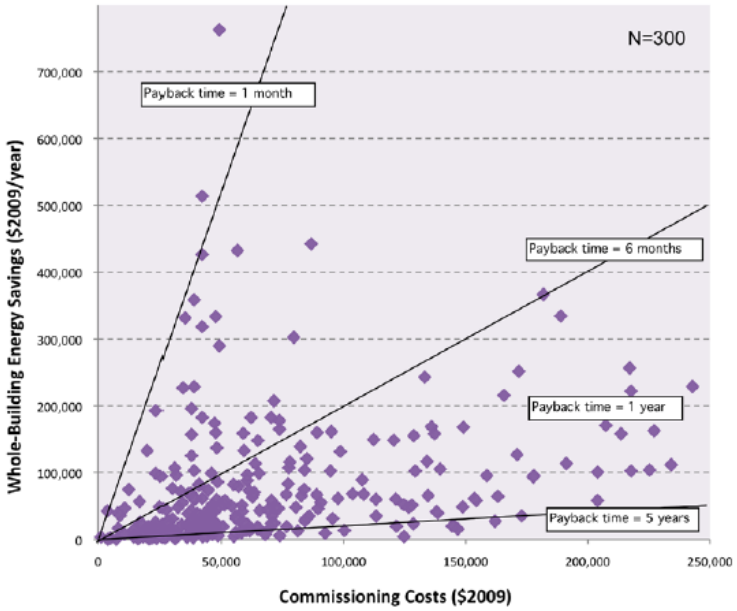
Description

A 2009 report from the Lawrence Berkeley National Laboratory (LBNL), *Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions* (the California Energy Commission, July 21, 2009)[56] terms commissioning "the stealth energy saving strategy." What exactly is it?

For our purposes, commissioning relates to energy performance and energy systems in buildings. The LBNL report aptly describes commissioning as a "risk-management process" that includes "installation and testing of equipment and ensuring that problems are corrected and the crew trained to maintain performance." It sounds simple—yet it is rarely done. As a result, buildings "are riddled with problems"[57]—*correctable* problems such as air leakage through improperly sealed openings and ducts, plugged filters, lights left on at night, photosensors that are shaded from sun, broken actuators, malfunctioning dampers, and missing or poorly calibrated controls. The act of commissioning requires an understanding of building systems and how they interrelate, and needs a practiced eye for observation. The major costs associated with commissioning are in time and labor: procuring the services of an experienced commissioning agent for facilities walkthroughs and subsequent development of recommendations and an action plan. Commissioning does not involve retrofitting or construction activities; its effects are money- and energy-saving *without* this expense. Commissioning conserves existing resources by ensuring that existing systems perform to their best ability through maintenance, adjustments, and occupant and manager education.

The following graph from the LBNL study well illustrates the potency of commissioning as a cost-savings strategy for existing buildings:

Figure 5: Relationship of Commissioning Costs and Payback Times in Existing Buildings [58]



Source: http://cx.lbl.gov/2009-assessment.html, page 33.

In addition, the "secondary" benefits of commissioning are considerable. These include improved operations and maintenance, improved indoor air quality, improved equipment life, and reduced liability.

[56] http://cx.lbl.gov/2009-assessment.html
[57] http://cx.lbl.gov/2009-assessment.html, page 3.
[58] http://cx.lbl.gov/2009-assessment.html, page 33.

Example Project: Erie County, New York, Juvenile Detention Center Building Commissioning

Project Summary. Erie County, New York borders the Appalachian Region to the north. In 2005, the county upgraded the mechanical systems of its existing medium security juvenile detention center, and during the process engaged an independent Commissioning Provider to review design documents and prepare functional performance test plans and start-up checklists for the new mechanical systems. The scope of this work was significant, involving each system and piece of equipment to be commissioned, including heating, ventilation and air conditioning (HVAC) and related distribution systems, kitchen hoods, variable air volume (VAV) and electrical system components.[59] The Commissioning Provider also:

- Worked with the mechanical contractor to choose high efficiency HVAC components that would meet the county's goal of reducing long-term operating costs;
- Verified that installation of systems and infrastructure was sound;
- Ensured through performance testing that systems and settings were correct and well-calibrated;
- Trained staff and building operators in maintaining the systems for best performance.

The end result was that the retrofitted Juvenile Detention Center experienced reduced energy use, reduced ambient noise from building systems, and improved temperature control.

Project: Erie County, New York– Juvenile Detention Center building commissioning

Cost: $115,000

Cost savings: $19,720 annually

Estimated payback period: 5.8 years

Cost Savings and Payback Period. Total commissioning costs for the Juvenile Detention Center were $115,000 for this 68,000 sf building, or $1.69 per sf. Compared to other commissioning examples, this example – possibly because of the significant scope of design and verification work involved -- had a high first cost for an existing building (it exceeds the LBNL average for new buildings of $1.16 per sf). Assuming an energy savings mirroring the average for existing buildings outlined in the LBNL study[60] -- $0.29 per sf per year – the energy cost savings per year would be $19,720, yielding a payback period of 5.8 years.

Extrapolation of Savings to the Region

For the extrapolation of savings from building commissioning and re-commissioning, we relied on data from the LBNL study sample; used the same calculations for overall square footage of affected local government space, outlined above in the section on lighting retrofits; and applied an 80% penetration rate. We also followed LBNL data and assumed commissioning costs to be lower than the Erie County example. The summary results are in the following table. Note not only the NPV total for the region, but also the average payback period of months rather than years.

[59] http://www.cacx.org/database/data/NYSERDA_ErieCounty.pdf.

[60] http://cx.lbl.gov/2009-assessment.html, page 28.

Table 18: Appalachian Regional Totals, Building Systems Commissioning Savings

TOTAL COMMISSIONING Costs-Savings	
Capital Cost / SF	$ (0.30)
Energy Savings	16%
Total Cost	$ (181,296,551.72)
Total Energy Saved (kWh)	8,331,241,229
Energy Saved / SF (kWh)	14
Cost of Energy Saved	$ 666,499,298.33
Cost Saved / SF	$ 1.10
Payback period (years)	0.27
Ongoing Commissioning Costs / SF	-0.15
NPV / SF	$9.95
Total NPV	$6,015,855,920.53

Conclusions

Energy efficiency is a source of wealth. If applied across the Appalachian Region, the energy conservation measures described in this report could result in significant wealth, with positive consequences:

- Cost savings, used to fund further local government operations and services, is a measure of higher performance, and signals accountability to taxpayers. Case study Calhoun County, AL is an example of the cost savings and voter satisfaction available as the result of implementing simple energy-efficient building retrofits.
- Energy savings equal carbon emissions savings. As a condition of receiving Federal and/or State funding, local governments must increasingly respond to Federal and State mandates that require them to pledge reductions in both energy use and carbon emissions. Case study Hamilton County, TN began to transform itself in response to such Federal mandates.
- Cost savings can create more investment, and more jobs. In some cases, these jobs—such as a local government's choice to hire an energy manager—may be a direct result of savings now reinvested in human "capital." But becoming energy efficient may in the longer term bring previously unimagined sources of employment.

Chapter 3: Case Studies of Counties in Appalachia

Introduction

To study energy- and resource-efficient counties is to understand what gives rise to the energy conservation measures examined in isolation in Chapter 2. By taking a broader view of energy efficiency at the county level, we can understand the drivers of and barriers to achievement, and the reasons for success or failure. We can see how counties make and finance their energy efficiency plans, how long the process takes, the arc of their progress, and more importantly the role of human and institutional interaction so fundamental to success. Chapter 2 described a range of potential ECMs to implement and why. The holistic picture of the counties described here is key to understanding *how* to implement and maintain success over the longer term. Energy-efficient infrastructure is indeed greater than the sum of its parts. Where counties are applying a handful (or more) of energy conservation measures, these often work together to yield greater benefits in their interrelationships than they would if functioning independently—the very definition of a synergy.

For some local governments, energy efficiency planning and implementation is part of a larger top-down county "vision plan" encouraging synergistic thinking and actions that get results. In the Appalachian Region, Tompkins County, New York (NY) and Hamilton County, Tennessee (TN) are two such examples. Other counties adopt more of a ground-up, measure- or system-specific approach to managing resources, implementing efficiency improvements, and achieving practical successes; Calhoun County, Alabama (AL) exemplifies this. Fayette County, West Virginia (WV) represents an ad-hoc approach, taking up opportunities as they arise; here, the private sector has had a major role in stimulating energy efficiency thinking. There is no single right way to tackle energy efficiency improvements; different approaches can be effective, although highly successful programs do tend to share certain common elements.

Of note in all four counties is the increasing role of public-private collaboration in furthering energy-efficient infrastructure. The relationship of multiple efficiencies—a relationship that also involves acknowledging the particulars of a place and the variety of its stakeholders across all sectors —is an important factor for local governments. Understanding how public and private sector forces can work together for success is critical to developing a framework worthy of use by other counties in Appalachia.

A trait common to the four case study counties showcased here is that county leaders acknowledge the power of their landscapes to attract in-migration and investment. This is an emerging source of potential wealth in these areas, and quite possibly in Appalachia as a whole. For example, Gene Hyde, the urban forester of Chattanooga, TN, describes the future of Hamilton County, TN, as "a three-legged stool—clean industry, green leadership, and outdoor living."[61] Acknowledging natural beauty (and the desire for outdoor living) as an economic driver carries a responsibility: to make environmental quality an ongoing priority. There is a strong relationship between environmental quality and energy efficiency; many of the ECMs described here benefit both.

Methodology of Case Study Selection

To identify counties performing at a high level in their energy efficiency efforts, the study team devised a set of objective measures to rank all Appalachian counties. Our methodology for case study selection applied the following criteria:

- The county's rank, numerically, among all 1,070 counties in the 13 Appalachian states according to two primary criteria: (1) energy efficiency, the ratio of economic output to kWh consumed; and (2) water efficiency, the relationship of water consumed to energy consumed (see Appendix B of this study for data sources and methodology).
- The amount of Recovery Act grant dollars per capita sought by and awarded to these local governments from DOE and other funding streams. (Note that many counties in the Appalachian Region are not eligible for the formula grants awarded to counties with high populations, so evidence of Recovery Act energy-related funding may indicate grants voluntarily sought, an indicator of energy efficiency awareness and ambition.)

[61] Gene Hyde, May 18, 2010 interview.

- The extent of voluntary engagement by these counties in nationally recognized energy efficiency and sustainability initiatives, such as becoming ENERGY STAR partners or Sierra Club Cool Cities members, signing the U.S. Conference of Mayors Climate Protection Agreement, or deciding to pursue LEED certification for public buildings.

For maximum applicability of the best practices to a variety of local counties in the Appalachian Region, the study team also sought a geographical dispersion of the selected case studies across this large and diverse region, and at least one rural example. The objective measures and the desire for a regional spread yielded these high-performing counties as case study candidates: Tompkins County, New York, Hamilton County, Tennessee, and Calhoun County, Alabama. The search for a rural county led to Fayette County, West Virginia, on the strength of its private sector achievements to date and its increasing linkages with the public sector.

Table 19: Objective Measures of Efficiency

Measure	Tompkins (NY)	Fayette (WV)	Hamilton (TN)	Calhoun (AL)
Energy efficiency rank (of 1,070 counties total in Appalachian Region states)	25th	931st	104th	147th
Water efficiency rank (of 1,070 counties)	144	211	957	371
ENERGY STAR Partner?	No	No	No	Yes
LEED-certified buildings?	Yes	No	Yes	Yes
Sierra Club Cool Cities / US Conference of Mayor's Climate Agreement signatories?	Yes	Yes	Yes	Yes
Total ARRA funding, per capita, 2011[62]	$1,655	$719	$738	$753
Energy-related ARRA funding per capita 2011 ($110 US average) [63]	$425	$4 (estimated; through State Energy office divided grant)	$346	$4

The case studies of four Appalachian counties look at how each community devised either an efficiency strategy or several initiatives to underpin a strategy, what concrete actions county officials and others implemented, their achievements, and which strategies or solutions are replicable by other counties in the Appalachian Region. In addition, cities and institutions in all four case study counties voluntarily pledged to meet the goals of two major voluntary U.S. climate protection agreements: (1) the U.S Conference of Mayors Climate Protection Agreement and (2) the American College & University Presidents' Climate Commitment. Because of their influence on local efficiency and sustainability initiatives, we include their primary objectives below:

[62] http://projects.propublica.org/recovery/
[63] http://projects.propublica.org/recovery/

(1) U.S. Conference of Mayors Climate Protection Agreement

http://www.usmayors.org/climateprotection/agreement.htm

"Under the Agreement, participating cities commit to take the following three actions:

- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns;
- Urge their state governments, and the federal government, to enact policies and programs to meet or beat the greenhouse gas emissions reduction target suggested for the United States in the Kyoto Protocol—7% reduction from 1990 levels by 2012; and
- Urge the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emission trading system."

(2) American College & University Presidents' Climate Commitment (ACUPCC)

http://www.presidentsclimatecommitment.org/

ACUPCC higher education institutions have agreed to:

- Complete an emissions inventory.
- Within two years, set a target date and interim milestones for becoming climate neutral.
- Take immediate steps to reduce greenhouse gas emissions by choosing from a list of short-term actions.
- Integrate sustainability into the curriculum and make it part of the educational experience.
- Make the action plan, inventory, and progress reports publicly available.

Case Study 1–Tompkins County, New York

Overview of Efficiency Efforts

Tompkins County, located within the Appalachian Regional Commission service area in south-central New York, is home to an active environmental community that is strongly committed to the implementation of sustainable policies and practices. Of all 1,070 counties in the 13 states spanning the Appalachian Region, it ranks 25th in energy efficiency and 144th in water efficiency, the highest of the four counties selected for case studies. In 2011, EPA designated Tompkins County an **EPA Climate Showcase Community**, recognizing that commitments by the public and non-profit sectors, including support for two national initiatives related to climate protection and energy efficiency, have spurred widespread community action. These actions include the study and subsequent implementation (or formal request to the legislature to enable implementation) of financial incentives, including a **sales tax rebate** and **PACE bonds**, increased capacity for developing **energy-efficient building designs**, a **performance contract to track progress** toward energy efficiency goals, tapping the skills and passion of an engaged college student population, and **assistance to low-income homeowners** that have historically had less access to energy efficiency programs. Elected officials in Tompkins County lead by example; they have a history of taking significant environmental initiatives. Their time-tested processes can now serve as models not only for the Appalachian Region, but also for other counties around the United States.

Appalachian County:

Tompkins County, New York

Energy efficiency ranking:

25th (of 1,070 total counties in 13 ARC states)

Other criteria for selection:

LEED-certified buildings; CoolCities member; high ARRA funding per capita

ECMs pursued:

County building, K-12 schools, and wastewater treatment plant audits and retrofits; renewable energy installations, including solar hot water and a community-owned photovoltaic array at a planned cohousing development

County leadership in energy efficiency demonstrated in:

Private sector partnerships; incentives and financing; transparent governance and formal planning efforts; promotion of community involvement; energy benchmarking in county buildings; LEED initiatives; Town of Ithaca is U.S. Conference of Mayor's Climate Agreement signatory

County Background and Local Context

Tompkins County, with a 2010 population of 101,564[64] and a total area of 492 square miles, borders on Cayuga Lake, one of the Finger Lakes. The county seat, Ithaca, is the hub of an active environmental community focused on implementing sustainable policies and practices. Supported by forward-thinking local leaders and students from Cornell University, Ithaca College, and Tompkins Cortland Community College, the community has actively pursued numerous energy efficiency initiatives. The County also benefits from its location in New York State, and thus its ability to leverage the resources of NYSERDA. NYSERDA provides an array of technical assistance and financial incentive programs related to energy efficiency, such as the Energy Audit Program, FlexTech, Existing Facilities Program, Green Building Services Program, and the PV/Small Wind Incentive Program. NYSERDA also managed the disbursement of ARRA funds in 2009.

The roots of environmental involvement in Tompkins County can be traced back to the late 1960s, when construction of the Bell Station nuclear power plant was proposed on the shore of Cayuga Lake. Local activists, energized by their successful opposition to the power plant, remained involved in discussions related to energy use and sustainability—conversations that continue today. Ithaca is now home to a vibrant farmer's market (part of a "buy local" effort across New York State) and a network of community organizations that are working with elected officials and leaders in the academic community to reduce Tompkins County's carbon footprint.

[64] http://quickfacts.census.gov/qfd/states/36/36109.html

Devising an Energy Efficiency Strategy

Tompkins County operates under a broad vision plan. To work towards a variety of goals, the County government began devising a comprehensive plan in the 1990s. Much of the current work related to energy efficiency in the County was initiated during the 2008 development of the Tompkins County Energy and Greenhouse Gas Emissions (EGGE) Element, a significant amendment to the existing comprehensive plan. The EGGE Element calls for the implementation of many practices that reduce the County's energy use as well as its greenhouse gas emissions on a community level. To implement practices and meet the goals of the EGGE Element, County leaders recognized the need to coordinate efforts between County departments and to work with organizations outside the County government, including academic institutions, non-profit organizations, and other local units of government. This is an important recognition. If a county's goal is to reduce community-level energy use and greenhouse gas emissions, partnerships across the private and public sectors are essential to success. Activity in Tompkins County is also driven by two major climate protection agreements, which the City of Ithaca and local academic institutions have pledged to support. Ithaca Mayor Carolyn K. Peterson explained the choice to sign one of the voluntary climate protection agreements, the U.S. Conference of Mayors Climate Protection Agreement:

"We have to have leadership, and if it's not coming from the federal government we need it from the states and we need it from the cities. Small changes in the smallest of cities to the largest of cities are going to make a difference because we can show that change will work." (*The New York Times*, 8/25/2005).

The comprehensive scope of Tompkins County's commitment to sustainability and energy efficiency necessitated a multifaceted implementation approach to achieving the County's goals. The most successful elements of the strategy can be characterized as follows:

- Formal planning efforts.
- Financing strategies.
- Benchmarking and tracking.
- Active interaction between the public and private, as well as non-profit, sectors.

Formal Planning Efforts

Tompkins' formal planning efforts began with County-sponsored forums for discussion. The Tompkins County government initiated the Vital Communities Initiative in 1999 to gauge public interest in preserving open spaces, clean water, and agricultural production. The Initiative held a public charrette (essentially, a facilitated brainstorming session) at which participants gathered around maps of the County during two workshops and discussed their preferences and reasons for preserving certain land uses. A total of 78 participants, representing a wide range of interest groups—agriculture, economic development, education, environment, human services, infrastructure, land development, elected officials, neighborhood quality and local planning, transportation, and youth—attended the workshops. Observers from the Planning Department recorded the salient portions of the participants' discussions and synthesized the content into 10 planning principles that were adopted by the Tompkins County Legislature and form the basis of a new comprehensive plan for Tompkins County.

After the plan's development, Tompkins County Principal Planner Katie Borgella recalls, "the issues of climate change and peak oil and rising energy prices came together to motivate the community." As resources became available, the Legislature began an additional planning effort to address issues related to energy efficiency and greenhouse gas emissions. That led to the development, in 2008, of the EGGE Element, the only amendment (to date) to the comprehensive plan. This document formally established goals for the County and articulated specific action items—each achievable within five years of adoption of the Element—needed to reach the goals. By incorporating those action items into the comprehensive plan and widely publicizing the document, the Tompkins County government provided a focus for the rest of the community. Note that the establishment of metrics by which to measure success is high on the list of action items.

Taking Action

Table 20: Action Items included in the Energy and Greenhouse Gas Emissions (EGGE) Element of the Tompkins County Comprehensive Plan

- Work with local municipalities, school districts, businesses, institutions of higher education, and non-profits to develop a five-year strategy to reduce community greenhouse gas emissions by at least 10% of 2008 emissions levels, including a detailed plan for County government to achieve that same target.
- Incorporate into the *Tompkins County Comprehensive Plan Indicators of Success Report* metrics of change in energy use and greenhouse gas emissions, energy efficiency improvements, and renewable energy systems installations in the community.
- Prepare an adaptation plan to help prepare the community for impacts of global climate change and peak oil.
- Conduct an educational campaign on energy issues and energy choices that address topics such as home heating options, energy efficiency measures, transportation options, food production, and renewable energy systems.
- Identify and promote utilization of Best Management Practices in agricultural, forestland, and water management to enhance carbon sequestration.
- Develop a strategy to divert 75% of the community waste stream from landfills by 2015.
- Develop a plan to address the specific energy needs of low-income people, including recommendations for improvements to existing energy-related programs and identification of potential pilot projects to address energy needs.
- Investigate the feasibility of developing a low-interest revolving loan fund to improve the payback period for energy efficiency investments made by homeowners, landlords, and businesses.
- Promote green business development and create green job training opportunities for workers, high-school students, and college students.
- Adopt and expand local tax incentives, such as sales and property tax abatements, to encourage homeowners and businesses to invest in energy efficiency and renewable energy systems.
- Develop or identify a model building energy code that can be phased in, as well as incentives to assist with code compliance.
- Adopt a County administrative policy that requires major new County government buildings or renovations of County buildings to be certified LEED Silver or higher.
- Determine the feasibility of developing a regional consortium of sustainable biomass growers and processors to supply biomass consumers in the region.
- Develop criteria and identify the sites most appropriate for locating community-scale wind power in Tompkins County.
- Establish a green fleet policy for County government, including participating in car share and bike share programs for County government employees, and determining needs for amenities to facilitate alternative transportation use.
- Include, in the 2009 update of the Long Range Transportation Plan, provisions to reduce vehicle miles traveled and enhance transportation efficiency through physical and programmatic improvements, such as park and rides, express regional commuter service, vanpool, and interconnected bike/pedestrian ways.
- Identify and, if necessary, create a board or committee to advise the Tompkins County Legislature on proposed federal and state legislation and policy initiatives regarding energy and greenhouse gas emissions.

Implementing the action items required the involvement of multiple County agencies, including those responsible for Planning, Solid Waste, Wastewater, and Transportation. Thus, to cover the scope of the effort, the Tompkins County Sustainability Team (TCST) was formed; its mission is "to promote sustainable practices including social, environmental, and economic stewardship to benefit future generations and inspire other municipalities, public and private entities, and the residents to do the same." The Team consists primarily of County employees who

are in position to incorporate sustainable practices. Divided into subcommittees, they address everything from procurement policy and building codes to fuels, waste reduction, and energy efficiency. Aiding the Sustainability Team is the non-profit Tompkins County Climate Protection Initiative (TCCPI), which serves as a forum for representatives from the public, private, and non-profit (including academic) sectors to gather and share ideas. The role of TCCPI is important. Its members helped to secure the initial commitment of elected leaders, and the TCCPI forum represents partial fulfillment of the Sustainability Team's mission, inspiring those from other sectors to follow the County's lead. This reciprocal commitment and support have been instrumental to sustaining implementation of the action items in the County's comprehensive plan.

