SMART SOLUTIONS: Applying today’s innovation to make tomorrow’s world smarter
Given the accelerating urbanization occurring globally, infrastructure is one of the most important critical elements to sustainable communities. The implementation of smart solutions will ensure that the optimization of the investments made will have an enduring impact on the health, safety, and economic development of communities around the world.

-Anthony S. Bartolomeo, President and CEO, Pennoni
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ABOUT US

As a multidisciplinary consulting engineering firm founded more than five decades ago, Pennoni approaches engineering challenges from a wider spectrum of angles than most, from land development to energy management. Our goal is to help communities and private sector clients alike navigate the ever-changing technological advancements available and learn how best to integrate “smart” technologies into the current landscape and make them a part of resilient and sustainable planning. Our combination of talent and experience generates unprecedented solutions for diverse and iconic projects around the globe. To learn more, visit www.pennoni.com.

Follow us on social media for the latest Pennoni news and announcements in between issues:
What is a Smart City?

For more information on our Smart Solutions, please contact:
Joe Viscuso, Senior Vice President and Director of Strategic Growth
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WHAT IS A SMART CITY?

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According to the Smart Cities Council, a smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability. First, a smart city collects information about itself through sensors, other devices, and existing systems. Next, it communicates that data using wired or wireless networks. Third, it analyzes that data to understand what's happening now and what's likely to happen next.

At Pennoni, we know that smart cities aren't just "cities;" both the public and private sectors are turning to smart solutions to further growth through attracting businesses, residents, tourists, and talent. As smart technologies and smart solutions are becoming more prevalent in our everyday lives, we are assisting our clients to navigate through the multitude of options with our four pillars: transportation, facilities management, energy/utilities, and water/wastewater/solid waste.

We are applying innovation to make today's world smarter.
How is innovation changing the way we’re selling our services?

The traditional services that firms like Pennoni offer will always be needed. The delivery of these services has changed in that software and technological advancements have given us better ways to arrive at our solutions for our clients. Our services – once purely design – can and must be part of a more complete ‘solution’ offering. That is to say, we must resist looking at design problems in isolation, and instead contextualize what we do with broader agendas that improve the profitability, operations, quality, of the organization with whom we are working.

Why is it important to partner with companies like Momentum Dynamics, Roadbotics, Sustainable Water, etc.?

Companies such as these are developing solutions using Artificial Intelligence and innovative technological enhancements. It is our responsibility at Pennoni to identify what we refer to as “channel partners” and to understand how our clients can benefit from solutions employing these types of innovative techniques. These companies all demonstrate the power of focus. By remaining small and distraction free, they each found ways to innovate and bring new products to market. Pennoni, as a generalist, understands how to place such groundbreaking technology into context, which makes these solutions useful in everyday life.

How has our partnership with Smart Cities Council changed since we became an Associate Partner?

We want to be more than just members of an organization that we support. We have engaged with the Smart Cities Council in each of their readiness workshops on presenting “case studies” to show cities and regions how smart solutions are being deployed in other parts of the country. The Council affords us an opportunity to improve visibility with communities that highly value technology and integrated solutions. Ultimately, we seek to improve the quality of life for ourselves and our friends and neighbors. The goals of the Smart Cities Council align identically with our goals.

Most of the US cities surveyed are “beginner” or “transitioning” in Traffic Management Maturity. Beginner cities can save 5.2 per capita hours in traffic by implementing Smart Traffic Signals. How can we educate our municipal clients about the benefits of adaptive traffic signals?

Traffic signals and systems will continue to get smarter. Cities that invest in the latest technologies can demonstrate proven results in economic development. Reduced travel times increase worker productivity for businesses, reduce emissions, and improve overall quality of life. We need to continue to reach out and educate officials at all levels of government to help them as we contemplate a new shared vision for high value mobility in the modern era. Intelligent Transportation System technology like adaptive signals is one solution that transportation and infrastructure officials should consider as they assemble their modern master plans.
How can we help our clients further their development in the use of data and data analytics when it comes to our facilities management offerings?

**JV**

The first rule of a Smart City is the use of data. Data has been coined the “new gold”. The use of this data through analytics allows our clients to make proactive rather than reactive choices in their marketplace.

**MW**

By adopting modern facilities management technologies, we can help clients better manage their assets, space, leases, fixed costs, and other associated items in a way never before possible. By making this data spatially aware, it allows for contextual visualization and ensures our clients have a lasting ability to ask and receive answers to the very questions that drive major strategic decisions for their organization.