Achievements

Emissions Reductions

Tompkins County government produces a biennial report of its progress towards the EGGE Element; TCCPI publishes an online summary of members' progress towards their energy efficiency goals, found at http://www.tccpi.org/TCCPI_2010.html. For 2010, Tompkins County and TCCPI reported the following results:

- In evaluating progress made toward a 20% reduction goal in government emissions that was set for 2008, County government findings showed that County facility energy efficiency improvements contributed to building emissions reductions, resulting in an 8% reduction between 1998 and 2008.[65] In the community sphere of energy use, commercial sector building-related emissions were down 4.6%; residential sector emissions were down 16.5%.[66] Emissions from the transportation sector, however, were up across the board, leading to a greater focus on promoting car- and ride-sharing programs, among other measures.
- Ithaca College reported that the annual update of its GHG emissions inventory showed a 5.7% decrease from FY 2007-2008 to 2008-2009, exceeding the College's annual reduction goal of 2.5%. Ithaca College's ECMs include direct-digital controls for HVAC systems, installation of VFDs on motors, and leapfrogging from incandescent lighting over fluorescent fixtures directly to extremely high-efficiency LED technology for many applications.
- Cornell University's 2010 emissions were 236,000 gross metric tons of CO_2 equivalent, a 26% reduction from the 319,000 tons reported in 2008. The University cited as a major contributing factor the start-up of the campus CHP Project and the ongoing phase-out of coal. In addition, Cornell approved and began $10 million worth of energy efficiency building retrofits to save energy, cut costs and prevent carbon emissions; this is part of a five-year, $46 million project expected to reduce carbon emissions between 22,000 and 30,000 metric tons, equivalent to between 9% and 13% of Cornell's FY 2010 footprint.

Financing Strategies

Two financial policies have been identified in Tompkins County government sector as potentially powerful mechanisms for incentivizing broad involvement in the county's energy efficiency and sustainability efforts. One of them, a sales tax rebate for energy-efficient products, has been implemented. The second policy, Property Assessed Clean Energy (PACE) Bonds, an innovative low-interest loan program, is moving forward for the commercial building sector.

- Sales Tax Rebate. In Tompkins County, the sales tax on the purchase of photovoltaic systems has been reduced from 8% to 2%. This sales tax reduction was originally a temporary measure, but the Tompkins County Legislature recently made it a permanent reduction. With this action, the Legislature sent a strong message of support for investment in solar energy. The tax rebate was not offset by increases in other taxes or fees; it was a new financial commitment by the County.

[65] Tompkins County GOVERNMENT GREENHOUSE GAS EMISSIONS, 1998-2008: A REPORT ON THE LOCAL ACTION PLAN, Tompkins County Planning Department, June, 2010.
[66] Tompkins County COMMUNITY GREENHOUSE GAS EMISSIONS REPORT, 1998-2008,Tompkins County Planning Department, June, 2010.

- Property Assessed Clean Energy (PACE) Bonds. Under a PACE bond the proceeds are lent to commercial and residential property owners to finance energy retrofits (efficiency measures and small renewable energy systems); in turn, they repay their loans over 20 years via an annual assessment on their property tax bills. PACE bonds can be issued by municipal financing districts (local governments) or finance companies, and typically the proceeds can be used to retrofit both commercial and residential properties. Because the assessment is attached to the property tax bill, there is very little risk exposure for the local government; and a transfer of the property (a sale) results in a transfer of the loan to the new owner. Thus, property owners interested in selling their property within the payback period for the retrofit may use a PACE bond without the fear of losing money on the initial retrofit investment. Tompkins County and the City of Ithaca are working to implement a PACE Bond program, but it requires passage of enabling legislation currently pending at the state government level.

In the private sphere, a local credit union, Alternatives Federal Credit Union, a regional credit union "dedicated to economic justice,"[67] made $1.33 million in green loans in 2010. The Ithaca community's Eco-Village development is an example of home-grown innovative financing; outlined in a later section and described in greater detail in Chapter 5 of this report, its community-owned solar array will be financed by investors who are projected to receive a 4% rate of return annually.

Benchmarking and Tracking Progress.

Leaders in the public and private sectors in Tompkins County work continuously to benchmark energy usage within the community, including energy use at County facilities. Past emissions inventories and technical assistance provided by ICLEI – Local Governments for Sustainability, an organization that provides technical guidance to numerous local governments, was instrumental in providing decisionmakers with a baseline benchmark, feedback, and information on which to base policy decisions.

In addition to tracking efforts in Tompkins County, the City of Ithaca contracted with Johnson Controls (an Energy Services Company, or ESCo) to provide information on needed energy-related building improvements and the anticipated payback period. This contract was a specific, direct response to Mayor Peterson's signing of the U.S. Conference of Mayors Climate Protection Agreement. Johnson Controls submitted a report proposing approximately $2.37 million in lighting system modifications, installation or upgrades to energy management systems, energy efficiency improvements to the building envelope (windows or roofs) or HVAC systems, and savings through education and staff awareness programs. The City is now working with Johnson Controls to implement the recommendations and will continue to track the energy savings over the life of the 15-year contract. To date, the recommendations have resulted in energy savings that have slightly exceeded expectations.[68]

In 2010, Tompkins County received $1.2 million in ARRA funding for energy efficiency retrofits and upgrades to public buildings. Ten projects in Tompkins County include lighting retrofits, building envelope improvements, installing a heat recovery system and solar panels, and the construction of the new wastewater treatment plant.[69]

Active Interaction Between the Public and Private Sectors.

One of the keys to past, present, and future success in Tompkins County is consistent, ongoing communication between the public, private, and non-profit sectors. The County has benefitted significantly from broad community support during the implementation of its energy efficiency initiatives to date.

Community Support. The EGGE Element successfully delegated many of its action items to other public, academic, and non-profit entities within the community, including the Cornell Cooperative Extension Service, the County Solid Waste Division, and the Tompkins County Area Development and Workforce Investment Board.

LEED Certification Efforts. One action item in the Tompkins County plan is: "Adopt a County administrative policy that requires major new County government buildings or renovations of County buildings to be certified

[67] http://www.alternatives.org/about.html
[68] This performance contract should yield useful information for a future cost/benefit analysis. Cadmus is working to connect with Arel LeMaro, Facilities Director for Ithaca, to learn more about the contract and the data available.
[69] *Ithaca Journal*, March 29, 2010.

LEED Silver or higher." TCCPI and Tompkins' elected leaders worked together to hire Robert A.M. Stern, dean of the Yale School of Architecture, and his firm to design a high-profile new wing at the Cayuga Medical Center in Ithaca. It received LEED-Platinum certification and has set the bar for sustainable design in the Tompkins region. More importantly, TCCPI and local leaders seized the opportunity to build on that success and used the medical facility's construction as an opportunity to enhance the LEED-design capacity within the Ithaca area. According to Peter Bardaglio, the Coordinator for TCCPI, "Bringing in an architect of that caliber, and facilitating interactions with the local design community, really gave our capacity for sustainable design a boost." Local engineers and architects worked with the Cayuga Medical Center and the national design firm to learn about energy-efficient design elements.

The result is a local community of designers that continue to design and build LEED-certified facilities, including the new business school at Cornell University (LEED-Platinum) and the new Tompkins County Health Department (LEED-Silver). Further, officials at the business school carefully tracked the marginal costs of incorporating LEED designs. The result is a detailed business case for incorporating sustainable design that has been shared with local businesses and construction firms.[70] New construction, however, represents a fraction of the built environment. For existing public buildings, Tompkins County is able to leverage the programs available through NYSERDA (such as the Energy Audit Program, the Existing Facilities Program, and the Green Building Services Program), and the City of Ithaca's partnership with the ESCo Johnson Controls is yielding energy-use information that will lead to plans for additional energy-efficient retrofits.

Students Assisting Homeowners. Another example of productive interactions in the Tompkins County area involves efforts that engage low-income homeowners to improve energy efficiency. This segment of the Tompkins community has traditionally been less engaged, partially due to less knowledge of or access to the efficiency initiatives in the area. Tompkins Community Action, a local non-profit organization, has worked to change this by linking the engaged student population in the area with low-income residents in need of home weatherization assistance. The DOE- and state-funded Weatherization Assistance Program installs energy-saving measures in owner-occupied homes and rental units. The program is available at no cost to income-qualified Tompkins County homeowners, renters, and landlords. Energy-saving measures can include insulation and air sealing, heating system repairs or replacement, hot water heater repairs or replacement, refrigerator replacements, and installation of energy-efficient light bulbs, and low-flow, efficient faucets and showerheads.

Co-housing Developments Powered by Innovatively Financed Renewable Energy Systems. The EcoVillage at Ithaca, a non-profit sponsored by Cornell's Center for Sustainability Education, partnered with the Tompkins County Planning Department to win a coveted 2011 EPA Climate Showcase Communities Grant. The grant will support the writing of new zoning ordinances and building codes encouraging a comprehensive approach to creating energy-conserving residential communities, as well as efforts to monitor and measure GHG reductions to educate a broad audience. The Eco Village's first-built cohousing neighborhood installed a 6 KW photovoltaic array on its community center in 2010, an array expected to produce 50% of the electricity needed by the Village's Common House. There are additional plans for a 220 panel ground-mounted, community-owned PV array to supply electricity for the entire 30 household neighborhood, to be master-metered through four energy centers. This will be innovatively financed: resident investors will be paid back over 20 years at 4% interest, with household bills remaining at market-level utility rates. EcoVillage's planned third cohousing neighborhood will apply the principles of a stringent energy conserving green building standard, the Passive House standard, in the design of its homes.

Water and Wastewater Treatment Efficiency Achievements

Overview

In Tompkins County, public awareness and community involvement extends to the water-wastewater sector. For example, the County Department of Health sponsors an annual Drinking Water Week and Water Taste Test to raise public awareness, the highlight of which is the competitive taste test pitting tap water samples from various County water treatment plants against each other. As part of the events, the County offers tours of its water filtration plants and wastewater treatment facility. At present the Ithaca Area Wastewater Treatment Facility (IAWWTF) is planning to make substantial infrastructure changes that will affect energy efficiency and

[70] Cadmus has requested, but not yet received, access to this report.

greenhouse gas emissions. Changes include construction of a new highly energy-efficient wastewater treatment plant, and retrofits to older plants, which involve the removal of cogeneration engines and the installation of dual-fuel boilers and a microturbine. Johnson Controls has conducted some benchmarking associated with these planned upgrades. The Ithaca wastewater facility was awarded $400,000 of Recovery Act money for lighting and heating upgrades.[71]

Description of Drinking Water and Wastewater Services

A summary of Tompkins County's water and wastewater systems suggests that inefficiencies may lurk in three areas. Two are connected with the many miles of system infrastructure: the need for extensive pumping and the potential for leakage. The third involves the quite variable needs for wastewater aeration due to seasonal fluctuations in usage, as this County has a significant college and university population not in residence during the summer.

Three community water systems—the Bolton Point, City of Ithaca, and Cornell Water filtration plants—meet the potable water needs of about 95% of the County's almost 100,000 residents. The largest single potable water supplier is the Bolton Point water treatment plant on the eastern shore of Cayuga Lake (its water source), which delivers on average 2.61 million gallons per day (MGD) to 6,566 service connections for approximately 30,000 customers. The City of Ithaca water treatment plant, drawing its source water from the Ithaca Reservoir, provides on average 2.17 MGD to almost 29,500 people through 85 miles of cast iron water mains and 5,400 service connections. The Cornell Water Filtration Plant, owned by and servicing Cornell University, provides an average of 1.3 MGD, distributed through approximately 120 miles of water mains to 221 service connections serving about 34,000 people.

The two main wastewater treatment plants are the Ithaca Area Wastewater Treatment Facility and the Cayuga Heights Wastewater Treatment Plant. The Ithaca Area plant has a permitted maximum flow of 13.1 MGD, and the average flow is 6.1 to 6.5 MGD with seasonal variation due to academic year schedules, as the plant serves both Cornell University and Ithaca College. Approximately 80 miles of sanitary sewer drain into the plant. The Cayuga Heights plant is located on the eastern shore of Cayuga Lake, which is also its discharge location. It has a design flow of 2 MGD.

Specific Energy and Water Efficiency Improvements

City of Ithaca officials are planning a new water treatment facility that will incorporate energy-efficient technologies. Even so, improvements were made recently in the existing water treatment plant, and the facility participates in ongoing energy efficiency programs by taking advantage of resources available from NYSERDA.

The Cornell Water Filtration Plant has a water conservation program in place, and works to avoid leaks in its distribution system by installing high-quality distribution piping, repairing detected leaks as soon as possible, and conducting annual flow and pressure testing of the distribution system. Energy- and water-efficient improvements are funded through rate recovery and informal loans from the Cornell University endowment. Christopher Bordlemay, plant manager, noted in an interview that the main barriers to energy/water efficiency projects are financial constraints and a lack of manpower to plan and implement them on top of normal plant responsibilities. He also pointed out that as a small system, the Cornell Water Filtration Plant is less able to pilot test new and unproven technologies and strategies. It is too risky because the impact of failure is larger on a small system.

The Ithaca Area Wastewater Treatment Facility used about 3.4 million kWh of electricity in 2003, and about 0.14 million therms of natural gas. An energy audit of the plant was conducted in 2004 as part of a NYSERDA grant, and Johnson Controls completed an energy audit and benchmarking analysis with 2008 and 2009 data. The firm has identified energy efficiency improvements that could be made to five systems: the plant's lighting system (namely motion sensors); cogeneration system; digester mixing system; the HVAC system; and the aeration system (blowers and dissolved oxygen (DO) control). Plant managers are considering entering into a performance contract with Johnson Controls, which would pay the capital cost of the efficiency improvements up front. In

[71] http://theithacan.org/am/publish/news/201004_County_given_energy_grants.shtml

return, the plant would repay Johnson Controls an amount equal to the cost savings in energy use for a negotiated number of years.

Energy efficiency equipment already installed at the Ithaca Area Wastewater Treatment Facility includes VFDs, a new belt-filter press for sludge, and primary settling tank chains and flights made of plastic and fiberglass instead of metal (being lighter they require less energy to drive). The plant also has cogeneration units that generate electricity from the methane produced by the sludge digester. However, these units were installed when the plant was constructed in 1987, and are near the end of their effective lifecycle. Their cooling is insufficient to allow them to run as often as the methane production demands; and while the plant has an automatic diverter that flares the methane when the co-generation units shut off, there is no automatic way to turn it back on again. Thus a lot of methane is wasted, especially at night. For those reasons, Johnson Controls suggested replacing the units with new ones more suited to the needs of the plant as part of the performance contract.

This treatment facility purchases electricity through the City of Ithaca, which negotiates rate contracts for all city operations. Additionally, the plant has been participating in a NYSERDA-promoted energy curtailment program (or peak-shaving) for the past several years. When electricity demand is very high, the operators turn on the emergency backup diesel generator and stop using grid power, which takes stress off the electric grid. The wastewater treatment plant gets paid monthly for participating in the program, and receives an additional payment every time the emergency generator runs. The resulting annual revenue totals more than $10,000.

The main challenge in making energy improvements at the Ithaca Area Wastewater Treatment Facility is obtaining capital to pay for them. As with the cogeneration units, many other components installed when the plant was built are nearing the end of their effective life cycle; with that in mind, plant managers recently drafted a capital improvement plan. One successful strategy for finding capital for the improvements has been to identify and use methods that make the improvements self-funding (for example, prioritizing the improvements with a short return on investment and using performance contracting, as mentioned earlier). But officials also have the opportunity to tap the Revolving Loan Fund financing alternatives available through the state, as explained below.

Opportunities for Financing Through State Revolving Loan Funds

New York State has been in the forefront of energy efficiency planning and financing for water treatment, and recently made energy-efficient retrofits and new construction a priority for award of revolving loan funds. The New York State Environmental Facilities Corporation (EFC) is a fruitful resource for many types of financing through Clean Water State Revolving Loan Funds (CWSRF) or Drinking Water State Revolving Loan Funds (DWSRF). These national, EPA-sponsored funds are accessible to all local governments across the country. ; and in applying for the funds, other ARC states and counties can adapt Tompkins County's ideas and actions to their own circumstances. Short-term interest-free financing is available in the form of three-year loans to cover design and initiation of construction. Types of financing include long-term subsidized financing through bond issuance for a pool of projects (leveraged financing); hardship financing; and short- or long-term market rate financing. Further plans for innovative financing incentives are in the works, according to an EFC 2009 memorandum:[72]

"Municipalities finance their water quality projects through EFC because of the cost savings derived from the interest subsidy and lower interest rates available through EFC. Other financial incentives could be created to encourage adherence to Smart Growth principles and energy efficiency. Examples of some of the possibilities include:

The formula for the interest subsidy could be modified to create an incentive for better behavior. Presently, the rate of subsidy is 50% for most CWSRF participants. The formula could be modified to give a 40% interest subsidy, and award the resulting 10% to communities that demonstrate adherence to Smart Growth and/or energy efficiency criteria.

Each loan offered by EFC is subject to collection of a State Bond Issuance Charge (SBIC) of up to 0.70% of the amount of the loan. The SBIC could be waived as an incentive.

A new state-only revolving fund could be created to finance energy efficiency projects. Such a revolving fund would be dedicated to improving energy efficiency on water quality projects, and could be designed with criteria

[72] Anne Reynolds, Kathleen O'Connor, Richard Svenson, David Bradley. Memorandum. January 28, 2009. http://www.nysefc.org/docs/smart_growth_draft_final__12-01-08.pdf

and project selection process specific to such projects. EFC, with its experience in administering the SRFs, is well suited to administer an energy state-only revolving fund. Capitalization of such a revolving fund could come from legislative appropriations, Regional Greenhouse Gas Initiative (RGGI) funds, or other sources. As the loans issued for such projects would be repaid to the revolving fund and reissued as new loans, the benefit to New York [or any other state] will be recurring, representing a better investment than providing grants."

Replicable Strategies

Tompkins County's progress on a wide range of energy efficiency and sustainability initiatives is the direct result of an engaged community and active partnerships between local governments, state government, academic institutions, non-profit organizations, and the business community. Although the cooperative spirit is different in each county in the Appalachian Region, opportunities for similar kinds of collaboration among sectors and institutions always exist. While the financing programs associated with a state agency like NYSERDA are currently available in only a few other states, some of the specific strategies for promoting energy efficiency in Tompkins County *are* replicable in other Appalachian counties. The most transferable ideas include the following:

- **Sales Tax Reductions for Energy-Efficient Products**. Although Tompkins County applied this reduction only to products that use solar power, public subsidies of a broader range of energy-efficient products (as other counties, cities, and states have implemented) may incentivize widespread adoption and lead to meaningful energy-use reductions and utility bill savings. See http://www.energystar.gov/ia/business/government/State_Local_Govts_Leveraging_ES.pdf.
- **PACE Bonds.** This innovative financing mechanism ties energy efficiency loans to the payment of local property taxes. While the nation's primary residential mortgage lenders have raised objections to PACE for residential sector loans, it has strong potential as a financing mechanism for the commercial sector. (New York State, for example, has pending legislation on PACE bonding.) By providing loans that can be paid back over 20 years at little risk to the property owner or the local government, upgrades can be made that may not occur otherwise due to long payback periods (in other words, where return on investment is long rather than short term). By removing this barrier to implementation, PACE bonds may result in sustained investments in commercial building and infrastructure that could result in substantial improvements in energy efficiency. Although there are few *direct* benefits to the local government, this financing service can be provided with little risk to the municipality and result in lasting community benefits through upgraded building stock and energy savings.
- **Performance Contracting and Energy Audits for Water-Wastewater Plants and Other Governmental Facilities**. This relies not only on the presence and willingness of ESCos to engage in the work, but on the availability of local government staff to develop, award, and administer Requests for Proposals (RFPs) for these services.
- **Community Planning and Partnerships**. Many of the accomplishments in Tompkins County can be traced back to the Vital Communities Initiative planning effort in 1999 that facilitated ongoing conversations with people that care about the future of land use in the County. Public charrettes, such as those that took place during this initiative, are an excellent and transferable method for establishing open communication about community planning. In addition to gathering information from the public, charrettes are a great opportunity to educate engaged citizens. Numerous organizations that operate at the county level in the Appalachian Region can provide guidance or direct assistance with the implementation of a community planning effort [charrette].[73]

  In addition, many initiatives in Tompkins County are the result of an active and positive relationship between the local government and the academic community. There are hundreds of community colleges, and four-year colleges and universities in the Appalachian Region, each with a student body seeking opportunities to learn and apply skills and a faculty seeking opportunities to teach. Local governments interested in engaging the community can leverage them to advance issues of local importance, such as sustainable development and energy efficiency.
- **Technical Assistance.** The technical assistance provided to Tompkins County by Johnson Controls and ICLEI cannot be underestimated. These resources can be leveraged at varying degrees of cost. Although

[73] These resources are noted in Chapter 1 of this study.

the cost of ESCo services, for example, may be prohibitive in some circumstances for some local governments, there are organizations that offer low-cost or free assistance to qualifying local governments.[74] In many cases, their recommendations include an evaluation of the payback period associated with implementing energy efficiency measures so local decisionmakers can make informed choices when investing public funds.

Tompkins County provides a model of how local support can lead to actionable plans and the implementation of innovative strategies for improving energy efficiency. In many respects, Tompkins County is a leader in the Appalachian Region, yet the community feels that its efforts to reduce greenhouse gas emissions and improve energy efficiency are still in the early stages. Continued progress toward Tompkins' energy efficiency goals depends in part on the identification and use of metrics that measure success, and the development of subsequent action items that maintain the momentum generated by the EGGE Element. For example, moving from analyses of feasibility to implementation of feasible strategies will require additional political support and financial investments. Even in counties like Tompkins where there is broad community support for the implementation of energy efficiency measures, fiscal and political realities remain.

The Future: Ongoing Challenges and Potential Roadblocks to Future Progress

Important barriers to progress in achieving the action items listed in the County's EGGE Element include:

- **Workload.** Each action item was intended to be addressed within five years of adopting the EGGE Element. As of mid-2011, two years into the timeline, some items, including the development of metrics to track changes in energy use, emissions, and energy efficiency improvements, have not yet been addressed. According to the Tompkins County Planning Department, staff workload pressures have resulted in delays in addressing certain action items. Some workload issues that have taken precedence over the action items may, in fact, also help achieve the County's energy efficiency goals. For example, the pursuit of federal funds available through the Recovery Act, demanded considerable staff time in 2009-10.
- **Enabling Legislation***.* The PACE program for commercial buildings is likely to be implemented within Tompkins County once the state enabling legislation is passed. According to the Planning Department, broad-based local support exists for the implementation of a PACE program.
- **Financing of Government-sector Projects**. Some energy efficiency initiatives are expensive, such as community-scale wind power. One action item in the EGGE Element is the identification of sites most appropriate for locating community-scale wind power. Although this action item has been completed, moving toward construction of a community-scale wind farm may require additional loans, grants, or other public investments that have not yet been determined or fully explored. In the area of water and wastewater treatment, NYSERDA offers many financing options (as discussed earlier). However, those grants or loans are competitive across New York State, and applying for financing requires the commitment of public resources to administer the program, in addition to the funds needed to engage in advance planning.

Beyond the three barriers mentioned above, some leaders interviewed identified the relationship with NYSEG, the primary energy utility in the County, as a complicating factor. Past efforts to persuade NYSEG to actively participate in local energy efficiency endeavors were met with mixed success. When invited to give specifics, those interviewed declined to elaborate. The perception exists locally that NYSEG is not supportive of incentives for energy efficiency.

Acknowledgments

Special thanks to the following individuals who generously offered their insights and assistance during interviews with the study team preparing the Tompkins County case study:

- Peter Bardaglio, Tompkins County Climate Protection Initiative
- Katie Borgella, Tompkins County Planning Department

[74] These resources are noted in Chapter 1 of this study.

Case Study 2–Fayette County, West Virginia

Overview of Efficiency Efforts

Appalachian County:

Fayette County, West Virginia

Energy efficiency ranking:

931 (of 1,070 total counties in 13 ARC states)

Criteria for selection:

Rural county example; private-public linkages; private sector lead-by-example and engagement in voluntary energy efficiency programs

ECMs pursued: Lighting upgrades in government buildings; for-profit water utility initiatives to reduce water loss and inflow and infiltration; energy efficiency upgrades in K-12 schools

County leadership in energy efficiency demonstrated in:

County-federal sector partnerships; grants applications; emerging private-public partnerships; U.S. Conference of Mayors Climate Agreement signatory

Fayette County in West Virginia is a rural county and according to the Appalachian Regional Commission, an "at-risk" county in terms of economic attainment. It is not an energy-efficient county by objective measures, yet is worthy of a case study because despite its challenges, new initiatives are underway in Fayette County for energy and water efficiency. They include networking among key entrepreneurs, activists, and organizations; collaborative activities; and pilot projects in energy efficiency and sustainability. Fayette County stakeholders in the non-profit, governmental, and private sectors are focused on the incentive of reduced energy costs to increase the capability of the local population to envision and achieve improvements in their quality of life. The value of this case study for other counties in the Appalachian Region lies in the successful linkages between and within the public and private sectors. Fayette County evinces an incremental, bottom-up approach with select top-down strategies. Multiple public and private actions are helping to achieve a measure of energy and water efficiency. Efforts have begun as dispersed rather than united, with the private sector sometimes leading the charge.

Specifically, Fayette County is beginning to see **performance contracting** offered by private-sector utilities and applied to school energy system retrofits; **Smart Growth** principles applied by a private investor to encourage clustered settlement in existing small towns and adaptive reuse of existing buildings; implementation of Leadership in Energy and Environmental Design (**LEED**) principles in building retrofits; and in the private sector a **smart metering** project to increase drinking water supply efficiency, sponsored by the County's for-profit water utility. The state has taken notice of these varied efforts and the local embrace of energy efficiency and sustainability. In August 2010, Fayette County was asked to become one of four member communities in the West Virginia Sustainable Communities Initiative,[75] an effort sponsored by the WV Department of Environmental Protection; as a member community, the County pledged to take the first steps toward creating a Sustainability Action Plan.

County Background and Local Context

Fayette County is located in southern West Virginia in the geographical heart of the Appalachian Region, with an area of about 665 square miles and a total population of just over 46,000. It has the lowest density of the four counties selected as case studies. Fayette is officially designated a "rural county" by the federal government,[76] with a population density of 70 inhabitants per square mile. The County consists mostly of forest and woodland (87%); the next highest is human land use (7.14%).[77] Fayetteville is the County seat, and the other principle towns are Mount Hope and Oak Hill, all sited near or along the north-south spine of U.S. Highway 19, west of the Allegheny Mountains. Recreational rivers and lakes attract whitewater rafters, kayakers, and other outdoor sports enthusiasts from hundreds of miles away. The County centers two annual public festivals around its water features: the New River Gorge Bridge Day and the New River Birding and Nature Festival.

---

[75] http://www.wvhub.org/wvsc/fayette-county-wvsc-2010

[76] Health Resources and Services Administration. *List of Rural Counties And Designated Eligible Census Tracts in Metropolitan Counties*. September 3, 2009. ftp://ftp.hrsa.gov/ruralhealth/Eligibility2005.pdf

[77] United States Geological Survey. *National Biological Information Infrastructure (2010) GAP: Land Cover Viewer*, vol. 2010.

The working population of Fayette County earns a lower average household income ($32,082) than the national average ($52,175), and the county has a much lower college graduation rate (10.7%) than the national average, which is 27.4%.[78] The lack of economic growth in the area, and perceived lack of capacity for economic growth due in part to lower advanced education levels in a fast changing economy that rewards higher education, represent the primary challenges to the support and funding of energy efficiency in the County. But that is beginning to change.

Devising an Energy Efficiency Strategy

Fayette County saw the need for efficiency initiatives years ago and began applying for grants to match the modest amounts it could set aside from its own budget for building improvement projects. It also took advantage of larger sums of money to study and evaluate its wastewater system needs. There was no grand plan or strategy at the outset; sensible projects were undertaken as funding and other resources became available. In 2010, through a grant-based program funded by a local foundation, Fayette County was one of 20 communities whose staff participated in sustainability training and received the framework for a sustainability plan. The County's ad-hoc, decentralized public- and private-sector efforts led to this recognition and financial support for creating a strategy.

Four sectors—government, community, for-profit, and not-for-profit—drive the energy and water efficiency initiatives in Fayette County, sometimes working collaboratively. Each of them contributes to the increased momentum in Fayette County, making gradual but expanding progress toward greater water and energy efficiency.

Taking Action

Energy Efficiency Activity in the Government Sector

Local Government Facilities. The Fayette County Commission has steadily requested and received funding from government agencies to pursue specific efficiency projects. For example, prior to the influx of Recovery Act money to incentivize efficiency program implementation, the Commission sought and received assistance from the state. According to Bill Willis of the West Virginia Department of Energy (WVDOE),

"In 2007, the WVDOE awarded the Fayette County Commission $13,512.50 for lighting upgrades in the Commission facilities. This award required a 50% match by the Commission, so the total estimated initial cost was $27,025. The estimated annual savings in energy costs for the project was $12,390; this amount returns the investment in less than three years. The audit recommended the replacement of existing lamps and ballasts in the four-foot, florescent fixtures with T8, 32 watt-lamps and four-lamp ballasts instead of the two-lamp ballasts. In addition, the audit recommended that T8, 59-watt lamps and two-lamp electronic ballasts be utilized in the eight-foot fixtures and compact fluorescent lamps be used as upgrades for some incandescent lighting."

Because the population of Fayette County was too small to qualify for direct ARRA energy efficiency funding from DOE in 2009, Fayette sought an energy efficiency local government grant allocation from the state (federal funds directed to the state to disburse), which is administered through the Region IV West Virginia Regional Planning and Development Council. Just over $1 million is being split across five counties for energy retrofit projects in county buildings.[79]

In 2011, the Fayette County Public Schools, through a performance contract with a local ESCo, financed $8.3 million of energy efficiency retrofit projects in a 15 year plan, the net savings from which are expected to be $14 million.[80]

Public Wastewater. During the late 1990s/early 2000s, the town of Fayetteville's wastewater system faced operational and regulatory challenges due to high inflow and infiltration. In older communities such as

[78] U.S. Census Bureau, American Community Survey 2006-2008.
[79] West Virginia Division of Energy (WVDOE). 2009. Grant Application: Recovery Act, Energy Efficiency and Conservation Block Grant. www.recovery.wv.gov/Documents/WV%20EECBG%20Submission%20060309.pdf
[80] http://www.register-herald.com/todaysfrontpage/x1517689596/Fayette-schools-to-begin-energy-saving-upgrades

Fayetteville, it is common practice for rooftop downspouts and footer drains to carry stormwater directly into the sewer system (termed "inflow"), which makes overflow and discharge to natural water bodies a frequent occurrence. At the same time, aging manholes needed replacement to reduce infiltration. The town constructed a new wastewater treatment plant to accommodate the high flows.

In 2005, to manage its wastewater better, the Fayette County Chamber of Commerce and Fayette County Commission applied for and received a $450,000 grant from EPA to develop a Comprehensive Wastewater Management Plan to help address wastewater issues throughout the County.[81] The plan contained a "full evaluation of all current treatment systems ranging from the public service district (PSD) and municipal systems to currently permitted package plants." It examined which locations "had the highest failure rates for septic tanks, straight pipes, etc., and laid out a strategy for upgrading existing plants and for providing low-flow systems to communities that have the population base to support them." This plan provided a means to have private septic tanks come under public ownership. The local government would make sure systems were pumped and maintained in exchange for a monthly fee, and "if and when they failed, the public agency would replace them through the rate base garnered from the monthly fees."[82]

The plan also offered recommendations for addressing the ownership, administration, and operation of each type of wastewater technology utilized so that old and outdated systems, or those unable to operate efficiently, could be improved and managed efficiently in the future.

- *Individual and clustered onsite system.* The plan recommended that the County conduct a complete inventory of existing systems and their condition. For some areas, construction of cluster systems, which treat wastewater at a neighborhood level while avoiding reliance on septic fields, were deemed beneficial. The plan also recommended that the County implement a "responsible management entity" (RME) management system in which a public or private organization (system) takes over ownership and operation of existing systems to ensure they are inspected, operated, and managed in an efficient and effective manner. The RME would fund installations and repairs as needed. Cluster systems, if properly maintained, tend to be energy-efficient and cost-effective alternatives both to the construction of central, conventional grey infrastructure and the energy costs incurred by its operation.
- *Package plants.* The plan recommended that each of the 15 package plants in operation in the County be upgraded or replaced. It suggested the majority of the old "extended air" package plants be converted to recirculating media filters. For ownership and operation of these facilities, an RME management system was also recommended.
- *Public Service Districts and Municipal WWTF*. Of the 14 systems in the County, most were aging and in need of improvement; one was scheduled to be abandoned. The plan outlined the specific problems and needs facing these systems, but did not recommend a change to the existing management structure. It did recommend consolidation when there were advantages to all parties.

The recommendations of the wastewater management plan constitute a roadmap for local governments to install energy-efficient, decentralized wastewater systems. After considering the costs to implement—however modest in comparison to more conventional infrastructure—as well as the management and oversight needed in the future, Fayette County decided, in 2008, to allow West Virginia American Water to purchase its public wastewater system in exchange for $4.2 million in investment in wastewater infrastructural upgrades. (More on American Water appears later in this case study.)

Federal Buildings. In Fayette County, the federal sector also assists in local efficiency efforts; the National Park Service provides the equivalent of an energy efficiency demonstration project for the County. The New River Gorge National River Park spans four West Virginia counties, but the park is a special draw for Fayette County, providing whitewater rafting opportunities for residents and tourists. The New River Gorge Park participates in the Climate Friendly Parks Program, which provides national parks with management tools and resources to address climate change. The program's objective is to determine how climate change impacts can be reduced through increasing the efficiency of resource use. The program's approach requires three steps: (1) measure emissions,

[81] Prepared by Lombardo Associates, Inc of Newton, MA, in association with Stafford Consultants Incorporated of Princeton, WV, available for download at www.lombardoassociates.com/fayette-county/051221%20Proj%20Summary.pdf

[82] Interview with Dave Pollard, Resource Coordinator.

(2) develop strategies to mitigate emissions and adapt to impacts, (3) share success and educate the public about what they can do in their own lives to use energy more efficiently (and reduce emissions).

New River Gorge Park staff held a workshop with 53 park staff, community members, local businesses, and Partners of the Park to establish a year 2008 baseline carbon inventory.[83] As part of the park's commitment to energy efficiency, the visitor's center incorporates advanced geothermal heating, sensor-based lighting, north facing windows, thermal mass in the floor and radiant heat, recycled cellulose insulation, and efficient lighting. Additionally, the park headquarters uses duplex printing practices, has recycling stations, and uses recycled motor oil, among other green practices. To honor the park staff's commitment, the WV Division of Energy provided a free lighting audit, which showed they could save over $2,000 a year by changing the fluorescent lights from T12 to T8 lamps.

Energy Efficiency Activity in the Community and Non-Profit Sectors

Community-based non-profits and individual activists are trying to create a model for community collaboration, improvement, and transformation. One practical example is their organizational support for a farmer's market to bring together local farmers and community members, to promote buying locally produced food and other items, and to spread the word about eating fresh, healthy food. With the help of community stakeholders, Fayette County now has a farmer's market in four different locations. There is some momentum in the County to introduce the community to the benefits of an energy-efficient lifestyle. The most successful example to date is the Fayette County Green Advisory Team (GREAT).

GREAT. GREAT was formalized as a non-profit community-based organization in 2009. The catalyst for its creation was the West Virginia Sustainable Communities Project (WVSCP). WVSCP partnered with the WV Department of Environmental Protection in a three-year pilot program that was instrumental in creating the County's Green Advisory Team. As part of the partnership, GREAT was encouraged to join with ICLEI: Local Governments for Sustainability to evaluate greenhouse gas emissions, set targets for energy reductions, and create an action plan. From this joint effort, **emerged the Fayette County Sustainability Task Force, to facilitate discussions on which projects to undertake to reduce greenhouse gas emissions within the County.**

WVSCP also established the now annual Earth Day Festival held in April in downtown Fayetteville. Because WVSCP funding from the Benedum Foundation and the state ended in August 2008, GREAT has taken over organizing the Earth Day event, and also staffs a booth and organizes recycling efforts at the New River Gorge Bridge Day Festival. WVSCP was instrumental in the initial phases of community organization, and now the community continues the activities.

The Benedum Foundation. The Claude Worthington Benedum Foundation, which funded WVSCP, is an example of an institutional sponsor of community development efforts around energy efficiency. An independent foundation established in 1944, it focuses on grant-making in West Virginia and Southwestern Pennsylvania—the native and adopted homes of the founding family. The Foundation generally invests two-thirds of its grant dollars in West Virginia and one-third in Southwestern Pennsylvania (www.benedum.org). Grants are made in the areas of education, civic engagement, health and human services, economic development, and community development. The latter two are particularly relevant to initiatives that create and enhance community-level infrastructure. Many of the communities served by the Foundation are rural, and enjoy abundant natural assets that provide economic opportunities to complement centers of technology-based growth. The Foundation supports efforts to promote entrepreneurship, technology-based economic development, and programs that create job opportunities in communities categorized by ARC as "distressed." Under community development, the Foundation supports initiatives that improve the capabilities of local leaders, organizations, and interested citizens to address challenges and find opportunities that will help the community residents be more prosperous through their own efforts.

[83] http://www.nps.gov/climatefriendlyparks/downloads/Action%20Plans%20and%20Inventories/NERI-Climate-Friendly-Action-Plan-Final.pdf

West Virginia Sustainable Communities (WVSC). The WV Department of Environmental Protection (DEP) credits the West Virginia Sustainable Communities (WVSC) with, statewide, "more than 100,000 kilowatt hours of energy saved, more than 90,000 gallons of water [saved], and more than 500 tons of solid waste prevented from going to a landfill."[84]

Based in Stonewood, WV, WVSC is a not-for-profit DEP initiative that is funded through a grant-based program of the Benedum Foundation. The overall goal of WVSC is to be part of a sustainability "niche" network—a place where someone with an idea or challenge can be connected to the right people for assistance and support. To further this goal, WVSC assisted in developing a draft sustainability plan for 20 communities, including Fayette County. During 2010, the 20 communities were invited to send community members to a Riverside Sustainability Awareness Training offered by Bridgemont Community and Technical College and WVSC in five locations across the state. Based on their respective engagement and capabilities, five communities will be chosen for WVSC to work directly with its staff on networking, financing, and activity selection. Together, they will develop and implement a step-by-step Sustainability Action Plan for water and energy conservation, waste management, and pollution prevention. A key part of the process will be identifying community team members who can engage the entire community and help the team become an important part of the local government network/support system.

WVSC works to improve access to funds and ideas that will help communities whose resources and support are limited. WVSC tries out different scenarios and approaches, fosters collaborative leveraging of resources, and provides a forum for communication and information sharing among counties.

Energy Efficiency Activity in the For-Profit Sector

LightsOn! West Virginia. The presence of whitewater drew the founders of LightsOn! West Virginia to Fayette County. Brandon Holmes brought his first business enterprise—Elite Swiftwater Institute, which provides training and certification for first responders to river accidents—to Fayette County in 2000. A native of Maryland, educated in North Carolina and Colorado, Holmes is a devotee of adventure sports and a self-described "serial entrepreneur."[85] His second business enterprise, WELD, is a media consultancy offering Web-based promotional solutions to clients. Holmes was looking for an affordable place to locate his businesses. The West Virginia Commerce website says the following about his decision to locate in Fayette County:[86]

"Proximity to the New River Gorge area is one reason Holmes and [partner George] Rogers decided to locate their operations in Oak Hill. Both men are avid outdoorsmen who enjoy the limitless activities the New River Gorge provides. They like the fact that when their work days are over, they don't have far to commute for world-class climbing, paddling, biking, hiking, and whitewater rafting. Holmes believes that a sense of place and quality of life are drawing members of the 'creative class' [Holmes' term] to scenic locations like West Virginia's New River Gorge. Of WELD's 10 employees,[87] only Rogers is a native West Virginian. The duo has recruited employees from across the nation to come to West Virginia. 'The creative class can work anywhere and still be connected to the world by the Web,' Holmes said. 'When you can work anywhere, then you can live anywhere, and there's no better place to live and work than the New River Gorge area. A little bit of money goes a long way in West Virginia, and when you add that to the state's great people, non-existent traffic congestion, great weather and fantastic views, you've got a winning combination.'"

In looking for office space, Holmes settled on a vacant building in downtown Oak Hill; from that decision evolved a third company, LightsOn! West Virginia, a real estate business that buys old buildings and renovates them into environmentally friendly office spaces. The company promotes sustainable renovation of historic small-town downtowns. His ideas draw on Smart Growth principles tailored to rural areas—principles that support clustered settlement and promote the advantages of already-developed small towns, with their preexisting infrastructure and human and physical connections. LightsOn! West Virginia intends to create a toolkit for entrepreneurs and city leaders to coordinate, learn the ropes, and recruit citizen support to renovate dilapidated downtowns. The toolkit aims to be replicable and sustainable, encompassing different ways to make green work for residents.

---

[84] 2007-2008 WV DEP Annual Report www.dep.wv.gov/insidedep/Pages/2007-08DEPAnnualReport.aspx)

[85] Leslie Fitzwater. Weld. 2010. http://www.wvcommerce.org/people/successstories/weld.aspx; West Virginia University Integrated Marketing Communications Master's Degree Program. *[Profile of] Brandon Holmes*. 2010. http://www.imc.wvu.edu/weekend/holmes.php

[86] Fayetteville. 2010. http://www.wvcommerce.org/people/communityprofiles/smalltowns/fayetteville.aspx

[87] Weld. 2009. http://www.weldtheweb.com/Team-WELD/

Holmes and the directors of LightsOn! West Virginia are renovating the Bellann building in downtown Fayetteville, following LEED standards for the silver certification. The Bellann is a 10,000 square foot office building completed in 1930; each tenant signs a "Greenleaf" agreement promising to participate in recycling and sharing of energy costs, among other sustainable measures. Some of the companies and organizations with offices in the building are Earthmark, Drive Current, WELD, Constellation Software Engineering Corp., a yoga studio, and the National Parks Conservation Association. The Bellann building aims to be the first privately owned LEED certified building in West Virginia. Funding for the work has been supplied by Natural Capital Investment Fund, the 4-C Economic Development Authority, and BB&T.

West Virginia American Water. Since 2000, Fayette County has been served by a for-profit water utility, West Virginia American Water, a wholly-owned subsidiary of American Water, the largest investor-owned U.S. water and wastewater utility company. American Water had the resources, financial and otherwise, to begin to correct Fayette's increasingly urgent water supply problems. In the 1990s, it became apparent that Fayette County's small, local, and aging drinking water systems, particularly in the historic Fayetteville downtown area, were in need of substantial rehabilitation and were unable to support a growing population. Many of the systems were plagued with poor water quality or an inadequate supply, and in some cases both, as there was a heavy reliance on flooded abandoned coal mines as a supply source. In addition to poor water quality and quantity, the County's systems faced aging infrastructure and poor fire flow. Although there remain many individual wells and some small public water systems in Fayette County, since 1999 much of the County has been supplied with drinking water by WV American Water's New River Water Treatment Plant through a public-private partnership between the New Haven Public Service District and the Fayette County Commission.

In contrast to the public or non-profit sector, for-profit organizations may face fewer barriers when working toward efficiency. If it chooses to invest its own profits or borrow to invest, the private sector can often overcome financing hurdles more quickly than the public sector. Also, there is great potential in the for-profit sector to realize energy and water savings through funding technological advances in both conventional and alternative energy and water systems. In particular, the efficiency gains of WV American Water illustrate the potency of for-profit companies in planning and implementing infrastructure improvements. Government-owned water utilities can build on their research and example.

In 1999, WV American Water built the New River Water Treatment Plant, which went online in September 2000. This plant provides 4 MGD and is expandable to 12 MGD. Supplying water to 27,000 residents throughout Fayette County, the plant uses conventional treatment practices such as flocculation, sedimentation, filtration, and disinfection. Construction of the New River Water Treatment Plant in 1999-2000 took advantage of cost-effective design and construction methods, with the result that the County has an energy- and water-efficient plant designed to provide cost-effective water for decades to come. [The old Fayetteville Water Treatment Plant was taken offline, but the town kept the treatment building for use as a recycling center. Today, the New River plant provides water service to all Fayetteville residents, and WV American Water continues to improve fire flows throughout the town.

Efficiency Measures in Potable Water Treatment

Parent company American Water believes that a well-maintained piece of equipment is almost always an efficient piece of equipment. Large savings can come from a commitment to maintenance, which includes how, what, and when the equipment is run. This approach is apparent in the wide range of best operating practices (BOPs) that WV American Water applies to access, analyze, and maintain the equipment used to reduce water leaks and increase energy efficiency. A computerized monitoring system allowing supervisory control and data acquisition (SCADA) continuously monitors water quality at the New River plant and sends findings to operators in the control room. Monitoring leads to more efficient operation and lower energy costs. To date, ongoing projects have removed more than 13,000 feet of aging, small-diameter water mains, installed more than 14,000 feet of new mains, and replaced 27 fire hydrants. WV American Water is currently replacing all customer meters with modern "smart metering" technology to reduce losses, improve service, ensure residents have an uninterrupted supply of clean water, and improve capacity to handle fire emergencies.

As part of WV American Water's efforts to increase efficiency, Fayette County was chosen for the installation of Advanced/Smart Metering Infrastructure (AMI), the same technology that American Water used in the Connellsville, PA, pilot project described in Part 1, ECM #1. This is being funded primarily through ARRA stimulus funds. Currently, water distribution systems in Fayette County experience high water losses due to their age. With this new technology, the company expects to reduce losses by at about one-third.

The AMI system will transmit water consumption data collected at customer meters to the company's computer network daily via radio frequency. The company can then evaluate the data not only for billing purposes, but also to uncover irregularities such as a water leak on a customer's service line. The system will also be able to detect leaks along the utility's water mains through the use of acoustic monitors. Such monitoring "listens" on pipelines for frequencies typical of leak noise. It is activated automatically at night, when there are fewer other noises to detract from the leak sounds. This system is much more practical than the current one, in which personnel are equipped with mobile listening devices and must move methodically from area to area listening for leak noise. The new system will provide a leak survey every night, as opposed to a few times per year as under the current method.

WV American Water expects to see the water and energy efficiency benefits of this project in several areas:

- First, the project is expected to significantly decrease the amount of water lost and wasted in the Fayette district. With the vast majority of energy consumption for a water system related to pumping, reducing losses will decrease the energy used to pump the water in the treatment plant and throughout the system.
- The reduction in lost water will reduce the amount of chlorine and other chemicals needed in the water treatment process, as well as the amount of waste residuals created during the process. This translates into lower CO_2 emissions, fuel use, and tire wear on the vehicles that transport chemicals to the water treatment plant and carry away the waste residuals.
- The smart meters will also negate the need for drive-by meter readings, thereby reducing the energy use and costs of transportation. This will reduce emissions of pollutants associated with the manufacture of the vehicles and related products.
- Finally, the technology will allow customers to see how and when they use water and, subsequently, where they might conserve more water.

Meter installations began in 2010, and are expected to be complete in 2011. As a matter of practice, WV American Water tracks its nonrevenue water monthly. Because the new AMI system will provide continuous monitoring, that will allow the company to see trends in water usage and loss, as well as helping personnel identify and fix leaks more quickly. The resulting water conservation will reduce production costs and allow WV American Water to provide better service to its customers, while lessening negative effects on the environment. Installing smart meters is a strategy that public waterworks across the Appalachian Region might also pursue, depending on funding.