Why are smart cities initiatives important for our clients?

**JV**

SmartCities are those that best engage with their constituency and employ the latest technologies available. Pennoni prides itself on our ability to be at the forefront of these technologies and then to recommend to our clients which ones would best fit their needs.

**MW**

Public and private organizations of all sizes continue to seek ways to deliver high value products and services, while maintaining balanced financial operations. While the objectives vary greatly, all of the above organizations have unprecedented opportunities to modernize and improve operations with the availability of IoT over 4G (soon 5G), the drop-in costs of cloud computing and storage, as well as the ubiquity of mobile devices and smart infrastructure.

Concerns about cybersecurity is rated as the largest obstacle cities face when implementing smart city plans. How are we taking this into consideration when providing smart solutions to our clients?

**MW**

We owe our clients resiliency in all respects. The security of data systems is treated no differently. When we encounter projects that require advanced computerization and control (such as SCADA), we take all necessary precautions and ensure that our third-party vendors understand the associated risks and deliver securely designed solutions that address current and future concerns.
CITIES NEED TO BUILD A CLEAR PATH TO SMART CITY TRANSFORMATION

The Smart Cities Council is a global alliance of smart city experts committed to helping communities use innovative approaches to improve the quality of life for their residents through smart technologies and sustainable practices. Each year, the Smart Cities Council donates coaching, workshops, and more to five communities in North America through the Smart Cities Readiness Challenge grants. As an Associate Partner for the Council, Pennoni is invited to participate in the on-site Readiness Workshops offering case studies from our clients and services to provide communities with the knowledge to become smarter. Jennifer James, Smart Cities Council Global Readiness Program Director, and Kevin Ebi, Smart Cities Council Global Managing Editor to learn more about Smart Cities Council, Smart City initiatives, and the Readiness Program.

Jennifer previously worked at an engineering firm and led their smart city solutions area. She now uses that industry insight to work with Smart Cities Council partners, like Pennoni, to coordinate with cities as they figure out how to apply technologies and best practices to make communities more successful. Kevin manages the editorial team at Smart Cities Council where he and his team collect best practices and success stories from all around the world to share inspiration with cities considering smart city initiative and next steps toward implementation for cities that have already begun the process.

So, what is a Smart City according to Smart Cities Council?

A ‘smart city’ isn’t defined strictly as a city. And “cities” aren’t being advised to apply technology for technology sake. “We believe a smart city is one that uses technology wisely to solve real problems and make a real difference in the community,” Kevin explained. And to do this, a clear idea of what needs to be accomplished based on the specific needs and problems of their community should be established. Jennifer reminded us that while being a smart city isn’t a whole new thing, it is about bringing an additional set of tools and way of thinking to the table that helps communities achieve their goals.

Smart Cities Council offers various resources for cities and communities no matter where they are in their journey, whether that’s at the start developing an action plan or further along in need of some hands-on-help. One tool that is helpful is a type of checklist, the Smart Cities Journey. It helps cities to create an understanding and structure of where to go, planning and then the implementation. There must be feedback loops throughout the process to ensure an adaptive approach. As cities learn what works and doesn’t work for them, they can go back and make adjustments to achieve their goals.

Another resource the Council offers is the Readiness Program, including the Readiness Challenge. The Challenge is a competition that helps cities and communities prepare and advance their smart city journey. As part of the competition, and beyond the competition itself, workshops are held to bring together industry experts with the community stakeholders, people from various departments and entities, to create a common actionable implementation. Often, an obstacle doesn’t exist solely within one department and the various departments don’t always communicate effectively to solve it. Getting people from throughout the city together to begin working on a plan for what they truly want and need to accomplish is a good starting point. According to Kevin, “A lot of the solutions that end up coming out of the workshops, really do involve different people who are looking at problems from different lenses and with different resources backing them to figure out how they could come together and do more than one person could do by themselves.”

At the Readiness workshops, Smart Cities Council Partners provide free expertise in an environment that doesn’t feel as though someone is trying to sell the city something. Since they have been through the process before, the Partners understand what solutions work. As Jennifer told me, “It’s that expertise that is invaluable to cities who are embarking on a smart cities journey or who are at some stage on their journey. Nothing matters until things are implemented, making a difference and achieving benefits for citizens, and that’s what our partners do.”

With the knowledge that each partner has, communities don’t need to reinvent the wheel. Kevin told me he can’t think of a time when the Council has been in a situation where a city has been struggling to solve an issue and a Partner couldn’t help. At the workshops, cities can ask Council Partners or the subject matter experts in the room for advice and there has always been a partner who has some experience they can point to or some project they can adapt. “We are just very proud of the partners that we have and are proud of the work that they have done.”