Efficiencies in Wastewater Treatment

As with its drinking water systems, Fayette County experienced problems and challenges in wastewater collection, treatment, and disposal. Existing wastewater management practices in the County up to 2008 included individual onsite septic systems, clustered subsurface systems, privately owned package plants, small public service district wastewater treatment facilities, and municipal facilities:

- An estimated 6,400 to 9,700 homes depended on onsite septic tanks and drainfields for treatment and disposal, and approximately 80% of these systems were thought to be more than 25 years old.
- Fifteen small package plants served small systems ranging from 1,200 to 24,000 gallons per day. Many of these systems had passed their useful life.
- Fourteen public service districts or municipal wastewater treatment facilities treated and then discharged to a surface water body. These facilities ranged from 16,000 to 1.25 MGD.

Rather than implement a plan of decentralized wastewater treatment, in 2008, WV American Water purchased the Fayetteville Wastewater Treatment Plant. As part of the transaction, the company committed to making a minimum of $4.2 million in improvements to help address aging infrastructure and meet regulatory requirements. This acquisition enabled the town to use the proceeds to retire outstanding debt on both the water and wastewater systems and make capital improvements to other town facilities.

After WV American Water purchased the Town's wastewater facility, it developed a plan for a more efficient collection and treatment system to identify and relieve inflow and infiltration problems and ongoing overflow and backup problems. Managers and operators mapped the entire collection system, initiating flow monitoring, and installing computerized monitoring devices within the plant, as well as line replacements. The company also dye-tested and performed camera inspections on targeted trouble spots. Based on the data collected, problem areas were identified and repair work prioritized. At the wastewater plant, WV American Water is currently pilot-testing

Geo-textile tubes (acting as filters) for use in separating liquid waste from solid waste. At the end of that process, the separated liquids are recycled back into the plant for treatment, and the residual cake-like substance is then used in a government-regulated soil fertilization project.

Figure 6: Geotube Illustration

Source: http://onondagalake.info/index.php?/knowledgebase_entry/what_are_geotubes.html

Achievements

Although measurable achievements are increasingly found in the private sector, Fayette County's quantifiable achievements in the public sector are yet to come. The County's decision to divest itself of its publicly owned water and wastewater infrastructure is meaningful. For Fayette County, the involvement of American Water seemed an assured means to better water quality and service for its residents. One positive result is that the County and the community no longer have the maintenance costs and concerns; on the other hand, they no longer benefit from the revenue. The private sector water utility, American Water, will reap the financial rewards of the efficiencies the company is implementing. The County will, however, share in these benefits in a secondary way because reduced energy use means reductions in greenhouse gas emissions at the power plant. In this case, the move to private water service has not only brought an infusion of investment in infrastructure, it has gained the County breathing room by shifting the burden of addressing infrastructural deficiencies to the private sector.

At present, Fayette County's major achievements are in laying the groundwork for the future. This progress now includes increasing levels of public discourse and involvement, and collaboration between the public and private sectors.

Replicable Strategies

Fayette County is in the beginning stages of energy efficiency planning. Its efforts to date highlight the important role of human education and interaction in successful energy efficiency initiatives. Importantly, Fayette used the seed money from the non-profit sphere to support the development of community-wide discussion and awareness, trusting that action and results will follow in time. This is an alternative beginning point for counties with limited financial resources and limited energy efficiency awareness. Fayette County has within a very few years developed a foundation for community-wide awareness and action, and attracted a financial sponsor (WVSC) by:

- Using public funding and grant dollars to seed and develop public awareness, and establish a tradition of public discourse and participation. Note that the success, by national and international measures, of Tompkins County, NY, and Hamilton County, TN, depends on just such an established tradition of public discourse on energy and the environment.
- Establishing or seeking forums that sponsor roundtables or discussions between a variety of private and public sector institutions to determine a sensible path forward. Pooling resources and knowledge across sectors and institutions leads to multiplied applications and benefits.
- Borrowing or leveraging innovative strategies from the private sector for the public sector, and building on and customizing existing best practices.
- Using recurring weekly, monthly, and annual events, festivals, or gatherings as forums for public awareness. This is another way to leverage existing resources.

The Future: Ongoing Challenges and Potential Roadblocks to Future Progress

County involvement in efficiency efforts is limited by resource constraints (human and financial), not unlike many counties across the Appalachian Region and the nation; however, in Fayette, because the economy has not been growing, the tax base that provides public funds for County activities is relatively low. Continued progress will depend on creative thinking, collaboration, and leveraging others' resources whenever possible.

- County officials must continue to step up to champion the planning process.
- Community involvement, while growing, is still sometimes limited by other more pressing concerns, so there is a need to raise awareness and engagement by spreading clear savings and quality of life messages and showing how easy it is to build efficiency into everyday decisions at home and at work.
- Not enough people in the County are trained yet so that they can, in turn, train others about energy and water efficiency.
- The various groups involved in efficiency efforts do not always agree on where the future of the County lies in terms of efficiency and sustainability.
- There is a lingering view among some in the community that what is good for the environment is bad for people and may affect jobs.
- Rural communities will benefit from opportunities to network more and share best practices with each other. National models of such things as land use and transportation planning or d property-tax-keyed fees and rebates do not always work in smaller, less dense, rural areas with modest tax bases.

Acknowledgements

Special thanks to the following individuals who generously offered their insights and assistance during interviews with the study team preparing the Fayette County case study:

- Doug Arbogast, I Travel Green Appalachia
- Aimee Rist, Fayette County Green Advisory Team Board
- Brandon Holmes, LightsOn! West Virginia
- Dave Pollard, Fayette County Commission
- Greg Adolfson, WV Dept of Env Protection
- Jeff Herholdt, Bill Willis, WV Division of Energy
- Jeffrey Lusk, YES Network
- Joseph Jones, WV Appalachian Power
- Judy Radford 4-C Economic Development Authority in Beckley
- Kelley Gillenwater, Randall Cain, Brett Morgan, David Bowles, WV American Water Company
- Levi Rose, Plateau Action Network
- Lisa Kesecker, Danny Neele, WV Governor's Office of Economic Opportunity
- Matt Wender, WV Jobs Investment Trust and County Commissioner for Fayette County
- Rick and Heather Johnson, Rivers Whitewater Rafting
- Rick Remish, Imagine WV
- Savanna Lyons, Citizens Conservation Corps of WV, National Park Service
- Tomoko Tamagawa, WV Sustainable Communities
- W.D. Smith, Region IV Planning and Development Council

Case Study 3–Hamilton County, Tennessee

Overview of Efficiency Efforts

Over the past 40 years, Hamilton County, Tennessee has greened itself in a highly public process of intentional transformation. Environmental action to address air quality, begun in the early 1970s after the County's poor air quality received national attention, had succeeded by 1989. That, and community sponsorship of innovative initiatives, helped lay the foundation for economic vitality and business success; two key international business wins for the area included the Volkswagen AG plant (a $1 billion investment) and wind tower manufacturer Aerisyn LLC's first North American facility.

For Hamilton County, energy efficiency planning and goal setting are part of a larger, holistic, top-down plan for energy efficiency and sustainability; they are intertwined with new local government requirements for **mandatory LEED certification** and **stormwater fees**. Local initiatives are the result of both top-down and bottom-up **open decision-making frameworks;** political leaders as well as the Chamber of Commerce and residents are highly aware of and involved in sustainability efforts. And the appointment of the City of Chattanooga's first Sustainability Director at the end of 2009 has institutionalized the pursuit of energy efficiency, which should ensure continuity for many years to come. Specific municipal energy efficiency activities include the installation of **LED street lights** and **green roofs**, as well as the implementation of **energy audits and energy use benchmarking** of all government buildings. Public-private initiatives include **grants for LEED fees** and **building systems commissioning**.

Appalachian County:

Hamilton County, Tennessee

Energy efficiency ranking:

104 (of 1,070 total counties in 13 ARC states)

Other criteria for selection:

LEED-certified buildings; CoolCities member; high ARRA funding per capita

ECMs pursued:

Stormwater fees and incentives; low-impact development (LID), including tree planting initiatives; energy benchmarking; energy audits; LED traffic signals and street lights; renewable energy; building systems commissioning; co-generation to supply energy for wastewater treatment

County leadership in energy efficiency demonstrated in:

Formal, public goal-setting and community charrettes; mandatory LEED certification for new public facilities; transparent governance; private sector incentives; public-private partnerships; U.S. Conference of Mayors Climate Agreement signatory

County Background and Local Context

Hamilton County, on the Tennessee River in the southeastern part of the state, has a total area of 576 square miles and a population of just over 330,000. That makes it the most densely settled of all the best practice counties selected as case studies, with 573 residents per square mile (sqm), compared to 204 residents/sqm in Tompkins County, 188 residents/sqm in Calhoun County, and 70 residents/sqm in Fayette County. Hamilton County borders 10 other counties and anchors the growth spurt of a six-county area. Since 2000, the County's population (which includes the City of Chattanooga) has grown by 7.2%, accounting for 58.6% of regional growth.[88] This impressively reverses a trend of population loss seen in the 1980s—a trend common to other parts of Appalachia and the nation. According to the Ochs Center for Metropolitan Studies,

"Chattanooga is unique, however, among American cities in its ability to reverse decades of decline. Of the ten cities that lost more than 10% of [their] population in the 1980s, Chattanooga was the only one to increase population in the 1990s and sustain that increase in the current decade."[89]

Many factors account for this turnaround in fortune. Business growth and economic opportunities are aggressively sought and promoted by the active regional Chamber of Commerce. Local culture and history is rich, from the Civil War battlefields of Lookout Mountain and Chickamauga, to the new Tennessee Aquarium in downtown

[88] Dr. Eileen Robertson-Rehberg. *Demographic Change: 2008 State of Chattanooga Region Report*. March 2009. http://www.ochscenter.org/documents/SOCRR2008_demographics.pdf

[89] Ibid., page 10.

Chattanooga, to a local government initiative offering mortgage assistance to artists. Local leaders support the construction of dramatic architectural landmarks, like the Walker Center for American Art in downtown Chattanooga on the banks of the Tennessee River, further embedding the image of civic energy and progress.

Quality of life is an important draw for Hamilton County. An active outdoor lifestyle amidst great scenic beauty centers on the interplay of the mountains and the many water bodies in the area. The overall ratio of parks and open space to people in Hamilton County is high: 70 acres per 1,000 people.[90] Situated in the Lower Tennessee Watershed, the County has 750 miles of streams.[91] But not all is idyllic. The Ochs Center 2008 Report on the State of the Environment states that 75% of assessed streams are impaired, most commonly by *E.coli* contamination from human waste "collection system failure," which includes septic system failure.[92] Environmental contamination is an abiding problem for Hamilton County; however, public awareness of this contamination and support for prevention or remediation efforts have also been drivers of the area's present success.

Historically, the economic engine of Hamilton County was a group of booming, but polluting, industries.[93] They included chemical and pesticide manufacturers, tanneries, foundries, and food product companies. Beginning in World War II, the U.S. Army sited an ammunition plant in the area.

Forty years later in 2009-10, Hamilton's top 10 major employers include one food product company, but most firms in the top 10 are service-oriented companies. Number one is BlueCross BlueShield of Tennessee, followed by the Hamilton County Department of Education, the Tennessee Valley Authority, the Erlanger Health System, McKee Foods, Unum Insurance, the Memorial Health Care System, the City of Chattanooga, CIGNA HealthCare, and the Hamilton County Government.[94]

Designing an Energy Efficiency Strategy

The beginnings of Hamilton County's energy efficiency and sustainability strategies go back to 1969, when the U.S. Department of Health, Education, and Welfare named Chattanooga the most polluted city in the nation. Tuberculosis rates were three times the national average.[95] Walter Cronkite reported to the nation on the CBS Evening News that Chattanooga was "America's dirtiest city," with dangerous air quality and smog thick enough that people drove with their headlights on in the middle of the day.

Hamilton County was shamed, and that was the impetus for action. According to a 2010 interview with Gene Hyde, the City of Chattanooga's Urban Forester, "people were just sick of breathing bad air and dealing with that reputation." And the 1969 shaming persists in the residents' collective memory as a continuing spur to action, remembered today even by Chattanoogans not yet born in 1969 who were interviewed for this case study. Several of them, all less than 40 years of age, forcefully recounted the same story.

> *That negative national public exposure resulted in a positive legacy, one of community activism and strong political leadership. Public adoption of a local air pollution control ordinance and the establishment of the Air Pollution Control Bureau put some teeth into the new law, which required industry to comply with new standards by 1972. In less than a generation, in 1989, EPA officials revisited Hamilton County and declared it to be "in attainment" for the 1-hour ozone standard, one of the first areas in the eastern U.S. to achieve that goal. EPA's Director of the Office of Air Quality Planning and Standards congratulated the County, remarking, "You all have done what has not been done in very many places in the United States."*[96]

[90] Ibid.
[91] Ibid., page 15.
[92] Ibid., page 17.
[93] Michael Elliott. *Civic Discourse and Environmental Justice in Chattanooga. City and Regional Planning Program*, Georgia Institute of Technology.
[94] The Chattanooga Chamber of Commerce, Major Employers List, 2010.
[95] Ibid. p. 6.
[96] The Chattanooga Green Committee, *The Chattanooga Climate Action Plan*. January, 2009. http://www.chattanooga.gov/Final_CAP_adopted.pdf, p. 17.

Formal Planning Process

It may have been that the "loss of face" in Chattanooga's 1969 public environmental shaming meant that there was no point in civic concealment of any kind. It may have been that there was a preexisting activist spirit among Hamilton County's residents and institutions. Perhaps as a mid-sized city, it was easier to bring people together for a cause. Whatever the reasons, Hamilton County since the 1970s has experienced and facilitated enormous public engagement around issues of the environment and energy efficiency, as exemplified by these milestones:

- In 1981, architect Stroud Watson, a migrant to Chattanooga and the head of the Urban Design Studio at the University of Tennessee's School of Architecture, devised an exhibition on the Image of the City, which called for a return to the river as the origin of the City of Chattanooga. According to Watson, "Three thousand citizens participated, making this our initial public design "charrette," a tradition that continues today in all our planning to build the best mid-sized city in America for our citizens."[97]
- In 1982 the Moccasin Bend Task Force held 65 open and inclusive public meetings to begin riverfront planning, which eventually resulted in Chattanooga's Tennessee Riverpark.
- In 1984, Chattanooga Venture, a non-profit with a board of 60, was formed as a "not-for-profit organization that provided the means for citizen participation in establishing the agenda for the City's future. This organization also helped address strategic issues for the community's vitality and served as a catalyst for change . . . . Chattanooga Venture was founded on the premise that as with other communities facing the same difficulties as Chattanooga, success is based on a comprehensive process that incorporates ideas from the community, and is supported by decisive citizens who form coalitions to implement the changes."[98] In 1984, the Venture-sponsored Vision 2000 during which 50 facilitators and 1,700 citizens developed a "commitment portfolio" of 40 consensus goals and 223 projects.[99] In 1992, ReVision2000 followed with 150 facilitators and the participation of 2,600 residents.[100] In 1996, Futurescape engaged 2,500 residents in a "visual preference survey" about growth patterns.[101] In 1998 the IMAGINE Eastgate public design charrette garnered ideas for a failing mall.[102] In 1998, Recreate 2008 focused on the City's parks system.[103]
- From 2000 to 2009, the City of Chattanooga created the Tennessee Riverpark and built the Tennessee Aquarium. As the result of public will, a disused truss bridge, the Walnut Street Bridge, was saved from demolition and renovated to become one of the longest pedestrian bridges in the world and an anchor of downtown Chattanooga's renewal. Following the area's tradition of inclusiveness, in 2009 the Chattanooga Green Committee[104] held a series of publicized, open charrettes. This process produced the Chattanooga Climate Action Plan.

The ambitious strategic plan encompasses 17 distinct objectives (lettered A through Q). Each objective has two or more specific implementation goals, metrics, and strategies (not included here), and energy efficiency takes a starring role.

A. Increase the community's use of alternative energy sources

B. Increase energy conservation

C. Increase green building practices

D. Increase recycling & reduce waste

---

[97] The Renaissance Remembered: Milestones In Chattanooga's History. 2004. http://www.chattanoogachamber.com/newsandvideo/trend_spring_04_pge816.asp

[98] City of Chattanooga, TN. Best Practice: Chattanooga Venture/Community Vision. January 18, 2007. http://www.bmpcoe.org/bestpractices/internal/chatt/chatt_8.html

[99] Michael Elliott. Civic Discourse and Environmental Justice in Chattanooga. City and Regional Planning Program, Georgia Institute of Technology.

[100] Ibid.

[101] Ibid.

[102] Ibid.

[103] Ibid.

[104] 12 members appointed by the Mayor from city government, and local business and industry, as well as individual citizens.

E. Make Chattanooga a leader in sustainable industry

F. Reduce sprawl by recognizing the environmental implications of the built environment and promoting Smart Growth practices

G. Strengthen the local food and agriculture infrastructure

H. Address transportation as a major contributor to greenhouse gas emissions and increase transportation options for all residents

I. Build on previous successes and continue to improve air quality

J. Protect our region's natural biodiversity

K. Expand the network of effective green infrastructure throughout the city and the region

L. Expand and maintain healthy urban and regional forests

M. Improve current water quality and protect water quantity

N. Increase and stress the importance of community awareness & participation

O. Increase and stress the importance of business participation

P. Set the standard and provide leadership in sustainable government policy and purchasing programs

Q. Stress the importance of dynamic environmental education in schools.[105]

The Action Plan included a 2006 baseline greenhouse gas emissions report, showing government emissions and community emissions. Baseline calculations indicated that for 2006, the biggest sector in government emissions was buildings, accounting for 74% of total government emissions, followed by streetlights, at 16%. In community emissions for 2006, the biggest sectors were transportation (31%) and industrial (30%), followed by residential (14%) and commercial (13%).[106] Such a breakdown is useful in providing a roadmap to action. For example, the report found that Hamilton County's major governmental source of emissions is electricity generation,[107] and its major sector for emissions is buildings. Thus to achieve the greatest reductions in the government sphere, focusing on reducing electricity use in buildings is likely to bring the greatest reward.

Taking Action

The timing of the Chattanooga Climate Action Plan was fortuitous. It coincided with the 2009 passage of ARRA with its promise of funding for energy efficiency improvements and associated jobs creation. The City of Chattanooga's 2009 DOE formula grant of $1.8 million under ARRA has gone toward creating and implementing an Energy Efficiency Conservation Strategy, funding a permanent Office of Sustainability, and prioritizing the decisions as to which activities on the Action Plan will be most effective in reducing GHG emissions and creating energy savings.

Taking action on the goals of the strategic plan has involved the following:

- High public awareness and civic engagement, described earlier.
- Active public-private cooperation.
- Local institutions that contribute intellectual and financial capital.
- Bold political leadership.

[105] City of Chattanooga. Chattanooga Green: Climate Action Plan. 2009. http://www.chattanooga.gov/chattanoogagreen_Climate%20Action%20Plan.htm
[106] http://www.chattanooga.gov/Chatt_Green_Interim_Report.pdf pp. 16-17.
[107] Ibid.

Public-Private Cooperation

The Chamber of Commerce. Hamilton County attracted the new Volkswagen North America automobile plant, a $1 billion, energy-efficient manufacturing facility that opened in 2011. To compete for and attract this plant, the County had to partner with the business and industrial community to lower its community carbon emissions—aggressively and demonstrably—to meet federal requirements for the location of a new industrial plant. In fact, a major partner in the 30-year transformation of Hamilton County has been the Chamber of Commerce, which still regularly teams with the Air Pollution Control Bureau. In 2002, the Chamber and the Bureau jointly submitted an Early Action Compact to EPA aimed at more quickly achieving the new EPA 8-hour ozone standard. The Hamilton County Chamber recognized early on (in the 1970s) that under the Federal Clean Air Act, counties that do not achieve air quality "attainment" may face serious consequences to future prosperity: new industry may be banned; regulation may be intense; fines may be imposed. So local government, the Chamber, local regulators, and the business and industrial community joined forces, and it's a collaboration that continues today with efforts to attract major clean energy industries. "[F]ocused on firms involved in the manufacturing of hydroelectric power, wind energy, LNG (liquefied natural gas), hydrogen fuel cells, geothermal, and other related energy sources, the Chamber recognizes that these industries not only provide jobs and a clean source of energy, but most are clean manufacturing operations that will not harm local air quality."[108]

Greenspaces and Private Sector Leadership in Energy and Environmental Design (LEED) Initiatives. Another example of public-private cooperation is the work of Greenspaces. Founded and led by Jeff Cannon, financed by the Lyndhurst Foundation, and located in a renovated storefront on Chattanooga's Main Street, Greenspaces functions in several ways:

- First, it is a **resource center** for green and reclaimed building materials and for information on energy-efficient practices.
- Second, it is an **education center**, holding seminars for builders, architects, and community members on green building techniques and the LEED green building rating systems. It also hosts the meetings of the East Tennessee U.S. Green Building Council (USGBC) Chapter, an activist regional USGBC chapter with its own green agenda and education programs.
- Third, it offers a **program to underwrite the costs of LEED fees** for commercial real estate and offers to **underwrite the costs of commissioning**, a process ensuring that a building's energy-consuming systems are performing as they were designed to perform. Commissioning is considered by many to be one of the most important actions to take for improving energy efficiency. Greenspaces covers all administrative costs associated with obtaining LEED certification and offers dedicated funding for the installation of high-profile, exemplary sustainable design features such as green roofs, solar or wind energy generation, and geothermal heating. The Greenspaces' LEED fee rebate program was popular and influential enough, in the first two years of its existence, to have persuaded city officials in 2010 to mandate LEED certification for all new public buildings.

By the end of April 2010, the efforts of Greenspaces had yielded nine LEED certifications, with 25 more projects in process. Jeff Cannon described his organization's mission in this way:

"We're spending money to show that green doesn't cost any more [than conventional construction]. We run classes, do outreach. We work with contractors and realtors. That has done wonders. We talk about true costs. In our first 14 months we'd reached 5,000 people; 10 to 150 people at a time. We sponsor the LEED 101 class for the East Tennessee USGBC. We had a lot of naysayers in the beginning: 'We build this way already, why pay a fee [for LEED]?' We said we'd pay that fee. Our incentive covers not only the administrative fee to the USGBC; we pay for commissioning. Commissioning is just good practice. We have some great companies here. It costs anywhere from $5,000 to $15,000 for larger buildings. Every building should do this, or should have done this. Every building owner should have done this."[109]

[108] Livable.com. *Clean Industries- Cleaner Air. 2009*. http://www.livable.com/livability-resources/best-practices/51-clean-industriescleaner-air; Chattanooga Chamber of Commerce. Chattanooga Can Do. 2010. http://www.chattanoogachamber.com/economicdevelopment/home.asp

[109] Jeff Cannon, December 7, 2009 and May 18, 2010 interviews.

Committed Local Institutions

Hamilton County reaps intellectual, financial, environmental, and social benefits from the presence of several respected local institutions:

- The Lyndhurst Foundation
- The Chattanooga *Times Free Press*
- The Ochs Center

The Lyndhurst Foundation. The Lyndhurst Foundation takes as its mission "the revitalization of the Chattanooga area and the conservation of the region surrounding it."[110] In 2009, funded by the fortune of the Lupton family, who were pioneers in the Coca-Cola bottling business, the Foundation gave more than $9 million in grants to institutions active in cultural affairs, conservation, and urban redevelopment. Three of those interviewed for this case study—Jeremiah Smith, Jeff Cannon, and Gene Hyde—cited the Lyndhurst Foundation as the primary, longest enduring, and most influential benefactor of sustainability efforts in the region.