Funding and financing are both huge hurdles that cities face in their smart city implementation. Having a roadmap for smart city implementation is more likely to attract technology partners and/or funding for projects and programs. But Jennifer
partners and/or funding for projects and programs. But Jennifer cautioned, “It’s not just having access to the money, it’s knowing how to structure a project and how to define it in a way that would attract funders and financiers. We are looking to advance our efforts to help communities better structure projects as well as connect with financing and funding organizations to accelerate implementation of projects.”

Smaller communities often have the same problems as larger cities, just at different scales. However, they don’t always have the same drawing power to attract the interest of technology partners and financing. Banding together with neighboring communities provides a bigger impact by aggregating resources and buying power. Building a smart region is often more practical from a citizen point of view. “We are seeing a lot of focus on smart regions,” Jennifer explained. “Not necessarily at the state level, but the reality is that if city leadership is structured around city limits, that’s not the way people interact. I mean how many city limits do people cross every day in commuting? The reality of working across boundaries and bringing multiple communities together is something that is not just an opportunity from a buying power perspective, but it just makes sense from an actual people perspective.”

For the 2019 challenge, Smart Cities Council is embracing this outlook. And even if a community is not picked as a winner of the Readiness Challenge, they have access to the resources available, including the new Smart Cities Project Activator, which is an online tool to help plan, manage, and finance smart city projects. Also new this year, there is no longer a population limit, giving communities of any size access to the best practices and resources that are going to help them move things forward. And as Kevin reiterated, “While their challenges may be different, the idea of using technology and building relationships to deliver stronger results to the community, that’s the same regardless of what size that community is.”
ESI ThoughtLab is an innovative thought leadership and economic research firm providing fresh ideas and evidence-based analysis to help business and government leaders cope with transformative change.

Benchmarking analysis on 136 cities around the world
The path to a smart city future is often unclear to urban leaders; many are looking for help in developing a roadmap that will drive the best results. To provide support, ESI ThoughtLab teamed up with a coalition of organizations with urban and technology expertise to conduct ground-breaking research into the impact of smart city solutions on urban performance.

ESI ThoughtLab conducted an in-depth benchmarking survey of government leaders in 136 cities around the world to understand their smart city perspectives, practices, and performance results. To gain insight into the views of city stakeholders, 750 business leaders and 2,000 residents were also surveyed in 11 “proxy” cities with varying levels of economic development, social and geographic diversity, and technology use.
Ten smart city pillars were identified that work together to drive benefits to stakeholders. While urban leaders will vary in their approaches based on the issues their cities face, successful cities create roadmaps based on the foundational and tech-enabled pillars. Foundational pillars underpin a successful smart city. Tech-enabled pillars drive value to all urban stakeholders.
The biggest obstacles facing cities implementing smart cities plans

* data from large and very large obstacles

How smart city leaders are investing across the 10 pillars

- Mobility: Beginner 15.5%, Transitioning 14.6%, Leader 14.9%
- Environment: Beginner 13.4%, Transitioning 14.6%, Leader 14.2%
- Governance: Beginner 13.2%, Transitioning 14.0%, Leader 15.9%
- Infrastructure: Beginner 10.1%, Transitioning 8.9%, Leader 15.8%
- Economy: Beginner 7.0%, Transitioning 10.7%, Leader 11.2%
- Public safety: Beginner 7.8%, Transitioning 7.9%, Leader 7.8%
- Health: Beginner 7.5%, Transitioning 7.0%, Leader 8.5%
- Budget: Beginner 6.8%, Transitioning 7.4%, Leader 7.2%
- Payments: Beginner 6.2%, Transitioning 7.2%, Leader 7.2%
- Talent: Beginner 6.8%, Transitioning 5.7%, Leader 5.4%
Transportation DRIVERS

- Sensor Deployment and Data Collection
- Real Time Traffic Management
- Vehicle-to-Vehicle Communications and “Platooning”
- Autonomous Vehicles (AVs)
- Electric Vehicles (EVs)
- Aging Infrastructure (Highways, Roads, Bridges, etc.)
- Pedestrian Mobility

Transportation SOLUTIONS

- Intelligent Transportation Systems
- Nondestructive Testing (NDT)
- Adaptive Traffic Signals
- Rapid Electric Vehicle Charging
- Vehicle Training Facilities
- Bridge Information Modeling (BrIM)
- Vision Zero
As electric vehicles of all types become widely adopted, the world’s vehicle fueling infrastructure is undergoing a radical transformation. Momentum Dynamics, a pioneer in battery electric vehicle (BEV) inductive charging technology based in Malvern, PA is leading the way. Momentum’s technology is designed with the future in mind, and safely transmits electrical energy without the use of wire or cables to electric cars, commercial vehicles, and autonomous vehicles. Automated wireless charging offers an alternative to plugin charging and allows for Opportunity Charging from transmitters embedded in the road. For municipal electric bus fleets, the battery of the bus receives enough energy at a bus stop installation to allow the bus to complete circulation loop, thereby enabling essentially unlimited driving range.

Momentum Dynamics recently installed a 200kw wireless charging system for Chattanooga Area Regional Transportation Authority (CARTA) municipal BEV bus fleet. This follows other installations in Columbia, MD and Wenatchee, WA with planned installations for additional electric bus fleets in partnership with Pennoni.

For more information, read the Philadelphia Inquirer’s profile on Momentum Dynamics.

Channel Partner Highlight: Momentum Dynamics

For smart cities, the future of mobility is multi-modal transportation systems. Our study shows that smart cities are developing a wider array of smart transportation choices to meet the needs of residents from across generations, including:

**RIDE-SHARING** Although currently private-sector, ride-share technology can be adapted for public transport or combined with autonomous vehicles in the future.

**BIKE AND CAR-SHARING** Both reduce the need for car ownership; bike-sharing can speed travel, reduce congestion and pollution, and promote public health.

**SMART TRANSIT SYSTEMS** These can speed transit times, reduce waiting, and ease congestion and pollution by alerting riders to bus and train arrival, and helping transport systems manage fleet deployment.

**SMART TRAFFIC SIGNALS** By adapting to real-time traffic flow, these save time and fuel for drivers, and ease congestion and pollution.

**SMART PARKING** By providing drivers with real-time locations for available parking spaces, this can reduce time spent searching, and as a result, reduce pollution and congestion.

**REAL-TIME TRANSIT MOBILE APPS** These reduce wait times and increase user satisfaction by alerting riders to arrival times for public transit.

Depending on a city’s traffic management maturity level, Smart Traffic Controls can provide varying savings in: CO₂ emissions, fuel costs, gallons of gas, number of hours in traffic, and personal cost of congestion.
US Route 15, in Lewisburg, Union County, PA, is a major arterial road and a critical part of the region’s transportation system, linking the Lewisburg area with Harrisburg to the south and I-80 to the north. Lewisburg is a primary commercial center and has the greatest population density in Union County. Motorists traveling along the corridor experience frequent traffic delays and congestion. Consequently, Lewisburg Borough in collaboration with East Buffalo Township and Pennsylvania Department of Transportation (PennDOT) Engineering District 3-0 retained Pennoni to provide engineering consulting services to address vehicular traffic congestion and pedestrian safety by means of implementing an Adaptive Traffic Signal Control (ATSC) system on three signalized intersections along a portion of US Route 15. ATSC systems are capable of reducing congestion and improving safety without the need for more expensive and disruptive capacity-adding improvements, such as new traffic lanes.
ATSC systems are regarded as the most effective technology for improving signal coordination and vehicular progression. ATSC systems better accommodate varying traffic volumes and changing demand patterns throughout each hour of the day and day of the week (i.e., peak and off-peak hours, weekdays and weekends). Under ATSC operation, the improved traffic flows lead to fewer stops and less disparity in traffic speeds; reduced delays causing less driver frustration and thus safer driving behavior; and reduced queueing which results in less opportunity for rear-end crashes.

Out of five prospective “off-the-shelf” adaptive technologies, the In|Sync system was ultimately chosen by the stakeholders for deployment in the US Route 15 corridor. In|Sync does not depend on a central server to run adaptive operations. In|Sync uses a web-based software application that allows authorized users from Lewisburg Borough, East Buffalo Township, and PennDOT District 3-0, remote access to the system from anywhere at any time. In|Sync employs true dynamic signal phasing and variable period lengths, allowing the system to call up a pair of non-conflicting phases in response to real time demand, thus enabling the signals to use green time more efficiently, getting motorists to their destinations faster. In|Sync can be restricted to conventional phasing only if required by the system owner.