The Foundation provided major seed money as well as ongoing funding for Greenspaces Chattanooga (discussed above). It also funds the work of the Ochs Center, described below, specifically the State of the Region biennial report, an important mirror and reality check on the region's performance.

The Chattanooga Times Free Press and the Ochs Center. The Chattanooga *Times Free Press*—owned for over 100 years as the Chattanooga *Times* by the Ochs family until its merger with the Chattanooga *Free Press*—established the non-profit Ochs Center for Metropolitan Studies (www.ochscenter.org). The Center is a legacy of community service by the Ochs family, which includes the establishment of Chattanooga's first public library and the preservation of Lookout Mountain.[111]

The Ochs Center's mission is to conduct "independent data analysis and policy research to improve the quality of life in the Chattanooga region."[112] Among its many publications, the Center publishes the annual *State of the Chattanooga Region Report* (released for the first time in 2006), examining in detail a number of area attributes, including health, the economy, housing, public safety, education, and the environment. The advantage of such an in-depth examination is that it birddogs issues of immediate concern, and thus stimulates civic action. The Center looks at the region and its impacts in a synergistic way, making the report a valuable resource for local planning.

Political Leadership

Hamilton County's two elected leaders, Chattanooga Mayor Ron Littlefield (who signed the U.S. Conference of Mayors Climate Protection Agreement) and Hamilton County's Mayor Claude Ramsay are environmentalists who collaborate regularly and leverage each other's staffs and resources. The region has been moving toward a consolidation of County and Metro governance. Such a consolidation is itself a shift in the direction of efficiency, both in terms of human resources and the delivery of services, including the coordination of water and sewer services. Consolidation can break down the inefficient management "silos" between infrastructure managed at the county *and* at the city levels.

Mayor Littlefield in particular is a champion of bold energy efficiency initiatives, including the following examples:

Stormwater Management. To further environmental and energy efficiency goals, the Mayor has taken some stances unpopular with voters. One example is his support for and enactment of civic stormwater fees. For Hamilton County, incentivizing onsite stormwater capture/treatment has become an important strategy both to counter environmental contamination and to reduce energy use from avoided stormwater treatment. The County charges fees on properties that do not take measures to treat stormwater runoff onsite. The nonresidential fee

[110] Lyndhurst Foundation. About the Foundation. 2010. http://www.lyndhurstfoundation.org/page/about-the-foundation/
[111] The Ochs Center for Metropolitan Studies. About Us. 2008. http://www.ochscenter.org/theochsfamily.php
[112] The Ochs Center for Metropolitan Studies. Mission and History. 2008. http://www.ochscenter.org/missionandhistory.php

rate in early 2010 was about $115 per year, and the City has already raised about $14 million from the fees. In his 2010 State of the City speech[113] Littlefield took a strong stand in addressing his critics:

"All of the issues that we are presently discussing and debating relative to water—water quality fees, sewers, leaking service lines and, yes, even annexation—are related to how we provide and manage the water that we as a community claim as a resource. As for the shock and shouting over the recent rise in water quality fees, I certainly understand . . . . I will not try and downplay the financial impact of that necessary action. It is regrettable but necessary. There is a simple solution to it all . . . . If every residence, business, church, and industry could just capture and hold a one-inch rain and allow it to soak into the ground—never leaving the site in question—the issue would be largely handled without further governmental action or expense. . . . Every acre of impervious surface, such as asphalt, concrete and rooftop, creates over a million gallons of stormwater runoff per year. . . . Our approach in the past has been to try to put more and more pavement on top of the ground and more pipes and bigger holding areas under the ground. That approach is not financially sustainable for us or any other city. More importantly, it is not cleaning the water from all the oil and other pollutants that are carried from the parking lots and other hard surfaces."

The Mayor cited the example of Philadelphia's low-impact development (LID), described in Part I, as a way to control combined sewer overflows, beautify the city, create jobs, and reduce carbon emissions at the same time:

"Philadelphia estimated that it would take $16 billion of pipes and holding areas over the next fifteen years just to meet their requirements and those of EPA and the state of Pennsylvania . . . They have found that by putting green infrastructure on the surface (holding areas, landscaping, trees) that they can meet their requirements for 10% of that cost (or $1.6 billion instead of $16 billion). In the process they accomplish multiple objectives: Communities and Business Districts are revitalized. Recreation areas are created. The city is more attractive and healthier. And, thousands of jobs will be created in the process. None of that happens by just expanding the city's plumbing by adding more pipes and pits underground."

LEED Certification of Public Buildings. Also in 2010, Littlefield unveiled his mandate for LEED certification of all new public buildings—a mandate that came out of private-public sector collaboration, specifically with Jeff Cannon of Greenspaces.

Engagement in Voluntary Climate Protection programs. Chattanooga is a Sierra Club Cool Cities member. The Mayor was an early signatory to the U.S. Conference of Mayor's Climate Agreement (summarized in the case study on Tompkins County).

Creation of an Office of Sustainability. In December 2009, Mayor Littlefield created the Chattanooga Office of Sustainability and named as its first Director David Crockett—a local businessman, former City Councilman, nationally recognized environmental activist, and descendant of Davy Crockett—to help lead the charge. Littlefield pledged to partner with local businesses, local communities, and leading cities around the country to develop innovative, collaborative approaches and to evolve new codes and ordinances for landscaping, urban forestry, stormwater, and street design "that are integrated and promote functional and attractive green infrastructure."

Achievements

Lighting Retrofits of Public Facilities, including Water-Wastewater Facilities. For a total cost of around $860,000, the City is replacing lighting in ten buildings for an estimated annual savings of $536,000 or 10,367,810 kWh.

Installation of LED Traffic Signals. Gene Hyde of Chattanooga provided the following analysis of Chattanooga's efforts now in progress:

"The monthly bill for the City of Chattanooga's traffic signals and flashers is now about $13,000 per month.

By replacing the incandescent bulbs with LED modules, we will save about $8,000 per month or $96,000 per year. The project will cost $650,000 [to implement] and would require less than 7 years to recover that cost, considering only the savings in power. Other savings realized from the change-out will be (1) the reduction in maintenance required, since the LED units will last more than 5 years, while incandescent bulbs last only a year or two; (2) a savings in bulb costs of about $360 per month or $4,320 per year; and (3) reduced consumption of

[113] Ron Littlefield. State of the City 2010. http://www.chattanooga.gov/Mayors_Office/MayorsOffice_5110.htm

natural resources because of reduced power requirements. A total of about 4,046 signal bulbs are to be replaced, besides those in 163 signal heads that are to be replaced. About 150 of the city's Walk signals will be replaced. The total number of signalized intersections in Chattanooga is about 290."[114]

LED Streetlights Pilot Project. In the North Shore area, an energy-efficient lighting pilot project underway estimates a reduction in energy consumption from 274,740 kWh to 98,400 kWh, for an annual savings of 176,340 kWh or 64%. This energy-use reduction will prevent 122 metric tons of CO_2 emissions from entering the Earth's atmosphere. The effort will also reduce the City's energy bill for streetlights by 43%. The current total annual energy bill for high pressure sodium lights for the pilot project area is $17,345, and the projected estimate after installation will be $9,840. Because LED and induction lights have a longer life span than traditional lights, the reduction in annual city maintenance costs is estimated to be $50,059.[115]

Green Roofs. Costs and benefits for five City of Chattanooga green roof projects underway are projected as follows:[116]

Table 6: Chattanooga Tennessee Green Roofs Costs and Benefits.

	Sq ft	Cost	Tonnes GHG reduced	$s saved per ton GHG	Estimated annual $ savings	Estimated annual energy savings
Green Roofs		*$10/ft²* $285,980 total				
Bessie Smith Hall trellises	1,500	$15,000	36	$10,406/ton	$3,480	55,176 kWh
City Council	6,300	$63,000	12	$10,500/ton	$1,170	18,558 kWh
City Hall Annex	8,560	$85,600	18	$9,511/ton	$1,590	25,215 kWh
Health & Wellness Center	7,278	$72,780	15	$9,704/ton	$1,353	21,438 kWh
Police Precinct at Farmers Market site	4,960	$49,600	36	$10,277/ton	$3,438	54,495 kWh

Source: Gene Hyde

Tree planting for energy efficiency benefits. Gene Hyde, Chattanooga's urban forester, commissioned a report on the potential energy and cost savings available from ongoing tree planting initiatives in the City. The March 2008 report found that "the quantity of electricity and natural gas saved annually in Chattanooga from both shading and climate effects equals 8,247 MWh ($625,927) and 314,882 therms ($294,257), for a total retail savings of approximately $920,184 (±$112,961) or a citywide average of $5.54 per street tree."[117] The planting program is underway.

Public Transportation and Bike Sharing. Hamilton County is featured as an "Energy Smart Community" in DOE's Smart Communities Network, which summarizes the County's green dynamic in this way, with an example of a public-private partnership that is yielding more efficient public transportation: "A prominent example of local sustainability initiatives, the transit authority for the City of Chattanooga and Hamilton County formed an innovative public-private partnership to develop, build, test, and operate electric transit vehicles (ETVs) and ETV systems in downtown Chattanooga. Since 1991, 10 electric buses have gone in service on a downtown shuttle route; a local non-profit has been launched to promote research and provide information; and a company has been formed to manufacture electric buses." These buses are free to riders, an example of the local government's efforts to encourage public transportation use. In 2010 Chattanooga implemented a 20-station (100 bicycles total) public bike-sharing program.

[114] August 15, 2011 summary from Gene Hyde.
[115] http://www.newschannel9.com/news/energy-1002683-lights-lighting.html
[116] Estimates shared by Gene Hyde, May 18, 2010.
[117] Davey Resource Group, *City of Chattanooga, Tennessee Municipal Forest Resource Analysis*, March, 2008.

Water and Wastewater Efficiency Achievements

Description of Services

The three main potable water providers in Hamilton County are the Hixson Utility District, the Soddy-Daisy Falling Water Utility District, and the Eastside Utility District. About 332,100 people get their water from community water systems (2010 data). That is roughly equal to the County population, which means public community water service reaches almost 100% of the population. The Hixson Utility District's water plant draws water from two well fields; because the source water is groundwater, very little treatment is required. What energy Hixson saves in treatment costs, however, it uses in pumping. Water from the plant serves 55,880 people through a distribution network of about 550 miles of water mains. The distribution system uses four remote pumping stations and 12 storage tanks. In contrast, the Soddy-Daisy Falling Water Utility District draws its source water from Chickamauga Lake, a surface water source requiring treatment. It serves about 31,340 people. The Eastside Utility District in Chattanooga draws its source water from the Tennessee River, also requiring treatment; its distribution network serves 44,790 people through 18,900 connections.

The Moccasin Bend Wastewater Treatment Plant is owned and operated by the City of Chattanooga. The system has 1,254 miles of sewer mains, 70 miles of which are combined storm and sanitary sewers, as well as 71 pumping stations. Eight plants in the system are specifically designed to operate only during wet weather conditions (about six to eight times per year). They help, but cannot entirely prevent, combined sewer overflows (CSOs). On the positive side, sludge produced by the treatment system is gravity-thickened and digested in a heated anaerobic digester. The resulting methane is burned to produce heat for the digester, and the biosolids produced (80,000 wet tons per year) are sold and applied to land as a fertilizer. The Chattanooga wastewater treatment plant has been National Biosolids Partnership certified since 2005, and was the first plant in Tennessee to be so designated.

Specific Energy and Water Efficiency Improvements

The Eastside Utility District has been very active in planning and financing energy efficiency initiatives in drinking water treatment. The District installed high-efficiency motors in 2007 and 2010, and variable frequency drives (VFDs) in 2007. The VFDs have proven very useful for controlling pressure and head in pipes and tanks, as well as for saving energy. The VFDs allow the plant to run motors at low, consistent levels rather than starting and stopping them frequently; because starting a motor takes a lot of energy, this saves considerable energy. Major upgrades are paid for by bonds, and the Utility District has an excellent bond rating. The Eastside Utility District also has an emergency drought program in place to restrict water use, when necessary, for activities like irrigation and washing cars.

The City's Wastewater Treatment Plant has looked for and adopted innovative measures for improving energy efficiency. It produces natural gas from its sludge digester and burns that gas to heat the digester, which has **reduced the plant's monthly natural gas bills from about $25,000 a month to between $5,000 and $8,000 a month.** All motors in remote pumping stations and in the plant have VFDs. Management is planning on installing cogeneration units to generate electricity from the digester-produced natural gas, and then using the waste heat from those units to heat the digester, as the digester currently produces more natural gas than is necessary for self-heating and the excess is wasted (flared off). The general manager estimated that the plant can produce from 0.5 to 1 megawatt of electric power using cogeneration, a potentially profitable and replicable strategy for other local governments in the Appalachian Region. The plant's lighting has been converted from metal halide lights to LEDs, which consume considerably less power and last longer. Management is also considering participating in a utility-sponsored energy curtailment program ("peak shaving" program), which would pay the plant to use its emergency backup generator to alleviate stress on the electric grid during times of peak electricity use. In the longer term, solar panels may be installed on some south facing roofs. Jerry Stewart, Director of Waste Resources, has pushed forward these energy efficiency upgrades. In an interview, Stewart noted that anything that can pay for itself in 20 years—the period of a capital loan and conservative lifecycle estimate for new equipment—is considered a justifiable improvement by management.

Replicable Strategies

Hamilton County's replicable strategies for other municipal governments in Appalachia seeking to plan and finance energy efficiency are:

- **Interdepartmental cooperation** on energy and environmental issues, and the intentional breaking of "silos" of authority; possible **consolidation of scattered municipal responsibilities** as a way to save money; establishment of a **Sustainability Office** as the forum for interdepartmental cooperation.
- **Civic leadership**: publicized top-level buy-in among civic leaders; commitment to sustainability in high places.
- A **sustainable decision-making framework with public outreach and input** and ground-up decision-making opportunities.
- **Cogeneration opportunities** for energy production and energy savings at wastewater treatment plants.
- **Energy or green retrofits for multiple buildings, taking advantage of savings in scale of effort,** such as lighting retrofits or the installation of green roofs.
- **Incentives or mandates for LEED** certification for all new public buildings. To that end, a local government may need to provide **educational programs on LEED for builders and contractors**. Local governments can look to their local USGBC chapters for resources and training**.**
- **Disincentives: fees tied to environmental "loading,"** such as stormwater treatment fees for properties that do not pursue some form of onsite treatment.
- **Bold thinking,** experimentation and innovation; identification and implementation of bold projects and pilot projects.

The Future: Ongoing Challenges / Potential Roadblocks to Future Progress

Potential and actual roadblocks lurk around the edges of Hamilton County's plans for the future. The major barriers to energy efficiency in Hamilton County are:

- **Lack of consistent political leadership** through challenging economic times. While political leadership is acting to drive energy efficiency efforts in Hamilton County, over the years the lack of *consistent* government leadership has meant that some innovative programs have stalled. In the past decade, economic cycles and regulatory complacency have contributed to making progress intermittent rather than constant. The County's economic base is more fragile than at first glance. Despite the presence of new industry, the tax base appears to be stable, when it should be increasing, And significant increases in the tax rolls and thus in the revenue for Hamilton County are not necessarily expected. Instead, workers may be commuting to the County from homes in mid-state or farther away and not paying local taxes; that puts a strain on local resources.
- **A supply of inexpensive electrical power** and the relative **absence of utility-sponsored financing** programs for energy efficiency. Inexpensive power is a double-edged sword. While it is a barrier to energy efficiency due to the perceived lack of need for conservation, inexpensive electrical power has contributed to the County's success in attracting business investment. Electrical power subsidized by the Tennessee Valley Authority (TVA)[118] has made energy efficiency planning less urgent. Affordable electricity has been a big draw for manufacturers. TVA works with its largest industrial customers one-on-one to implement customized demand-side energy management and energy efficiency strategies.[119] This practice reduces energy costs for industry, while increasing the reliability of TVA's power grid. For smaller businesses and consumers, traditionally TVA has not encouraged its distributors and associated ESCOs to offer energy efficiency services.[120] That is starting to change; at present TVA

[118] Nearly two-thirds of TVA's electricity comes from 11 coal-fired plants, which emit carbon dioxide. (http://www.tva.com/power/fossil.htm)
[119] Tiffany Gibby: TVA, December 7, 2009 interview
[120] Gil Melear-Hough: the Southern Alliance for Clean Energy, December 8, 2009 interview.

offers residential sector efficient water heater and heat pump rebates, and a home energy efficiency audit pilot program.[121]

- **Lack of stringent electrical and building codes** and standards, and absence of a framework for enforcement by local regulators. According to Jeff Cannon of Greenspaces Chattanooga:

  "With the City of Chattanooga, there's a lot of talk about climate protection, mandates, and incentives. Yet nothing is inspected; nothing is building to latest IECC [International Electrical Conservation Code] or IBC [International Building Code] standards. The AGC [Associated General Contractors] constituency is so powerful. They are against regulation. There's no perceived profit in green."[122]

  Unblocking this situation may be a matter for the state and the local governments to work together on, if there is the will to do so. As of summer 2011, Hamilton County's building and zoning department website indicates that the County adheres to the 2003 version of the IECC.[123] A report prepared for the state of Nebraska[124] suggests that energy savings available from the heightened efficiency requirements of adopting the 2009 IECC range from 3% to 12% in the residential sector. Hamilton County is missing out on these savings.

- **Environmental pressures**, including population growth in the region and settlement patterns that work against energy efficiency, the environment, and human health. These pressures require attention and investment, likely shifting resources away from energy efficiency. The Ochs Center's 2008 Environment Report flagged key findings, indicating that the per capita carbon footprint of the region was growing, mostly due to increased vehicle miles travelled and the lack of other transportation options.

Hamilton County Acknowledgements

Special thanks to the following individuals who generously offered their insights and assistance during interviews for the Hamilton County case study:

- Jeff Cannon, Greenspaces Chattanooga
- Tiffany Gibby, the Tennessee Valley Authority
- Jeremiah Smith, City of Chattanooga's Chattanooga Green
- Karen Hundt, Chattanooga-Hamilton County Regional Planning Agency
- Gene Hyde, Chattanooga Urban Forester
- Gil Melear-Hough, Southern Alliance for Clean Energy
- Sam Gomberg, Southern Alliance for Clean Energy
- Susanna Bass, Sustainability Program Manager, City of Knoxville
- Erin Burns, Sustainability Coordinator, City of Knoxville

[121] http://www.dsireusa.org/incentives/index.cfm?CurrentPageID=1&State=TN&RE=1&EE=1
[122] Tiffany Gibby: TVA, December 7, 2009 interview
[123] http://www.hamiltontn.gov/Inspect/
[124] http://bcap-energy.org/files/NE_codes_report_6-30-09%5B1%5D.pdf

Case Study 4–Calhoun County, Alabama

Overview of Efficiency Efforts

Calhoun County, located in northeastern Alabama, offers a view into the environmental issues facing the southern Appalachian Region, and illustrates how limited resources are not a barrier to addressing energy efficiency, land use, and water conservation. In the early 1990s, the County decided to assess and implement basic building efficiency measures in two buildings. That successful action led to others. Calhoun has taken a bottom-up measure- and system-specific approach with quantifiable cost-saving results.

Appalachian County:

Calhoun County, Alabama

Energy efficiency ranking:

147 (of 1,070 total counties in 13 ARC states)

Other criteria for selection:

ENERGY STAR partner; high ARRA funding per capita

ECMs pursued:

Building and lighting upgrades; energy benchmarking and tracking; demand-side energy management

County leadership in energy efficiency demonstrated in:

Earning ENERGY STAR on two county buildings; National Association of Counties Green Government Advisory Board member; green jobs and weatherization training; implementation of LEED guidelines in the public sector

The County's sustainability program *planning* is still very much in the formative stage. To date, there is no existing strategic, comprehensive energy policy or plan to guide decisions. Such an approach sidesteps the political ramifications of framing issues in a sustainability context—a political hot button for some—and instead places the focus on saving money by taking practical steps. Calhoun County is a good example of what can be done with limited resources and funding (and without an overarching plan) to create and execute a County-wide energy and water efficiency program. ARC statistics (for all 1,070 counties in the 13 ARC states) show Calhoun County ranks fairly high—147 in energy efficiency and 371 in water efficiency. It ranks relatively low in terms of per capita energy consumption (205th within the Appalachian Region), and very high in terms of ARRA funding per capita (23rd in the Region).[125]

Calhoun's story is an interesting one for other counties looking to start an efficiency program in that it illustrates how a local government can **leverage existing resources, such as those from EPA's ENERGY STAR** Program, to lead its peers in southern Appalachia and across the country.

Calhoun County participates in a number of voluntary efficiency programs. For example, it is an active ENERGY STAR Partner and has been benchmarking county building energy use in Portfolio Manager for a number of years. As a member of the National Association of Counties (NACo), Calhoun is one of about 20 members invited to serve on NACo's Green Government Advisory Board. The County's efficiency efforts have earned third-party recognition and accolades: two EPA ENERGY STARs for superior buildings and a LEED certification for another.

County Background and Local Context

Calhoun County, encompassing about 600 square miles, sits in the northeastern portion of Alabama and includes the cities of Anniston, Jacksonville, Oxford, Piedmont, and Weaver.[126] The County is located between two major southern cities, Atlanta and Birmingham, in the foothills of the Appalachian Mountains surrounded by the Talladega National Forest. The area is scenic and rich in natural sites dedicated to hiking, hunting, fishing,

[125] The Cadmus Group. Excel spreadsheet of county rankings of energy efficiency-based objective measures. February 16, 2010.

[126] Land area found at U.S. Census Bureau "State and County Quick Facts: Calhoun County Alabama." http://quickfacts.census.gov/qfd/states/01/01015.html. Information on cities in Calhoun found at Calhoun County Alabama, Calhoun County Alabama: Cities Located within Calhoun County, Alabama. http://www.calhouncounty.org/loclinks/cities.html

camping, and swimming. Its 2009 population was 114,081, a 1.6% increase from the 2000 census.[127] Unlike Hamilton County, the subject of the previous case study, it is not yet a fast growing area.

Devising an Energy Efficiency Strategy

As noted earlier, Calhoun County began with discrete efficiency initiatives. While to date it does not have a *comprehensive* strategy, it does have an operational plan: to leverage existing tools, resources, and strategies such as those from EPA's ENERGY STAR and NACo. Driving this effort is a strong champion of energy efficiency and strong County leadership to keep the focus on attainable improvements. This is not to say that the county has no plans for creating an overarching plan for infrastructure efficiency and sustainability. Calhoun has been looking into forming a sustainability team consisting of County Chamber of Commerce members, representatives of the academic community, and municipal leaders.[128] The County Commissioner hopes to expand on current projects and eventually, but gradually, make environmental stewardship a priority in the minds of all County Council members.

Drivers of Energy Efficiency Initiatives

Calhoun County has moved methodically toward a more energy-efficient, sustainable future, spurred by a prominent champion who serves as a Calhoun County Commissioner, Robert D. or "RD" Downing. Through Downing's drive and enthusiasm, Calhoun became the first county in the nation to join NACo's ENERGY STAR Courthouse Campaign, which offers county governments support in realizing their energy efficiency commitments (facility improvements) and developing strong environmental leadership. By following the Campaign's action steps, the County earned EPA's ENERGY STAR certification in 2005 for both the Courthouse and Administration Building, which were the first two public buildings in Alabama to earn this distinction for superior energy efficiency. Since then, with the support and assistance of the Calhoun County Highway Department, Commissioner Downing has had a hand in several other efficiency projects, discussed in the Achievements section below.