Vehicular detection for the US Route 15 ATSC system was achieved using thermal video detection devices mounted on signal mast arms. Adaptive processors, pedestrian modules, and other related devices required for the adaptive operation were installed in new signal controller cabinets, as requested by the client. The adaptive hardware was installed using the existing signal infrastructure, completely eliminating the need for costly and time-consuming Right-of-Way acquisitions. Supplemental underground conduit lines were constructed where existing lines did not have enough capacity to install the additional wiring associated with the ATSC components, and other miscellaneous signal upgrades installed as part of the project. Traffic signals were interconnected by means of broadband wireless communication antennas installed at each intersection. An Internet modem was installed at the US 15 and PA 45 facilitator intersection, so that the local Internet Service Provider could deliver high-speed Internet service for a fully functional, corridor-wide, Ethernet-based communications network. This network is remotely accessible through PennDOT’s Virtual Private Network.

The In|Sync system deployed in this project replaced a conventional signal system that was not operating consistently as an effective coordinated system. “Before and After” adaptive implementation travel time data were collected along the US Route 15 study corridor. The results indicate that traffic flow during the weekday morning and evening peak hours of the day significantly improved after adaptive operations were implemented. For example, the average morning southbound travel time for the “Before” adaptive scenario was 133 ± 19 seconds, while the average travel time for the “After” adaptive scenario is 78 ± 6 seconds—a significant 41 percent reduction. The average number of stops also noticeably decreased for each peak hour period and travel direction. In all cases, once the adaptive operation was activated, the average number of stops experienced by motorists traversing the corridor were reduced by at least 50 percent of what they were in the “Before” scenario.

Technological advancements are allowing us to provide more efficient automated adaptive traffic control in this congested corridor. By applying ATSC technology, the owner is anticipated to reduce the cost and time involved in traffic signal retiming. Additionally, the system-wide live camera feeds, and robust monitoring and alarm capabilities, are expected to noticeably facilitate operations, management, and maintenance of the US Route 15 signalized system.
Facilities Management

**DRIVERS**
- Client Need to Manage Assets
- Capital Planning and Budgeting
- Data Management
- Stakeholder Approvals
- Life Cycle Considerations
- Cost Segregation
- Resiliency Planning for Disaster Recovery

**SOLUTIONS**
- Data Visualization
  - Asset Management - GIS
  - Intelligent Pavement Management (IPM)
- SITEOPS
- Design Visualization (PennoniFX)
- 3D Laser Scanning
- Drone Application and Aerial Imagery
- Category 5 High Wind Hurricane Design
- Coastal Resilience

RoadBotics is a pavement management system that identifies potential problems on the road using Artificial Intelligence. Roadway data is collected by using a standard smartphone — with RoadBotics' proprietary data collection app — placed on the windshield of any vehicle. This data is uploaded into RoadBotics' AI platform where it is analyzed against a worldwide database of pavement distresses. Each road is then rated based on the condition of the road surface. This objective rating helps prioritize road maintenance needs. RoadBotics works with several cities including Savannah, GA, and Detroit, MI, and counties like Bryan County, GA. Pennoni has partnered with RoadBotics to provide an affordable and objective solution to our municipal clients, enabling them to analyze roads within their townships and objectively prioritize road maintenance needs, with the ability to provide an explanation on those decisions to the public as necessary. We also can take this data and import it into a GIS map where we can advise owners on which roads or parking facilities should be prioritized over others, and which roads will deteriorate more quickly. This can be done by introducing daily traffic counts, truck versus car traffic, poor subsurface drainage, etc. on any given road into the GIS.
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Cities reported their stage of development in the use of data and data analytics in the following areas:

<table>
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<th>Advanced</th>
<th>Maturing</th>
<th>Implementing</th>
<th>Planning</th>
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In the next three years, cities plan to use the following digital technologies to support their operations.

**Cloud-Based Technology**
We are seeing increasing opportunities to service clients with high quality data visualization tools that leverage the scalability and ubiquity of cloud platforms.

**Mobile Apps**
Field work has been transformed by mobile apps. Everything from data collection to report preparation is possible through the instantaneous collection of photos, data, and other information.

**City-Wide Data Platform**
Integration of a city’s data platforms take the value of any single system and multiply it.

**IoT/Sensors/Wearables**
Internet of Things (IoT) and the free availability of highspeed wireless internet via 4G and 5G make wearables, and a variety of remote sensing technology solve old problems with entirely new systems and approaches.

**Geospatial Technology**
Maps are becoming the default browsing context for asset management systems.

**Artificial Intelligence/Machine Learning**
In platforms like Roadbotics, the power of machine learning allows us to rank and prioritize the quality of road conditions by simply collecting data via video.

**Augmented and Virtual Reality**
Our 3D designs can be brought to life by rendering them in gaming engines and creating truly immersive experiences that allow our clients and the public to visually ‘experience’ the impact of designs on their communities.

**Drones and Robots**
Automation in the field of data collection and documentation has changed the way we survey and establish existing conditions.
PROBLEM

In 2017, Delaware Department of Transportation (DelDOT)’s Secretary Jennifer Cohan committed to the Federal ADA requirement by issuing DelDOT’s ADA Transition Plan, “As Secretary of the Department of Transportation, I make this personal vow to the citizens of Delaware... our success at making our transportation system fully accessible depends on the coordinated efforts of all levels of government, the public, and the policies and strategies outlined in the Plan.”

DelDOT required an organized way to ensure their curb ramps and public facilities were compliant with
the Americans with Disabilities Act (ADA). In addition to this, DelDOT needed a system to determine the repair priority order as a part of DelDOT’s Pedestrian Access Routes Program (PAR). The PAR program facilitates the creation of new accessible pedestrian paths or converts existing non-compliant pedestrian paths to acceptable standards.

To increase their efficiency in identifying non-compliant infrastructure, DelDOT reached out to Pennoni to see how we might be able increase efficiency and automate their methodologies. Prior to this, DelDOT had been utilizing no direct selection system for the PAR Program and printed excel sheets for field data collection methods that were subject to the weather and other limiting factors.

**SOLUTION**

Pennoni’s Technology Solutions team developed an application, the PAR Prioritization Tool, to be used in conjunction with our custom GIS based field data collection application. Prioritized curb ramps and other supplemental datasets can be viewed with our tailored prioritization score to see what curb features should be prioritized first for full ADA compliance. This application has the most up to date information as possible and can store reports, status updates, and documents (design, approvals, etc.) for each curb feature allowing for specific details to monitor and track progress.

Our Technology Solutions experts developed a formula to determine what areas should be prioritized in the project pipeline process by analyzing demographics, transit, ADA and walkability scores. Once calculated, this prioritization score was utilized to refine features for a prioritized rehabilitation strategy and helped narrow down thousands of curb ramps to several identified by work zones and county delineations. As an ESRI Silver Partner, Pennoni leveraged ESRI’s ArcGIS Online platform. The application also contains other decision-making datasets such as ongoing Capital Transportation Projects and to help select features outside of current work limits.

**RESULTS**

The application is currently being used for curb ramp and barrier inspection and work tracking. DelDOT staff work closely with Pennoni to design and implement changes at a faster rate. Data can be tracked with the application and utilized for reporting and display via DelDOT dashboard website. Working directly within the application, DelDOT can make decisions based on the insights offered through our analysis.

The insights offered could be used within an asset management tracking system. The goal is to ultimately update the DelDOT ADA database (for their asset management purposes) to show our changes and assist with their future planning. Pennoni is also implementing a new application for the DelDOT Planning Section to help determine which sidewalks (and missing links) should be prioritized as well.
Energy DRIVERS

- Renewable Requirements (Public and Private)
- Cost Uncertainty
- Natural Gas Availability
- Governmental Regulations
- Sustainability Initiatives
- Resiliency
- Energy Efficiency and Savings
- Aging Infrastructure
- Portfolio Management
- Life Cycle Costs
- Rebates and Incentives (Grants)

Energy SOLUTIONS

- Pennoni OPTICS (Operation Procurement Tracking Intelligence Control System)
- Utilities Watch (UW) – Facilities Continuous Commissioning
- Waste-to-Energy
  - Biogas
  - Syngas
- Distributed Generation (CHP and Solar)
- Microgrids
- Conditions Assessment
- Utilities Mapping
- Turnkey Design-Build and Financing
- PACE Financing
According to the survey of government officials in 136 cities, energy and the environment are ranked as the number one challenge out of the 17 issues cities are addressing or planning to address through smart city initiatives.

Energy and the environment are high priorities for all cities, regardless of their maturity level. However, climate change becomes a bigger challenge as cities mature and work through more basic environmental and energy management issues.

Integrated volt control capabilities from smart utility grids is an important tool to optimize voltage that can help utilities more efficiently manage voltage on their distribution lines, allowing utilities to reduce the total energy used by citizens without any sacrifice in service or quality.