Downing and others have purposefully chosen not to frame the debate as one about sustainability, believing that they are acting in what they believe to be the community's best interest. They frame the issue first and foremost in terms of cost savings—and who would oppose cost savings?

When asked about motivating factors, Downing simply replies, "We're not doing anything special, we're just doing things that ought to be done." The energy efficiency and sustainability initiatives in Calhoun County have been occurring in a decentralized fashion, or as Downing professes, "We're just doing things where they make sense."[129] This may seem like a simple concept, but it isn't; it is also a very profound one. It is a key strategy in the gradual development of green thinking in Calhoun County. This is a County that achieved energy efficiency by starting with practical energy use benchmarking and tracking in County buildings, seeing success, and moving on from there. In Calhoun, such an approach has this advantage, noted earlier: avoiding the political ramifications of framing issues in a sustainability context. Creating mandates or provisions for energy efficiency under the banner of climate change can alienate those in the area who oppose green issues, as well as provide them with an "out" for taking any action on the environment. The sustainability-related projects in Calhoun County thus far have been targeted and practical, rather than sweeping and ideological.

There is one other noteworthy player in the development of sustainability projects in Calhoun County: the Anniston Army Depot, an installation that is the region's largest employer. Located in the county seat, the 25-acre Anniston Army Depot (ANAD) has been operating in the area since the 1940s. Due to the nature of ANAD's operations, which include munitions testing, the site is an inherent environmental risk to the County. But, as the employer of more than 7,200 area residents, ANAD has the opportunity to influence environmental initiatives and increase public awareness. The Depot has, in fact, created its own sustainability program. Although the Depot does not fall under the County's jurisdiction, it represents a significant opportunity for the County to create a local-federal partnership and further its efficiency and sustainability agenda. About a year ago, ANAD approached

[127] U.S. Census Bureau. State and County Quick Facts: Calhoun County Alabama. http://quickfacts.census.gov/qfd/states/01/01015.html.
[128] Pete Conroy: Director of EPIC, April 23, 2010 interview.
[129] All quotes from Robert Downing taken from phone interview on April 23, 2010.

County officials to help in developing a methane capture mechanism at the neighboring landfill. The project is still in the planning stages.

Taking Action

Calhoun County has been grappling with energy efficiency issues for the better part of 10 years. In the early 2000s, RD Downing was already brainstorming ways in which the county could enhance its environmental reputation and earn recognition for its environmental efforts. Lacking the substantial funding and resources necessary to develop a comprehensive policy or plan, he looked to an existing program to leverage resources and create a name for Calhoun County in terms of efficiency and environmental stewardship.

In 2004, Calhoun was the first county in the nation to join NACo's ENERGY STAR Courthouse Campaign, a program that assists counties in assessing and improving the energy management of their courthouses and office buildings. The County's collaboration with EPA's ENERGY STAR Program and NACo's Courthouse Campaign seems to have jumpstarted the idea of efficiency, particularly in buildings.

A major ENERGY STAR resource is the Portfolio Manager (PM) tool for building energy use measurement and tracking. PM ranks the energy efficiency of existing buildings on a scale of 1 to 100; results can be used to compare like buildings to one another. The ENERGY STAR program also offers best practices for upgrading buildings, based on the experiences of thousands of partners across the country since 1991. Such upgrades can lead to improved scores in PM. If a building is an eligible space type, it will get a relative ranking in PM compared to similar buildings. If a building scores 75 or higher in PM, it will earn the prestigious ENERGY STAR and national recognition. This is the path the County followed.

Achievements

Calhoun County's success can be quantified in a several ways. Under the umbrella of the EPA's ENERGY STAR program, the County was able to make the efficiency improvements outlined in ECM 5 in Chapter 2, and earn the ENERGY STAR for the first two public buildings in the state of Alabama.[130] The County Courthouse rated 90 out of 100, where 50 is the national average; and the County Administration Building rated 88 out of 100. Combined annual cost-savings on utility bills for the two facilities is about $20,000.

Success through ENERGY STAR has led to other initiatives in the County that are even bolder in concept and to more achievements. The Calhoun County Highway Department building is one of the premier projects in the County in terms of energy efficiency and sustainability. In 2008, officials began considering a new site for the existing highway department administration building. Looking to expand on the work that was done with ENERGY STAR, Calhoun made energy efficiency *and* sustainability a priority for the highway department facility. As a result of that commitment and attention to LEED guidelines, it earned LEED for New Construction certification in 2009.

The new facility features many innovative technologies, but most notable is the presence of an onsite biodiesel processor in one of the buildings. In a joint program with the Anniston Water Works Board, the County devised a creative way to collect the used vegetable oil from local restaurants and use it in the highway department's onsite biodiesel processor to provide energy to the building. The kitchen oil collection began as a way to supplement the diesel fuel used in many of the county-owned vehicles, but has been accelerated to help power the new highway administration building.

Another practical initiative undertaken by the Highway Department involves the conversion of all County bridges to trussed bridges. The conversion takes into consideration the ecosystems of the waterways below the bridges, as trussed bridges do not require the presence of multiple supports installed in the water that could potentially disrupt the ecology of the waterway. Calhoun County has also helped to develop a weatherization and green jobs training facility at Gadsden State Community College, and was awarded $486,000 in ARRA funding to upgrade the County jail and another County administration building. The project includes lighting upgrades, DDC controls, swapping out old showerheads and water heaters, and the possible installation of solar water heaters.

The Anniston Army Depot, introduced earlier, has developed and implemented its own sustainability program, including provisions for pollution prevention, waste reduction, and recycling. For existing buildings, the Depot has implemented several energy efficiency projects, including a Headquarters building that runs completely on

[130] Kelly Zonderwyk. Calhoun County earns ENERGY STAR labels. *County News*, Volume 38, No. 11. June 5, 2006.

geothermal power. Also, the Depot's sustainability program mandates that all new construction be built to LEED-NC Silver certification level.

Last but not least, the County was honored with the Excellence in County Government Award from the Alabama Association of County Commissions four times in the past 13 years: in 1997, 2003, 2005, and most recently, in 2009. The 2009 award centered on the County's submission "How Calhoun County is Saving Energy and Protecting the Environment," winning in the urban county category.[131]

Water and Wastewater Efficiency Achievements

Description of Services

The Water Works and Sewer Board of the City of Anniston (a public non-profit corporation referred to as Anniston Water Works) owns and operates two water treatment plants (Coldwater Springs and Hillabee) and two wastewater treatment plants (Choccolocco and McClellen), which comprise the main water and wastewater treatment facilities in Calhoun County. They serve 60,000 people in total. Anniston Water Works has a common distribution network of 550 miles of pipe, 14 water storage tanks, and six pumping stations for the two drinking water treatment plants combined. On the wastewater side, the collection system is *not* combined with stormwater collection; it consists of 180 miles of pipe and 12 pumping stations.

Water shortages are uncommon in Calhoun County. Power costs in the state of Alabama are significantly lower than many other geographic areas in the Appalachian Region: Anniston Water Works pays 5 cents/kWh or less at most of the plants. The abundance of source water coupled with low energy costs can create an environment where energy and water efficiency are not priorities. However, Anniston Water Works' managers have recognized the benefits of reducing energy and water use and have moved forward with evaluations and programs.

Specific Energy and Water Efficiency Improvements

Anniston Water Works has a contract with a consulting firm to analyze energy use and make recommendations as to which rate structure is most economical and at what time during the day it is most economical to use power (purchasing energy during off peak hours being cheaper). Using the recommendations, Anniston Water Works engages in economically beneficial contracts with Alabama Power, the local power company.

In addition, treatment costs have become a major criterion in the County's choice of a drinking water supply source. The Coldwater Spring Water Treatment Plant draws its source water from the Coldwater Spring, a groundwater source requiring little treatment. The Hillabee Water Treatment Plant receives its source water from Hillabee Lake (a surface water source), which requires conventional treatment roughly five times more expensive than treating water from Coldwater Springs. Therefore, as an efficiency measure Anniston Water Works operates the Hillabee Water Treatment Plant at very low production levels, using it as a backup for emergencies. Even though Calhoun County experienced a very serious drought in 2007, the Coldwater Springs Plant was able to meet the demand and provide twice the amount of source water than is typically needed.

Replicable Strategies

Calhoun County's successes are remarkable considering the small amount of County funding available for efficiency and environmental efforts. The County's replicable strategies for other counties pursuing energy-efficient infrastructure include:

- Identifying and engaging a locally respected environmental champion who will devote energy to making his or her county a healthier, more sustainable place to live and work. (Note that this champion does not have to be the County Commissioner.)
- Leveraging and creatively using the no-cost tools available from third parties, such as those provided by the EPA's ENERGY STAR Program.

[131] Calhoun County Alabama. County Wins Award…Again, and AGAIN! August 2009. http://www.calhouncounty.org/news/award09.html

- Being flexible and avoiding formulaic processes that make the community and business stakeholders (whose engagement is essential) hesitant to participate. As Commissioner Downing describes it, County officials are always looking "to pitch a big tent so people can get under."

The Future: Ongoing Challenges / Potential Roadblocks to Future Progress

The challenges to expanding Calhoun County's energy efficiency and sustainability efforts are significant:

- A **severe lack of funding** prevents it from developing a sweeping County-wide sustainability policy. Although the County ranks high in terms of ARRA funding per capita (23rd) compared with other Appalachian counties, it is apparent from interviews that funding is a huge barrier in creating and implementing the future projects and programs that the County wishes to pursue. ANAD Chief of Staff Phil Trued cites lack of funding as the major roadblock to getting the Army Depot's methane-capture project off the ground, and Commissioner Downing certainly echoes that concern when asked about the development of County-wide efficiency or sustainability efforts.
- Another major roadblock is the **lack of community and citizen involvement**. A general awareness and concern for environmental issues has not seemed to touch the community as deeply as it has the Commissioner's office. Pete Conroy, Director of the Jacksonville State University Environmental Policy Information Center, cites the lack of public awareness as the largest barrier to furthering sustainability initiatives in Calhoun County. Neither Conroy nor Commissioner Downing could point to any prominent citizen groups in the County that are doing work in efficiency or sustainability. Downing believes that a major factor missing in the County's emerging efficiency and sustainability efforts is citizen support and participation to help the programs grow and embed themselves in the community.
- It appears that the Commissioner's office has owned most of the initiatives thus far, without much input or active participation from community members. Although it is laudable that the County offices have carried the torch on most issues related to energy and water efficiency, the environment, and sustainability, this singular driving force could have larger (possibly negative) implications as the County continues to try to expand its efficiency and environmental initiatives. Big opportunities may lie at the community level but may be overlooked at the official County office level. There may be needs that citizens recognize in their own backyards, but without regular dialogue, those needs may not be obvious to the Commissioner's office. Without regular input from the community, ideas and opportunities (even for small changes and improvements) might never surface.

Although noteworthy, the challenges are not insurmountable. Calhoun County has been creative thus far in finding funding mechanisms or ways to leverage no-cost programs, and that is expected to continue. Also, as the environmental programs and efficiency projects expand, citizens may in the natural course of their daily routines become more aware and involved in local sustainability efforts. Through the development of green jobs educational programs, such as the weatherization facility at Gadsden State Community College, the County may begin to see more public awareness and support for energy efficiency.

Acknowledgments

Special thanks to RD Downing, Pete Conroy, and Phil Trued, who generously offered their insights and assistance during interviews for this case study.

Chapter 4: Self-Assessment System for Local Governments in Appalachia

This study began with a question: **what actions and efforts are best for implementing energy efficient infrastructure in Appalachia?**

The tools reviewed in Chapter 1, the ECMs described in Chapter 2, and the county-level case studies presented in Chapter 3, all point to the importance of the six following actions. These six actions form the basis for the self-assessment system presented in this chapter. They represent the inherent opportunities of the region, and involve issues local governments can control. Furthermore, these are the actions with proven value—the case study counties have adopted them, and are already experiencing their benefits in cost savings, increased citizen engagement, and the attraction of outside investment.

- **Developing and promoting a culture of energy efficiency and sustainability, within government and as public discourse.** Collaboration across disciplines and between the public and private sectors is vital for lasting engagement and success. This includes outreach to private utilities and other public institutions, whether neighboring county governments or State Energy Offices. A public culture of energy efficiency includes opportunities for input from all stakeholders and a measure of openness and transparency in governance.
- **Assessing energy use and retrofitting the existing building stock.** The importance of benchmarking and measurement is a critical first step in setting performance goals; once poor performing buildings are targeted, audits and then retrofits can occur. Tracking energy use through no-cost tools offered by EPA ENERGY STAR is the preamble to action.
- **Implementing efficient water and wastewater infrastructure, including stormwater control and low-impact development.** Energy use for water and wastewater treatment is a large proportion of a county government's operating costs. The potential benefits of efficient water/wastewater infrastructure include not only energy and cost savings, but also improvements in the health of Appalachian watersheds and the purity of surface and ground water.
- **Using renewables as part of the mix of energy conservation measures.** The abundance of natural resources in Appalachia favors regionally-appropriate renewables such as biomass and biogas, and suggests potential competitive advantage for regional green power production in the region.
- **Striving for high-performance and high-profile new construction.** To that end, implementing a holistic approach to high-performance buildings—embodied, for example, by the content of the LEED rating systems—will likely yield the best results. There are greater and more lasting savings from interacting efficiencies. Better stormwater and waste management may lead to greater energy efficiency; innovative waste management may provide a source for the production of energy.
- **Leading by example through development of policies encouraging efficiency in all sectors and through active resource management.** Adoption of the latest standards in energy efficiency construction will further this goal. Evidence of such thinking and leadership can attract potential investors.

These actions are the basis for a self-assessment system, a group of actions relevant for governments in the Appalachian Region. Each action also has associated performance measures for energy efficiency improvements that emphasize leading by example, through pledging and policy setting; measurement, tracking, and re-measurement; water and wastewater sector efforts; cost-benefit and financing analysis; and implementation of renewables.

Table 21 below presents the 40 actions that comprise the self-assessment system and Table 22 provides the preliminary results of applying this system to the four counties highlighted in the case studies of Chapter 3.

Table 21: Self-Assessment System for County Governments

KEY
Tier 1: pledge or commitment; planning; adopting an energy efficiency strategy or standard (binary: Y/N) Tier 2: measurement to create baseline, establish benchmarks, or assess facilities; installing EE/RE systems (% of total public facilities, meters, or energy) Tier 3: measured annual improvement in facility-scale EE, RE, or cost savings (% improvement); achievement of third party green certification for facilities (% of total public facilities) Tier 4: measured annual improvement in community-scale energy efficiency and/or cost savings (% improvement)
ABBREVIATIONS
PM - Portfolio Manager ES - ENERGY STAR LEED -- Leadership in Energy and Environmental Design ASHRAE -- American Society of Heating, Refrigeration, and Air-conditioning Engineers IECC -- International Energy Conservation Code EECBG -- Energy Efficiency Conservation Block Grants CWSRF -- Clean Water State Revolving Fund DWSRF-- Drinking Water State Revolving Fund EPA- Environmental Protection Agency

Tier	Tool	Performance measure for energy efficiency improvements	Goals, measures, comments
1	N/A	Designate an Energy Manager	With funding and authority to set clear goals and objectives
1	N/A	Designate an Energy Management Team	Empowered to make decisions. Interdisciplinary: drawn from many backgrounds and departments. Use ES to train and empower public employees
1	N/A	Establish an energy pledge and set performance goals (LEED, ENERGY STAR, EE/RE grants)	Performance goals must include comparative measurement against a benchmark.
1	N/A	Establish a climate action plan and set performance goals	Develop pattern of public discourse; public charrettes and other opportunities for involvement are key. Decision-making from the ground-up -- buy-in -- is important.
1	N/A	Incentivize and recognize individual and community energy conservation and efficiency efforts	Host and sponsor energy efficiency educational programs for all sectors (how to weatherize; how to finance). ENERGY STAR has resources for externally-focused marketing (and possible public pledge) “change” campaign for citizens. Reward and recognize high performers.
1	N/A	Adopt leading stormwater management practices	Educate; include public and private sectors- through tax credits, access to County revolving loan fund, or similar.
1	N/A	Become a Sierra Club Cool Cities participant	
1	ES	Become an ENERGY STAR partner	Either for K-12 or local government sector, or both. Use ES communications and outreach plan to raise awareness.
1	N/A	Become a U.S. Conference of Mayors Climate Protection Agreement signatory	
1	IECC	Adopt latest IECC as official new construction standard for all sectors	

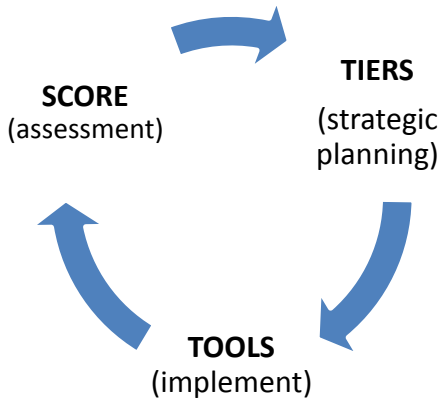
Tier	Tool	Performance measure for energy efficiency improvements	Goals, measures, comments
1	N/A	Secure financing for EE/RE improvements	PACE, ESCO, utility financing, on-bill financing, internal revolving loan funds, municipal bonds.
1	N/A	Secure Federal EE/RE grants	Measure success in $$ per capita (EECBG, EPA-DWSRF, EPA-CWSRF, SEP, ARRA)
2	ES	Inventory, submeter, and establish separate billing for individual facilities	Proportion of public facilities.
2	ES	Implement smart metering for real time monitoring of energy use	Proportion of public facilities.
2	ES	Record water use/efficiency for public buildings (gallons/s.f./yr)	Proportion of public facilities: established consistent water use baselines and benchmarks by year and metric.
2	ES	Record energy use/efficiency (kBTUs/s.f./yr) for public buildings	Proportion of public facilities: established consistent water use baselines and benchmarks by year and metric. Convert energy data into BTUe to determine energy use intensity (EUI) by building (BTU/sf/yr). Normalize energy data to adjust for different measures of energy use. PM does this automatically. Enter twelve recent months' data and begin to track energy use (all fuel types) efficiency for public buildings (KWh/sq.ft. and/or MCF/sq.ft.)
2	ES	Record energy use/efficiency for public water/wastewater treatment plants (KWh/MGD)	Proportion of public facilities: established consistent water use baselines and benchmarks by year and metric.
2	N/A	Establish leak detection system for public water supply system	Proportion of system.
2	N/A	Record wastewater I&I (inflow & infiltration) (Kgallons/yr)	Proportion of system.
2	ES	Record GHG emissions and track GHG emissions over time	Proportion of public facilities. Establishment of baseline GHG emissions year and GHG emissions scopes and boundaries, and a choice of measurement protocol are critical steps. ES accounts for building-level emissions.
2	ES	Conduct cash flow opportunity analysis	Proportion of public facilities.
2	ASHRAE	Conduct technical assessments and audits	Proportion of public facilities.
2	ASHRAE	Conduct cost-benefit analysis of recommended strategies	Proportion of public facilities.
2	N/A	Combined heat & power for public buildings	Proportion of public facilities.
2	N/A	Waste recovery & recycling for public buildings	Proportion of public facilities.
3	N/A	Onsite renewable energy generation (wind, solar, biomass) for public buildings	Measured increase in proportion of electricity consumption from onsite renewable energy.
3	EPA	Earn EPA "Green Power City" ranking for offsite renewable energy purchase (wind, solar, biomass)	Measured increase in proportion of electricity consumption from offsite renewable energy purchase, leading to reductions in GHG emissions - see www.epa.gov/greenpower/communities/gpcrankings.htm
3	ES	Earn ENERGY STAR status for eligible	Measured reduction in electricity costs or

Tier	Tool	Performance measure for energy efficiency improvements	Goals, measures, comments
		public facilities	consumption for public facilities.
3	LEED	Earn LEED certification for public facilities	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Water use/efficiency for public buildings (gallons/s.f./yr)	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Energy use/efficiency from improvements in public buildings (KWh/sq.ft. and/or MCF/sq.ft.)	Measured reduction in electricity consumption for public facilities: from lighting, thermostats, motion sensors, behavioral modification, commissioning, new HVAC systems, building envelope upgrades, window replacements, water efficient fixtures, and so on.
3	PM	Energy use/efficiency for public water/wastewater treatment plants (KWh/MGD)	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Reduction in leakage from public water supply system	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Reduction in wastewater I&I (Kgallons/yr)	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Reduction in stormwater inflow to sewage treatment plants	Measured reduction in electricity costs or consumption for public facilities.
3	PM	Reduction in facility-scale GHG emissions (tons/year)	Measured reduction in GHG emissions for public facilities.
4	N/A	Community-scale energy intensity: residential sector	Measured improvement- energy use efficiency for households (KWh/household).
4	N/A	Community-scale energy intensity: commercial sector	Measured improvement- energy use efficiency for commercial sector (KWh/commercial customer) using county-level EIA sector data for comparison.
4	N/A	Community-scale energy intensity: industrial sector	Measured improvement- energy use efficiency for industrial sector (KWh/industrial customer) using county-level EIA sector data for comparison.
4	N/A	Reduction in community-scale GHG emissions (tons/year)	Measured reduction in GHG emissions.

The 40 actions included in this self-assessment system for local governments are “tiered.” Actions that involve pledging or planning are in Tier 1. These actions are threshold activities and form the foundation for the remaining actions. Tier 2 covers actions that involve assessment or measurement of facilities and their energy use.. Tier 3 captures measured improvements, and Tier 4 includes measured improvements at the community level in energy and water efficiency. Many actions have an associated tool from among those discussed in Chapter 1. Tiers 2 through 4 emphasize the establishment of metrics and a tracking program, and **measured performance. In general, retrofitting and similar actions do not in themselves confer points; the improved performance that results from the actions yields rewards.** This is, predominantly, a performance-based rather than a prescriptive assessment system. Local governments can choose a variety of paths to increased energy efficiency, including energy conservation, systems commissioning, LED signals installation, renewables installation, and more.

Assessment of performance should be continuous. Indeed, the relationship between strategic planning (represented by the Tiers), implementation (represented by the tools), and assessment (represented by the score) is circular:

Figure 7: Continuous Assessment Cycle



The Actions of the Self-Assessment System

Implementing energy-efficient infrastructure requires nothing more—and nothing less—than straightforward changes in the way local governments manage resources, make decisions, and measure and manage energy and water use. The needed transformation is, first and foremost, in our behaviors.

Many counties still manage energy the same way today as they have for years. When energy and water prices were comparatively low, it was simpler to receive one bill for a building inventory rather than installing multiple energy meters and managing the multiple bills that come with them. Moreover, a common approach to operations has been to take the path of least resistance, putting energy and water systems and equipment in place and operating them with as little maintenance as possible, until something has to be replaced. This approach to energy management is no longer cost-effective with the present-day reality of high energy costs (and increasing water costs).

As rates go up, finding wealth through better energy management and energy efficient actions will be more cost effective than maintaining the business-as-usual scenario of energy management. The goal of this study and the self-assessment system described in this chapter is to help local governments interested in planning and financing energy-efficient infrastructure. To achieve the best performance in energy management, action and self-assessment must link. Self-assessment will help local governments establish a baseline to understand where they are starting from and where they can go; regular, repeated assessment will allow them to keep track of improved performance over time, and to gauge the most effective strategies for success—what is working, what is not, and where to focus or redirect efforts.

The Importance of the Threshold Tier 1 Actions

The self-assessment system was developed based on the tools and examples identified in Chapters 1 through 3. It builds on these examples of current best practices in and around the Appalachian region—of what's working now. The benefits of most of these actions are well understood, partly because these benefits, as documented in the case studies, are quantified—that is, they have a recognized monetary value in cost savings over time. Included in Tier 1 are also several important and foundational actions of the self-assessment system that embody the crucial role of the people involved in implementing energy efficient practices. For these threshold actions listed below, specific monetary values may be difficult to quantify; however, they are critical first steps that underlay the success of the whole system:

- Designate an Energy Manager
- Designate an Energy Management Team
- Establish an energy pledge and set performance goals
- Establish a climate action plan and set performance goals
- Incentivize and recognize individual and community energy conservation and efficiency efforts

The human contribution to planning and implementing energy efficiency infrastructure is vital. The ECMs of Chapter 2 are disembodied strategies without people to implement them. The case study counties of Chapter 3 owe their success to the individuals responsible for implementing these actions—the encouragement of leadership and collaboration, and the effective structuring of leadership teams and public engagement. The pursuit of holistic strategies and synergies productive of greater savings would be impossible without designating dedicated individuals to connect the dots and make an interrelated vision with concrete goals.

Designating an energy manager. A county energy manager will be the recognizable and responsible human face and point of contact for county-wide energy and resource efficiency efforts. This should be a funded, salaried position reporting internally to the county executive, as well as externally, out to the public. The duties of an energy manager involve coordinating municipal efforts across departments, helping to devise and track the County energy and/or sustainability plans, implementing their steps or by identifying the people and resources needed to get the job done, and ensuring accountability. As drivers of more extensive and lasting cost savings, and devoted to continuing improvement, energy managers can be worth their weight in gold.

Good energy managers can come from the more technical side of facility management, from the political or policy side, or from elsewhere. Ideally, they combine an ability to see the big picture with an understanding of technical detail, are open rather than rigid in their thinking, and they have an appetite for learning and teaching. They are strong communicators, taking the lead on seeking external recognition for achievements as well as communicating internally and to the community. Their success also depends on the depth of their support. County decision makers must encourage them to lead, back them publicly, and highlight their efforts. They must also receive enough training to develop or hone technical knowledge and enough resources to work effectively. Energy manager training conveys familiarity with, rather than deep knowledge of, a variety of topics: energy benchmarking and measurement, building systems and systems controls, energy conservation strategies, cost-benefit analysis and life-cycle costs, indoor air quality, building systems commissioning, energy codes, utility basics, and operations and maintenance best practices.

In the development and sponsorship of energy managers, the State of Kentucky is a leader in the Appalachian region. The state's initiative to place energy managers in Kentucky's public school districts—the School Energy Managers Project (SEMP)—is described at http://www.ksba.org/energy-management, and resources related to their training program are here: http://www.ksba.org/energy-management/semp-training. ENERGY STAR resources for energy managers are available at: http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index , and EPA's discussion of appointing an energy director is found at http://www.energystar.gov/index.cfm?c=continuous_improvement.appoint_director.

Designating an Energy Management Team. An "integrated management team" is an interdisciplinary team drawn from facility operations, purchasing, budget and finance, and includes workforce representatives and upper level decision makers. Such a team ensures that energy efficiency efforts embed and reach throughout an organization, bottom up and top down. Led by the energy manager, the energy management team is similarly empowered to plan and implement improvements consistently and throughout the organization. In some cases, such a team will represent the first interconnection between "silo-ed" departments. This interconnection is an essential step towards energy efficiency. Hamilton County, TN exemplifies this strategy. A significant advantage to having such a cross-cutting team is that **it saves money,** since it minimizes duplication of efforts and invites sharing of resources and ideas across departments. Through reducing redundant efforts, making documentation of efforts consistent, and ensuring widespread compliance with an energy plan, having an integrated management team ultimately results in lower operational costs.

The biggest steps in forming such a team are to identify and then engage the right people from among those who have energy and interest. Usually, there should be a balance of talents, specialties, and hierarchical

positions represented; team-members with different strengths teach each other informally and such informal exchanges can be as effective as formal training. As with the designation of an energy manager, County decision makers must back the energy team, supporting their decisions and allowing—and encouraging—team-members to devote time to this role. This should not be a burden simply added to the normal workloads of energy management team-members. Expect team members to devote a handful of hours per month to their energy management tasks, including a few more hours for initial training in the subject areas the energy manager has studied in greater depth.

Once the right people are engaged, setting up an energy team involves developing a framework of roles and responsibilities, as well as means and methods for communication. EPA's ENERGY STAR discussion of team-building is available here—http://www.energystar.gov/index.cfm?c=continuous_improvement.establish_team—with a discussion on determining roles and resources at http://www.energystar.gov/index.cfm?c=create_plan.determine_roles.

Establishing energy efficiency, conservation, and climate action plans and performance goals. Ensuring effective change and measuring progress in energy efficiency requires planning. This plan must include both specific action steps, as well as systems for measuring and tracking of progress. Determining initial benchmarks is essential; it provides a point of comparison to demonstrate future improvements. Goal setting as expressed by the SMART pneumonic focuses on Specific, Measurable, Achievable, Realistic, and Time-bound goals. For energy efficiency, measurable goals can be expressed in a variety of ways—as a percent energy use reduction over a designated period of time, a reduction in energy use consumption by square foot of building inventory, or even by a percent reduction in greenhouse gas emissions over a baseline year. County governments can set minimal as well as "stretch" goals, and in doing so it is wise to use several consistent metrics. See http://www.energystar.gov/index.cfm?c=performance_goals.establish_goals for ENERGY STAR guidance and no-cost resources for tracking energy use.

The content of the energy efficiency, conservation, and climate action plans should align with institutional mission and identity. Successful local governments, such as Calhoun County, AL, have formed their energy efficiency "identities" conservatively around efficiency, conservation, cost savings, and reuse. Others, such as Tompkins County, NY have made a name for themselves as innovation or energy technology hubs—sometimes in common cause with local institutions of higher education—or as local governments mandating the pursuit of LEED certification for public buildings. Whatever a county's energy efficiency plan, it should align with what the county is and wants to be; this helps ensure widespread adoption of the plan and success in meeting goals. The scope of an energy efficiency plan, who devises the plan and sets the goals, and who adopts the plan are characteristics that will vary by county.

Recognizing individual and community energy conservation and efficiency efforts. Rewarding success of energy efficiency champions leads to future success. In this, local governments should adopt a three-part strategy. First, they look outwards, to sponsor reward and recognition programs for the public and private sectors. The ENERGY STAR website at http://www.energystar.gov/index.cfm?c=challenge.challenge_toolkit contains a variety of ideas, and is a source of material for competitions and challenges which local governments can freely use and co-brand/co-sponsor. Secondly, local governments should seek recognition for their own efforts, and should publicize their own achievements in saving money and energy on behalf of the citizens they serve. ENERGY STAR certification put Calhoun County, AL on the energy efficiency map; LEED and EPA recognition underscores the achievement of Tompkins County, NY. Third, local governments should reward and publicize and reward their own internal energy efficiency champions.

Measuring Energy Use at the Community Level

The final four actions of the self-assessment system highlight the importance of holistic efforts at the community level. These actions include the measurement of improvement in community-scale energy intensity—for the residential, commercial, and/or industrial sectors—and the measurement of reductions in community scale greenhouse gas emissions for all sectors.

There are two basic methods for calculating energy use at the community level:

- **Method 1 (most accurate): Aggregation of measured energy usage per square foot or per facility per year**, using EPA's ENERGY STAR Portfolio Manager energy use benchmarking and tracking tool.

- **Method 2 (quick estimate): Energy usage per customer at the utility level,** using Energy Information Administration data.

Below are descriptions of these methods and the benefits and limitations of each.

Method 1: Aggregation of measured energy usage

Implementation. The most accurate and effective means of tracking energy use at the community level, in all sectors, is to gather and report utility data for all fuel types for all facilities. New York City and Washington, DC are examples of local governments which require such tracking and disclosure for the multi-family, commercial, and industrial sectors through EPA's ENERGY STAR Portfolio Manager. Assuming a complete and accurate building inventory, county governments can, for their own facilities, benchmark, track, share, and report energy use in Portfolio Manager; they can also enact policies to require the private sector to do the same. Once county governments have information at the single building level, they can compile summary reports aggregating and analyzing the data, understanding trends, and making recommendations for the future.

Benefits. Method 1 is highly accurate, since it is based on energy use data collection at the single building level. Establishing and requiring at least monthly energy use tracking is the foundation on which future cost and energy savings are built. Regularly reviewing tracked data helps identify low-performing facilities where subsequent retrofits may be most beneficial. Method 1 often yields to cost savings even without retrofits, since scrutiny of data helps uncover billing or rate errors, and promotes simple fixes for increased efficiency in systems operations. Method 1 if adopted across all sectors—residential, commercial, and industrial—can be a catalyst for public-private sector friendly competition and increased cross-sector cooperation. In addition, Portfolio Manager will account for all fuel types, and automatically converts entries to a single, common energy use intensity metric: kBTUs per square foot per year.

Limitations. This method assumes that an accurate inventory of facilities in both the public and private sector is available. County governments without an accurate inventory will need to assemble one (tax rolls provide knowledge of private sector properties). The private sector must also agree to use this approach and release the data; public mandates may be needed to encourage initial participation. The initial data collection effort needs to be well-organized and structured to ensure continued collection occurs. County governments may find it helpful to provide and maintain a website for information sharing, as well as other forms of outreach for the private sector.

Method 2: Energy usage per customer at the utility level

Implementation. For communities where no formal system for energy data tracking and collection exists, there are quick ways for counties to develop a ballpark figure of their energy consumption for two fuel types, electricity and natural gas, by sector (residential, commercial, or industrial). The Energy Information Administration (EIA) provides data files that counties can access and use to help estimate their year-by-year electricity consumption at http://www.eia.gov/cneaf/electricity/page/eia861.html. For natural gas deliveries, year-by-year information is here: http://www.eia.gov/cfapps/ngqs/ngqs.cfm?f_report=RP1&f_sortby=&f_items=&f_year_start=&f_year_end=&f_show_compid.

These databases provide and sort results by utility rather than by county. Therefore, an important caveat is that **utility service areas and county boundaries do not coincide**. As a result, the accuracy of these rough calculations will vary widely, depending on the correspondence between a utility's service area boundaries and a county's geographical limits. The more direct the correspondence, the more accurate the estimate will be in depicting energy use at the county level.

The estimation method is straightforward. Using the files on electricity usage as an example, the pertinent files in the EIA link above are File 4 (utilities sortable by US counties served) and File 2 (retail revenue, sales, and customer counts, by State and class of service, for all sectors). Counties should use File 4 to confirm the electric utility or utilities that service them. Each utility will have an ID number. File 2 contains, sorted by utility and utility ID, the total amount of residential, commercial, and industrial electric sales in MWhs by customer or consumer.

These are the steps for a quick reading of electrical consumption, at the utility level, based on EIA data:

- Copy the data from File 2 for each utility that services a county's residents, businesses, and industries.
- Separately for each sector—residential, commercial, and industrial—combine the numbers for all utilities for total electrical usage by sector in MWhs.
- Separately for each sector—residential, commercial, and industrial—combine the customer numbers for all utilities.
- Separately for each sector—residential, commercial, and industrial—obtain the ratio of electric usage in MWhs per customer. Note that this result will represent all customers within the service area of the relevant utilities. It may include customers outside the Appalachian region, if the utility service area is large enough, and counties should take note of whether that is the case.
- Repeat these steps for as many years of results as desired.

Counties can then compare these rough results by year to understand their electric usage trends—though again, **these results represent the average within their utility service areas,** and in some cases may include factors and results that, as they include non-Appalachian county information, do not accurately depict local performance.

Benefits. This is a quick method to estimate results using publicly available information.

Limitations. The limitations associated with Method 2 are as follows:

- Utility service areas and county boundaries do not coincide, and for this reason Method 2 may not depict local performance in an accurate way.
- The EIA database contains information on electric and natural gas usage but does not have information on other fuel types such as propane or fuel oil. This method will thus yield an incomplete picture of energy usage.
- As a portrait of industrial or commercial customers, this quick method has no way to distinguish between and compensate for the energy use variations among different building types, or among industrial uses. For example, if between comparison years a county gains a new employer—say, a research laboratory—this is likely to result in more proportionate energy use than in the case of a county that adds a lumber warehouse as a new employer.
- This method does not consider energy use by square foot per year (Energy Use Intensity) an effective metric for depicting energy efficiency at the single building level. Consider the case of public or private institutions that grow physically—increasing their energy consumption because of an increase in square footage. Under the ratio of energy consumption per customer, these institutions cannot clarify, by expressing their efficiency in energy usage per square foot, the representation of the community impacts of their growth.

  Ultimately, at the community level both approaches recognize that energy efficiency at the single building level, however it is measured, is most meaningful as part of a larger picture. The goal of community-scale assessment is an overall reduction, despite desired physical and economic growth, in energy use and greenhouse gas emissions; the effectiveness of energy efficiency must, in effect, outstrip growth.

Applying the Self-Assessment System to the Four Case Study Counties

Based on research conducted during the development of this study, Table 23 below provides the preliminary results of applying the self-assessment system to each of the four case study counties from Chapter 3.

For the case study counties in this report, to gain a sense of community-scale energy intensity, we employed Method 2, described above and demonstrated below in Table 22, to calculate the values for electrical usage for two years: 2002 (as a baseline) and 2008. There are many caveats arising from this analysis, most to do with the utility service areas of which these counties are a part. Tompkins County, NY is served by New York State Electric and Gas (NYSEG), which has an extensive service area scattered throughout New York State, including non-Appalachian counties. Further, the data for this utility shows that NYSEG considerably expanded its base of customers between 2002 and 2008, so that while usage per customer remains meaningful, expressing a decrease

in terms of percent of total MWhs reduced is not meaningful. Alabama Power, which services Calhoun County, has a service area covering most of Alabama, including counties on the Gulf Coast, outside the region. Appalachian Power Company (APCo) services Fayette County, WV and the entire state of West Virginia.

Hamilton County, TN appears to have the greatest correspondence between utility service area and county limits. In addition, one separate utility services only the City of Chattanooga, thus providing accurate results at the municipal level.

The overall community-scale results for the case study counties showed improved performance in most sectors in most utility areas of which these counties are a part. As explained above, expressing these reductions as percentages is problematic since utility service areas have varied during the years. Between 2002 and 2008, the utility area of which Tompkins County, NY is a part showed a decrease in electrical use for the residential and commercial sectors, and an increase for the industrial sector. Between 2002 and 2008, the utility area of which Fayette County, WV is a part showed a decrease in electrical use for the commercial sector, but an increase for the residential and industrial sectors. Hamilton County, TN showed decreases in electrical use in all sectors between 2002 and 2008. The utility area of which Calhoun County, AL is a part showed residential and industrial electrical use decreases, and an increase in electrical use in the commercial sector between 2002 and 2008.

Table 22: Electrical Energy Use at the Community Level in the Case Study Counties

Year	Residential (Res) Sector			Commercial (Com) Sector			Industrial (Ind) Sector		
	Res Sales (MWh)	Res Consumers (n)	**Res sales per customer/household**	Com Sales (MWh)	Com Consumers (n)	**Com sales/consumer**	Ind Sales (MWh)	Ind Consumers (n)	**Ind Sales/Consumer**
Tompkins County, NY (and entire utility/s service area)									
2002	231651	21289	**10.9**	818149	4891	**167.3**	402707	307	**1311.7**
2008	991053	105679	**9.4**	3409189	36386	**93.7**	2163862	1308	**1654.3**
Fayette County, WV (and entire utility/s service area)									
2002	5376575	368172	**14.6**	3580274	60278	**59.4**	4444482	2368	**1876.9**
2008	5885215	372131	**15.8**	3730885	65247	**57.2**	8243319	2453	**3360.5**
Hamilton County, TN (and entire utility/s service area)									
2002	3668703	238151	**15.4**	2497408	39747	**62.8**	2267203	139	**16558.9**
2008	3947536	258556	**15.3**	2695863	43602	**61.8**	2012707	140	**14376.5**
Calhoun County, AL (and entire utility/s service area)									
2002	17856186	1178104	**15.2**	13464402	205048	**65.7**	21275828	4932	**4313.8**
2008	18870685	1247084	**15.1**	14894600	224533	**66.3**	22260940	5990	**3716.4**

The application of the full self-assessment system to the case study counties includes the results of this quick analysis of energy use at the community level. Also note that these results reflect assumptions and educated estimates as to the proportion of public facilities measured and tracked. These educated guesses are provided to demonstrate how to use the scoring system. Using actual data would greatly enhance its usefulness to energy managers and decision-makers.

Table 23: Applying the Self-Assessment System to the Case Study Counties

Performance measure for energy efficiency improvements	Tompkins Co, NY	Fayette Co, WV	Hamilton Co, TN	Calhoun Co, AL
Designate an Energy Manager	1	0	1	1
Designate an Energy Management Team	1	0	1	0
Establish an energy pledge and set performance goals (LEED, ENERGY STAR, EE/RE grants)	1	1	1	1
Establish a climate action plan and set performance goals	1	1	1	0
Incentivize and recognize individual and community energy conservation and efficiency efforts	1	1	1	1
Adopt leading stormwater management practices	1	0	1	0
Become a Sierra Club Cool Cities participant	1	1	1	0
Become an ENERGY STAR partner	0	0	0	1
Become a U.S. Conference of Mayors Climate Protection Agreement signatory	1	0	1	0
Adopt latest IECC as official new construction standard for all sectors	1	0	0	0
Secure financing for EE/RE improvements	1	1	1	1
Secure Federal EE/RE grants	1	1	1	1
Inventory, submeter, and establish separate billing for individual facilities, % of public facilities.	.5	,25	.25	.5
Implement smart metering for real time monitoring of energy use, % of public facilities.	0	0	0	0
Record water use/efficiency for public buildings (gallons/s.f./yr), % of public facilities.	.5	,25	.25	.5
Record energy use/efficiency (kBTUs/s.f./yr) for public buildings, % of public facilities.	.5	.25	.25	.5
Record energy use/efficiency for public water/wastewater treatment plants (KWh/MGD), % of public facilities.	1	Private system	1	1
Establish leak detection system for public water supply system, % of system.	0	Private system	0	0
Record wastewater I&I (inflow & infiltration) (Kgallons/yr), % of system.	0	0	0	0
Record GHG emissions and track GHG emissions over time, % of public facilities.	1	0	1	0
Conduct cash flow opportunity analysis, % of public facilities.	0	0	0	.25
Conduct technical assessments and audits, % of public facilities.	.8	.25	.5	.25
Conduct cost-benefit analysis of recommended strategies, % of public facilities.	.8	0	.8	.25
Combined heat & power for public buildings, % of public facilities.	.1	0	0	0
Waste recovery & recycling for public buildings, % of public facilities.	1	.5	1	1
Measured increase, onsite renewable energy generation (wind, solar, biomass) for public buildings	.1	0	0	0
Earn EPA "Green Power City" ranking for offsite renewable energy purchase (wind, solar, biomass)	0	0	0	0
Earn ENERGY STAR status for eligible public facilities	0	0	0	.25
Earn LEED certification for public facilities	.1	0	.1	.1
Measured reduction, water use/efficiency for public buildings (gallons/s.f./yr)	0	0	0	0
Measured reduction, energy use/efficiency from improvements in public buildings	.5	0	.25	.25

Performance measure for energy efficiency improvements	Tompkins Co, NY	Fayette Co, WV	Hamilton Co, TN	Calhoun Co, AL
(KWh/sq.ft. and/or MCF/sq.ft.)				
Measured reduction, energy use/efficiency for public water/wastewater treatment plants (KWh/MGD)	.5	Private water	.5	.5
Measured reduction in leakage from public water supply system	0	Private water	0	0
Measured reduction in wastewater I&I (Kgallons/yr)	0	Private water	0	0
Measured reduction in stormwater inflow to sewage treatment plants	0	Private water	0	0
Reduction in facility-scale GHG emissions (tons/year)	1	0	.5	0
Measured improvement, community-scale energy intensity: residential sector[132]	1	0	1	1
Measured improvement, community-scale energy intensity: commercial sector[133]	1	1	1	0
Measured improvement, community-scale energy intensity: industrial sector[134]	0	0	1	1
Reduction in community-scale GHG emissions (tons/year)[135]	1	0	0	0
TOTALS (out of 40)	**22.4**	**8.5**	**19.4**	**13.4**

[132] For electric usage only, derived by applying Method 2 as described above and in Table 22 of this report.
[133] Ibid, as applied to the commercial sector.
[134] Ibid, as applied to the industrial sector.
[135] Tompkins County results are derived from the Emissions Report of the Tompkins County Planning Department at http://www.tompkins-co.org/emc/docs/DraftGovernmet10-yearGHGEmissionsReport.pdf.

Chapter 5: Partnership and Financing Opportunities

One challenge facing local governments in Appalachia is financing energy efficiency projects. This chapter identifies, for county governments, a variety of strategic allies available to help finance energy-efficient infrastructure. Two common themes repeated throughout the case studies, are (1) collaboration, and (2) partnership. For small jurisdictions, collaboration with others can bring energy efficiency efforts to scale as alliances help jurisdictions by establishing a larger market force and sharing risk. Examples of successful partnerships highlighted throughout the case studies of Chapter 3 include the following: Tompkins County public-private sector collaboration; SEDA-COG's LED signal light program; and the Cove Regional Digester.

The first step for local governments in Appalachia is to look for collaborators and sources of beneficial information among other public sector institutions and in the private sector. This requires time spent on research and outreach. Table 23 below provides a look at potential partnerships and organizations that might assist local governments in the financing process—either directly, through providing sources of capital or services like energy audits, or indirectly, through providing advice or strategic alliances. Adapted from a Chapter 1 resource, DOE's Financial Solutions Center at http://www1.eere.energy.gov/wip/solutioncenter/pdfs/ch06_partners_stakes.pdf, this table outlines organizations' partnership roles, and the types of information they offer.