Depending on a city’s electricity maturity level, Integrated Volt Control can provide reduction in: CO₂ Emissions, Electricity Use, Integrated Volt/Var Control peak demand.
PROBLEM

MRP Realty’s property, Constitution Place, is in Philadelphia’s Center City business district and has 187,000+ square feet of rentable space, 600 tons of chilling capacity, individual floor air handling units (AHUs), a central cooling tower, and 200 horsepower of boiler capacity. The building is conditioned by two chillers and two steam boilers located in the central plant. Each floor has a constant volume air handler which provides conditioning to the inner core of the building. After making significant lighting and HVAC updates, MRP Realty was looking for a way to continue to drive energy savings, enable their facilities team to efficiently identify any issues with the mechanical equipment, and adjust building controls to optimize energy efficiency and improve tenant comfort.

SOLUTION

Pennoni’s Energy division offered Utilities Watch as the answer to MRP Realty’s needs. The Building Automation System (BAS) was integrated with Utilities Watch (UW) Continuous Commissioning software platform, allowing the trending of more than 300 HVAC equipment points. In addition to the BAS points, the UW solution compiles data from additional disparate sources and locations: meters, mechanical equipment, third party applications, local weather stations, load profiles, occupancy schedules, etc. From there, our energy analysts wrote algorithms within the platform that automatically identify specific energy conservation measures (ECMs) and load management strategies that decrease energy use and cost. By analyzing comprehensive building data, our team automatically identifies ECMs at both a system level and within individual assets. Sophisticated fault detection algorithms identify when an asset is operating outside of expected, optimal efficiency specifications. Issues that typically go unnoticed for weeks or months, costing the facility money, are now diagnosed and resolved almost immediately.

While gathering equipment nameplate data and sequence of operations of the building, Pennoni’s energy analysts worked alongside the building engineers to achieve substantial energy savings within the first month of implementation. ECMs implemented include: boiler set point adjustments, site zone temperature and supply air temperature set point adjustments, diagnosed sensor failures causing cooling tower fans to run unnecessarily, as well as modifying the occupancy schedules for all AHUs and main plant equipment. Utilities Watch continues to collaborate with the building engineers to identify new opportunities for savings, faulty equipment, and potential equipment failures. Our technology in conjunction with the expertise of our energy analysts/engineers gives unparalleled insight into portfolios, buildings, systems and assets.

RESULTS

During the first 10 months of deployment - MRP Reality realized more than $37,000 in electricity cost savings, an energy usage reduction of 16% compared to the previous year normalized by weather, and an increase of seven points on their Energy Star rating. With significantly less hot and cold temperature calls from tenants, Utilities Watch has empowered the building engineers to more effectively operate their building. The facilities team receives customized alerts and recommended resolutions on potential equipment issues, allowing the team to be more proactive. The alerts can be delivered through daily/weekly emails or via a report of top sources of energy waste on a real time basis, all dependent on what MRP Realty needs at that time.
PROBLEM

MRP Realty’s property, Constitution Place, is in Philadelphia’s Center City business district and has 187,000+ square feet of rentable space, 600 tons of chilling capacity, individual floor air handling units (AHUs), a central cooling tower, and 200 horsepower of boiler capacity. The building is conditioned by two chillers and two steam boilers located in the central plant. Each floor has a constant volume air handler which provides conditioning to the inner core of the building. After making significant lighting and HVAC updates, MRP Realty was looking for a way to continue to drive energy savings, enable their facilities team to efficiently identify any issues with the mechanical equipment, and adjust building controls to optimize energy efficiency and improve tenant comfort.

SOLUTION

Pennoni’s Energy division offered Utilities Watch as the answer to MRP Realty’s needs. The Building Automation System (BAS) was integrated with Utilities Watch (UW) Continuous Commissioning software platform, allowing the trending of more than 300 HVAC equipment points. In addition to the BAS points, the UW solution compiles data from additional disparate sources and locations: meters, mechanical equipment, third party applications, local weather stations, load profiles, occupancy schedules, etc. From there, our energy analysts wrote algorithms within the platform that automatically identify specific energy conservation measures (ECMs) and load management strategies that decrease energy use and cost. By analyzing comprehensive building data, our team automatically identifies ECMs at both a system level and within individual assets. Sophisticated fault detection algorithms identify when an asset is operating outside of expected, optimal efficiency specifications. Issues that typically go unnoticed for weeks or months, costing the facility money, are now diagnosed and resolved almost immediately.

While gathering equipment nameplate data and sequence of operations of the building, Pennoni’s energy analysts worked alongside the building engineers to achieve substantial energy savings within the first month of implementation. ECMs implemented include: boiler set point adjustments, site zone temperature and supply air temperature set point adjustments, diagnosed sensor failures causing cooling tower fans to run unnecessarily, as well as modifying the occupancy schedules for all AHUs and main plant equipment. Utilities Watch continues to collaborate with the building engineers to identify new opportunities for savings, faulty equipment, and potential equipment failures. Our technology in conjunction with the expertise of our energy analysts/engineers gives unparalleled insight into portfolios, buildings, systems and assets.