Table 24: Potential Financing Partners

Organization/Strategic Ally	Potential Roles / Responsibilities or Impacts	Information
Financial Institutions (such as national and community banks, credit unions, community development financial institutions)	• Program administrator • Loan servicer • Source of capital • Loan underwriter • Warehouser of loans prior to securitizing loans	• Existing energy loan programs • Existing loan programs • Level of interest in providing new loans • Community development goals or objectives
State Legislatures	• Sources of loan capital or credit enhancement capital, through appropriations of funds • Sources of ongoing operational funds • Approval of enabling legislation for public utility commissions (PUCs) to allow funding for financing programs • Approval of legislation to require utilities to develop financing programs • Approval of other policies to encourage development of energy efficiency (EE) or renewable energy (RE) technology (energy efficiency resource standards, public benefit funds, tax incentives, etc.)	• Current energy-related legislative initiatives • Identification of energy advocates.
State-Chartered Bonding Authorities	• Program administration in some cases, meaning that bonding authorities may be able to originate loans and service loans • Sources of capital • Program marketing, especially to low-income households	• Existing, experienced bonding authority • Interest in playing expanded role in EE and RE
State Public Utility Commissions (PUCs)	• Authorization or requirements for regulated utilities to develop and run financing programs • Approval of utility EE or RE resource standards • Approval of rate structures that encourage EE or RE • Approval of utility-operated clean energy rebate or grant programs that may reduce loan amounts	• Interest in/support for pushing energy efficiency as part of Renewable Portfolio Standards (RPS)
Sustainable Energy Associations/Coalitions	• Marketing • Political support • Input into program design	• Capacity for and interest in supporting a loan program

Organization/Strategic Ally	Potential Roles / Responsibilities or Impacts	Information
Utilities (water, wastewater, electricity, solid waste)	• Payment collection in cases of on-bill repayment structures • Rebates for energy efficiency retrofits • Conducting audits before and after upgrades	• Interest in collecting loan payments via utility bill • Legal authority to collect energy loan payments and to take action for nonpayment • Existing energy efficiency programs • Willingness to provide usage data
Other Advocacy Associations and Organizations (environmental organizations, contractor associations, and so on)	• Marketing to constituency • Additional contacts to help develop program (bank or contractor contacts) • Political support/opposition	• Identification of energy advocates with a vested interest in an energy loan program • Willingness to support program
Existing Weatherization Organizations	• Development of retrofit standards and programs • Support for new retrofit program	• Information on how existing programs complement, integrate with, or compete with new loan programs.
Vendors (Lowes, Home Depot, locally owned retail and wholesale suppliers)	• Marketing and consumer education • Installation support • Possible source of loan loss reserves	• Interest is participating in program
Contractors	• Program marketing • Measure installation • (Auditors/Others) Quality inspection at completion of work and certifying eligibility for payment	• Interest in participating in program • Current financing programs
Nonbank Investors	• Sources of capital • Secondary loan underwriter	• Investment goals and objectives, which may align with new energy loan programs
Technical Colleges	• Workforce development and training	• Existing training programs • Interest in new training programs
Regional Planning Organizations	• Program administrator • Convener of local governments	• Capacity to assist programs
Nonprofit Organizations	• Program administrator • Marketing	• Additional organizations likely to be interested in energy loan programs

Source: http://www1.eere.energy.gov/wip/solutioncenter/pdfs/ch06_partners_stakes.pdf

Financing options for local governments

A recent CalCEF innovations whitepaper summarizes these first-cost impediments to energy efficiency investment, among them: reluctance of property-owners to finance projects, lack of options to finance integrated energy efficiency retrofits, lack of service providers who can conduct whole-building energy efficiency retrofits, and small-sized projects transactions at disparate facilities.[136] Add to this that some of the most innovative methods for financing energy efficiency improvements are not yet viable options for governments in the Appalachian region. For example, programs like Property Assessed Clean Energy (PACE) financing, described in the case study on Tompkins County, NY, are usually options offered *by* local governments *to* the private sector; this financing alternative attaches to property tax payments from the commercial or residential property owners. Even so, a several financing alternatives remain for local governments seeking funds. The three primary financing options covered in this chapter include:

- On-bill Financing
- Energy Services and Power Purchase Agreements
- Energy Performance Contracting

On-bill financing

On-bill financing lets utility customers finance energy-efficiency investments through payments on their monthly utility bills. Typically, on-billing financing requires no upfront investment in energy efficiency retrofits. It is structured in either of two ways—as a tariff that equals the cost of improvements and attaches to a utility meter for gradual payment over time by whoever owns the meter; or as a loan that attaches to the meter owner and moves with the owner when the property is sold. Loans can be generated either by the utility company or by third-party investors, and they typically are low-interest or even interest-free. Loan-offset grants, rebates, or other incentives sometimes complement the on-bill financing package to reduce the loan amount and make more improvements cost-effective for the customer. Loan-loss reserves are typically established to reduce the overall risk, which lowers the effective interest rate. The feature most attractive to utility customers is that loan repayments for energy-efficient improvements are generally calculated so that they are equal to the amount of the expected energy savings from the improvements. In terms of risk, local governments present a good bet for lenders/utilities, since they do not share the potential risks of the residential sector related to the complications from transfer of home ownership.

On-bill financing mechanisms seek to reduce several market barriers associated with energy-efficiency improvements, including insufficient information, lack of access to financing, and up-front capital costs. Allowing energy-efficiency improvement loans to be repaid via utility bills and aggregation of loans into a portfolio makes the energy-efficiency investment opportunity less risky for the lender, thus reducing the cost of capital. Energy audits and detailed savings estimates are typically included in such programs, reducing barriers related to the uncertainty of energy savings.

The attractiveness of the on-bill model is its ability to deflect risks and up-front capital expenditures for the consumer. Depending on the program's structure, however, participating utilities can become saddled with additional risks and responsibilities. Utilities are wary of entering into a banking role with their customers, because they are ill equipped to manage financial transactions and servicing, and they must satisfy consumer lending laws and other unfamiliar regulations. In addition, utilities' billing systems often are not set up to incorporate energy-efficiency loan payments. Utilities also can become exposed to risks associated with non-payment. To mitigate these concerns, some programs are structured so that third-party lenders, such as banks, originate the loans. One disadvantage often encountered is the inclination of the utilities and their lenders to reduce the term of the repayment. This action can have the unintended consequence of increasing the payback costs or reducing the size of the improvements that can be financed using this approach.

Several factors are likely to increase the use of on-bill financing. As legislation requiring utilities to include on-bill financing expands (a growing number of states already have enacted such legislation), utilities will likely improve billing systems to accommodate on-bill financing. Experienced energy service providers will deliver technical and engineering expertise to streamline energy-efficiency offerings. Contractors and auditors will tailor auditing and

[136] Hinkle, B., Kenny, D. (February 2010). *Energy Efficiency Paying the Way: New Financing Strategies Remove First-Cost Hurdles.* CalCEF Innovations. http://www.fypower.org/pdf/CALCEF-WP-EE-2010.pdf.

efficiency measures to take advantage of business opportunities created by on-bill financing. Banks are more likely to offer financing, once they better understand the low risk and potential profits of these investments. As implementation efficiencies, lowered risk perceptions, and more efficient delivery systems kick in, customers will become more familiar with on-bill financing concepts, and widespread acceptance of this approach could follow.

At present there are few examples of on-bill financing on offer in the Appalachian region. Working through direct outreach and through the Public Utility Commissions of their states, local governments can persuade private utilities to provide such financing mechanisms. On-bill financing is therefore a strategy for the near future rather than for the present. County governments who seek to explore on-bill financing with their utilities will find the following sources useful to bring to the conversation:

- Brown, M., ConoverBrown (2008). *Paying for Energy Upgrades Through Utility Bills.* Alliance to Save Energy. http://www.ma- eeac.org/docs/On-BillFinancingASEBriefMatthewBrown.pdf.
- Gandhi, N., Gray, P., O'Conner, D., Vagnini, R., Kiernan, K., Baggett, S. (June 2008). *On-Bill Financing of Small Business Energy- Efficiency: An Evolving Success Story.* American Council for an Energy-Efficient Economy. http://eec.ucdavis.edu/ACEEE/2008/data/papers/5_382.pdf.
- Brown, M., ConoverBrown (September 2009). *On-Bill Financing: Helping Small Business Reduce Emissions and Energy Use While Improving Profitability.* National Small Business Association. http://www.nsba.biz/docs/09OBFNSBA.pdf.
- Obbagy, J., The Cadmus Group, Inc. (June 2007). *On-Bill Financing: A Tool for Small Business.* Environmental Manager's Compliance Advisor. http://www.cadmusgroup.com/pdfs/on_bill_financing.pdf.
- Hyams, M. (April 2009). *"On-Bill Financing" for Energy Efficiency.* Center for Energy, Marine Transportation and Public Policy. http://energy.sipa.columbia.edu/researchprograms/urbanenergy/documents/On%20bill%20Financing%20FINAL.pdf.
- Fuller, M. (May 2009). *Enabling Investments in Energy Efficiency.* California Institute for Energy and Environment and Efficiency Vermont. http://wpui.wisc.edu/files/webcontent/reports/Residential%20Financing%20White%20Paper.pdf.
- Johnson, K., Shimoda, W., Willoughby, G., Volcker, M. (June 2010). *Lessons Learned from the Field: Key Strategies for Implementing Successful On-The-Bill Financing Programs.* International Energy Program Evaluation Conference. www.iepec.org/paris2010/JohnsonPresentation.pdf.
- Michigan Saves Pilot (February 2011). *Cherryland Electric Cooperative.* http://www3.michigansaves.org/cherrylandpilot/.

Energy Services and Power Purchase Agreements

One innovative, promising financial structure being developed to support energy-efficiency investments involves the combination of an Energy Services Agreement (ESA) and an energy-efficiency Power Purchase Agreement (eePPA). In this financial construct a private energy services company (ESCO) works with a large commercial or industrial customer to finance cost-effective energy retrofits. Private investors provide all of the funding for an energy-efficiency retrofit to a building, decreasing the building's calculated future energy consumption. Throughout the contract, the building owner agrees to pay the ESCO an amount based on the calculated future utility bill savings or cost of energy use avoided due to the efficiency investment, providing revenue for the investors. The benefits to the building owner are that the investment:

- Occurs off-balance sheet without encumbering the owners' own capital, budget, or debt capacity
- Occurs all at once, permitting an immediate reduction in energy use and a concomitant reduction in carbon emissions
- Goes beyond the quickest and least-costly efficiency improvements, typically focusing on achievement of the maximum energy savings by implementing a more comprehensive and synergistic combination of improvements
- Usually includes a monitoring component that ensures the persistence of the energy savings over time

This model is most effectively deployed where at least $1 million of potential investment exists. Most of the commercial companies offering variations of this theme are focused on the commercial and industrial markets.

ESA and eePPA arrangements begin with an identification of deeper potential energy-efficiency improvements, emphasizing a whole-building focus that leverages the synergistic effects of cumulative energy-efficiency upgrades across entire buildings and their systems. Moreover, the implementation of these measures also emphasizes the continued verification of energy savings by requiring the implementation contractors to monitor and adjust the energy-efficiency measures regularly to avoid degradation of energy savings over time.

The barriers associated with ESA/eePPA arrangements include the following considerations:

- Whether this type of contract could eventually be considered a lease, creating a liability that would need to be reflected on a local government's balance sheet
- Whether the profit margin required in any privately financed investment vehicle would increase costs to the point that it is no longer viable
- Whether local governments are willing to allow outside investors to own substantial equipment or systems in their facility
- Whether the performance contracting agreements that support the ESAs adequately measure prior energy usage and accurately project future consumption.

For this financial vehicle to become more widely adopted, it will have to overcome resistance based upon its limited track record in the face of the specific weaknesses outlined above. Once an implementation record has established the viability of this approach, objections to its newness may become moot. However, one significant barrier remains that makes this model less attractive than some of the others: the higher associated customer costs. Because the financing is all provided by the private sector, the required rate of return is typically higher than in those models relying on public or ratepayer funds. In addition, unfavorable tax and depreciation treatment negatively affects these programs' costs. The higher costs can have multiple effects upon the economics of these programs to participants. In general, they can increase the total customer cost, repayment terms, and monthly payments, to the point where payments almost equal original energy costs, thus having little positive impact on monthly expenditures. Typical terms for such ESA agreements range from 5 to 20 years.

Energy Performance Contracting (EPC)

Description. An energy performance contract, or EPC (also known as guaranteed energy savings performance contract, or, simply, a performance contract, PC) is a special type of contract for building improvements that can be paid using the savings that it generates. Energy Service Companies (ESCOs) specialize in helping organizations accomplish EPC projects, which are funded by the utility cost savings they produce. The ESCO contract includes a structure for verifying the savings that will be used to pay for the project. Careful planning in the first stages of choosing an ESCO is critical to a successful outcome. It is very important to understand the process and the nature of the contract up-front, and follow good ESCO procurement policies, create an effective measurement and verification plan, and exercise appropriate due diligence.

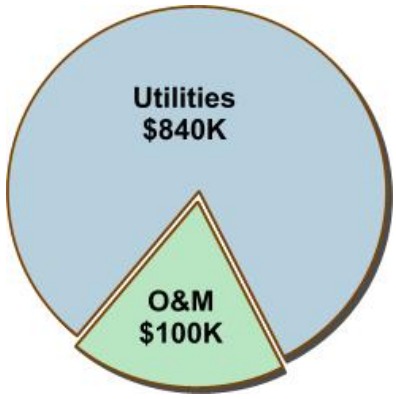
ESCOs develop, install, and arrange financing for projects designed to improve the energy efficiency and maintenance costs for facilities over a seven- to 20- year time period. In general, ESCOs can act as project developers for a wide range of tasks and assume the technical and performance risks associated with the project. Services are bundled into the project's cost and are repaid through the dollar savings generated through energy savings. There are a variety of services local governments can expect from an ESCO, including:

- Identifying and evaluating energy saving opportunities
- Providing engineering services from design to equipment specifications
- Ordering and installing equipment
- Managing construction of a wide variety of projects
- Providing long-term energy management and maintenance services
- Guaranteeing performance and savings
- Arranging financing (if needed).

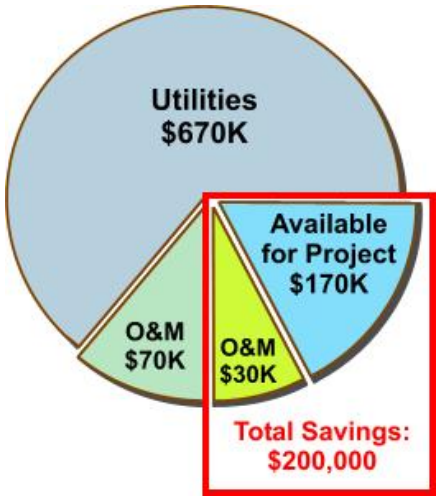
EPC is perhaps the most widespread currently available method of financing energy efficiency improvements. As such, the content below aims to demystify the process and explain the oversight and resources needed for its successful implementation.

EPC Basic Concepts

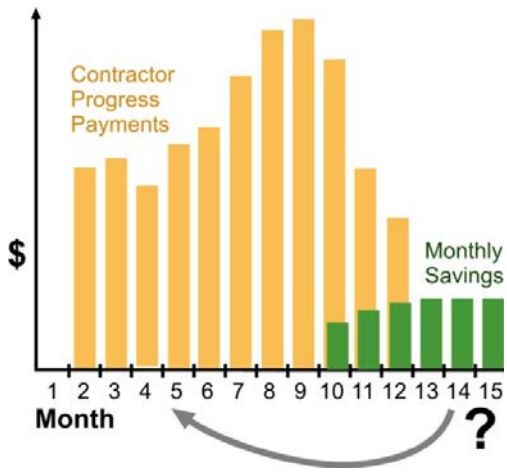
One way to understand EPC is to compare two pie charts—one of an annual operations and maintenance (O&M) budget before a green building renewal project and one after the project.



This example shows a $940,000 total annual budget for a specific number of buildings—$840,000 for utilities and $100,000 for operations and maintenance (including labor costs).



In the next example, after installation of facility improvement measures (FIMs), the annual O&M budget still totals $940,000. However, less is spent on utilities and maintenance.



The savings generated by the project will not occur until after the project is complete. In many cases, the contractor's payments will need to be paid during the construction phase, unless other arrangements are made. In EPC projects, a financing mechanism (usually some type of lending or lease-purchase instrument that accommodates deferred payment) addresses the cash-flow requirements needed during the project's construction/implementation period.

While often the ESCO will arrange for construction financing, there may be times when the owner must secure their own financial arrangements. Each project will be based on the financial needs/capabilities of the owner and those of the ESCO.

Implementing EPC

EPC may not be appropriate for all local governments. The following assessment questions are designed to help local governments understand if the scope of their need is a good match for possible financing through an EPC.

Table 25: EPC Assessment Questions for Local Governments

EPC Assessment Question	Rationale
Is the facility floor area greater than 200,000 square feet?	This question and the next one are gauges of project economics. There have to be enough potential savings to support acquisition of the new equipment retrofits, as well as project development (audits, design, administration, etc.) and project management efforts. If local governments do not have square footage meeting this minimum that needs to be retrofitted, they should look to make common cause with neighboring counties in the region who wish to pursue EPC.
Are annual facility energy bills more than $200,000?	This is an order of magnitude figure and is meant to indicate that the lower end of financial viability for a paid-from-savings project is of this magnitude. Depending on the scope, some projects may have a higher minimum. Counties who do not meet this minimum should not spend time developing an EPC project only to find out that it's not large enough to cover all the costs that will be incurred. Again, counties should look for partnership opportunities to meet this threshold.
Are there recurring maintenance problems or high costs?	This question speaks to project economics from another perspective. The idea is that when the project is completed, high maintenance, operating, or energy costs will be lower. It is possible that any savings in this area can offset project costs.
Are there comfort complaints?	The value of a project is not just measured in capital costs. Improved employee productivity (through a better indoor environment) can show itself in other ways when it comes to the bottom line.
Do maintenance budget constraints preclude major repairs?	This is an issue that the EPC process was designed to resolve. Providing that the above criteria are met, there are few conventional alternatives when the organization does not have funding for major repairs.
Has there been a major upgrade to the facility's lighting system?	The older the lighting system, the greater the potential for energy savings. Lighting represents the most significant savings stream of an EPC project and is often used to help fund lower payback equipment that must be replaced.
Are major mechanical systems ready for replacement?	The older the mechanical system, the greater the potential for savings in operation, maintenance, and energy use. This is another core value of the EPC process. System replacements can be evaluated based on quantifiable operation, maintenance, and energy savings through the energy auditing process. Savings performance is then monitored and verified during the performance period.

Since the ESCO will be a long-time partner, it is important to select one that shares your vision and is able to meet your needs. A request for proposal (RFP)—or a Request for Qualifications (RFQ)—is an excellent way for local governments to identify interested ESCOs and compare their approaches.

Phase One: Preparation

Step 1 – Pre-project education

Step2 – Assess building portfolio for savings potential

Step 3 – Assess EPC feasibility

Step 4 – Assemble EPC project team

Step 5 – Develop project scope and criteria

Step 6 – Assess financing options

Phase Two: ESCO Selection

Step 7 – Develop an RFP/RFQ

Step 8 – Tour of facilities by ESCOs

Step 9 – Evaluate proposals, presentations, and references

Step 10 – Select an ESCO

Phase Three: Project Execution

Step 11 – Conduct investment-grade energy audit

Step 12 – Finalize project development plan

Step 13 – Finalize measurement and verification plan

Step 14 – Complete energy services agreement

Step 15 – Complete financing agreement

Step 16 – Complete design and specifications

Step 17 – Accomplish construction and installation tasks

Phase Four: Post-Project Activities

Step 18 – Monitor and verify savings

Step 19 – Maintain and service new equipment

Step 20 – Manage financial arrangements

On the left are the basic steps for selecting and contracting with an ESCO for the accomplishment of building performance improvements.

Local governments may decide to use third-party consultants to help with the selection process and due diligence throughout the procurement phase.

The performance period for EPCs can last up to 20 years and a guaranty of savings is required with an annual reconciliation.

In Phase One, local governments get acquainted with the EPC and determine if the project is appropriate for this type of contract. If financing will eventually be needed for the project, it is not too soon to be looking at options and confirming the availability of project financing.

In Phase Two, counties evaluate proposals from prospective ESCOs. Some states have a list of pre-qualified ESCOs and require the issuance of a request for proposal (RFP). Counties will need to establish a selection committee (4 to 6 members), most likely from members of the project team. They should all be familiar with the selection criteria and process.

In Phase Three, counties receive the project deliverables. The EPC process also involves a detailed energy audit at the very beginning; this will be used as a basis for calculating energy savings and developing the project elements.

In Phase Four, the post-project phase, several important activities are conducted that need to be monitored by the building owner/manager. The length of this period will be based on the number of years that will be required for M&V, the financing term, and servicing and maintenance requirements of newly installed equipment. Many ESCOs offer M&V services, which should be specified in the M&V plan, as well as maintenance services for the newly installed equipment (usually a separate contract). Owners can determine the best arrangement based on their needs and capabilities. If the ESCO was involved in financing the project, this will be a continuing aspect of the relationship until the project is paid.

Importance of Measurement and Verification in EPC

One of the unique and important aspects of EPC is the predetermination of utility cost savings that the project will create. This is also an important requirement as contractor compensation is based on the ability of the project to produce savings. Since savings are guaranteed, both parties must come to a mutual understanding of how savings will be measured and verified. It is essential to develop an appropriate measurement method to ensure both parties are satisfied. Performance problems could arise if savings are merely "stipulated" or under-measured. On the other hand, M&V costs can be unnecessarily high when over-measuring. A proper balance must be established. The measurement and verification process involves specific practices and calculations to ensure expected savings are being realized. The International Performance Measurement and Verification Protocol (IPMVP) has become the industry standard process for creating the M&V plan.

Key elements of the plan are developed in the investment-grade audit phase and are completed prior to signing an agreement. The plan details the procedures that will be used to measure the pre-project existing conditions, measure the post-project new conditions, and calculate the baseline (or make any adjustments to the baseline or pre-project conditions). The baseline (or adjusted baseline) will be calculated after the first year that savings begin. The methods used to calculate the adjusted baseline are critical to determining whether the savings meet the guarantee. Facility managers and engineering staff can work with the ESCO to determine how savings will be calculated and verified. Energy accounting software is often used to analyze and calculate the adjusted baseline.

EPC can be an effective approach to building renewal if properly planned and executed. As energy costs continue to rise, EPC projects will become more viable. Counties may also find that leveraging available internal funds in conjunction with financing a part of the project will facilitate a larger and more economical project. Sometimes completely financed projects are more difficult to achieve in areas with low utility rates, such as in Appalachia. For example, instead of a project consisting of repairs in three large buildings, which can be funded internally, owners should consider adding two or three more buildings to the overall project and include financing. This way, there is a wider array of savings that can be applied to a smaller amount of financing.

Conclusions

Given the limitations of county funding to invest in energy efficiency, the introduction of private capital provides a promising opportunity to vastly expand investment and overcome the first-cost barriers facing local governments. As the need grows to increase the energy efficiency of buildings and facilities, counties need more innovative financial models to help avoid large upfront outlays and pay for large efficiency investments over time. Innovative vehicles for county governments are not widely available, yet energy efficiency in the local government sector may represent a good opportunity and a fairly low risk for private investors. Whatever the financing vehicle adopted, it will be important to balance the needs of counties and investors—for example, to set payment terms that balance the need of participants to minimize monthly utility plus finance costs against the desire of funders to reduce risks—and to ensure support for the options most beneficial to citizens. As the benefits of the ECM analyses of Chapter 2 suggest, low-tech approaches to energy efficiency—rather than the higher-tech options presented by renewables—present the largest, and potentially most beneficial, economic opportunity.

The positive consequences of the potential wealth from implementing energy efficiency cannot be ignored, and should not be postponed:

- Cost savings can fund future local government operations or can be rebated to taxpayers when funding needs are met. A measure of high performance, this signals accountability to taxpayers.
- Energy savings are usually the lowest cost approach to reducing carbon emissions. Reducing carbon emissions is likely to become more important over time, and governments must increasingly respond to Federal and State mandates that require them to pledge reductions in both energy use and carbon emissions.
- Energy efficiency upgrades save money, induce investment, and create jobs. In some cases, these jobs—such as a local government's choice to hire an energy manager—may be a direct result of savings now reinvested in human "capital." Energy efficiency investments can generate new sources of wealth and employment as private and public investment seeks to maximize cost savings that enhance quality of life, and support forward-thinking leadership.