RESULTS

During the first 10 months of deployment - MRP Reality realized more than $37,000 in electricity cost savings, an energy usage reduction of 16% compared to the previous year normalized by weather, and an increase of seven points on their Energy Star rating. With significantly less hot and cold temperature calls from tenants, Utilities Watch has empowered the building engineers to more effectively operate their building. The facilities team receives customized alerts and recommended resolutions on potential equipment issues, allowing the team to be more proactive. The alerts can be delivered through daily/weekly emails or via a report of top sources of energy waste on a real time basis, all dependent on what MRP Realty needs at that time.

Monthly baseline versus post implementation usage. Utilities Watch will provide continuation of this trend.
Water/Wastewater/Solid Waste

DRIVERS

• Increased Governmental Regulations
• Waste-to-Energy Solutions
• Sensor Technology for Data Collection and Analysis
• Aging Infrastructure
• Resiliency Planning
• Water Supply (Quantity and Quality)

SOLUTIONS

• SCADA Systems
• Wastewater Reclamation for Cooling, Heating, and Re-use (Graywater)
• Smart Meter Deployment
• Sustainability
• Wast-to-Energy
• Advanced Treatment Technologies
• Innovative Financing Options
• Education and Training
• Advanced Stormwater and Green Street Solutions
• Conditions Assessment
• Utilities Mapping
Water is not a limitless resource, and most specifically, neither is clean, drinkable water. Sustainable Water is committed to changing the landscape of water resource management through reclamation of on-site wastewater for non-potable reuse by providing clients impactful water management solutions that minimize risk and enhance environmental stewardship. Using a unique development approach called a Water Processing Agreement, Sustainable Water provides the opportunity for clients to maximize financial savings while dramatically reducing drinkable water consumption as well as wastewater disposal. By extending the lifecycle of water, generations to come will benefit greatly from these innovative solutions to enhance an aged infrastructure.

Pennoni is working in partnership with Sustainable Water to identify new clients for on-site reuse as well as provide the complete design-build services that Sustainable Water needs to build successful water reuse projects. Our water/wastewater team has the engineering and technical expertise to deliver our innovative smart solutions while minimizing design and construction costs and reliably meeting the project budget.

For more information, read about the WaterHub developed in partnership with Emory.
Educational Testing Services
Wastewater Treatment Plant Upgrade

PROBLEM

Educational Testing Services (ETS), is an independent, nonprofit organization devoted to educational research and assessment. Their Corporate Headquarters and Conference Center is in Princeton, NJ and is home to approximately 2,800 people, which increases to 3,500 people over the summer. The facility is not served by a public sewer and maintains a Wastewater Treatment Plant (WWTP) to treat the sanitary wastewater onsite. The WWTP Upgrade project was initiated in response to a nitrate limit being added to the plant’s New Jersey Department of Environmental Protection (NJDEP) effluent permit. The effluent permit also called for the plant upgrades to be complete within three years. Additionally, the existing plant was not able to treat at its rated capacity of 80,000 gallons per day (GPD), which hindered expansion, and most the WWTP equipment had reached the end of their useful life.

Over the years, plant modifications had been completed to increase capacity and improve effluent quality, but these modifications had made an already restrictive site tighter. The electrical distribution system had also been added to over the years, however it was fragmented, so feeding electrical power to new system components would be difficult. The steepness of the site and its restrictive nature limited the area to potential construction activities.

SOLUTION

Two design alternatives were considered for the upgrade process: a “conventional” treatment process and a membrane bioreactor (MBR). The MBR uses ultrafiltration membranes to separate biological solids from the discharge effluent. The advantages to MBRs are that very low discharge concentrations can be achieved and the process tanks can have less volume. Operationally, the ultrafiltration membranes provide a barrier between the biological treatment and the discharge effluent, which aids in the management of the WWTP.

ETS selected the MBR for several reasons. The installed cost for the two system alternatives were comparable, but the “conventional” system would have required the installation of two new cast-in-place concrete process tanks. The conventional system would have expanded the system footprint and required a new enclosure constructed on site. The MBR plant would also ensure there would be less disruption to the WWTP during construction.
To expedite the project, ETS pre-purchased the MBR system, which included the membranes, membrane tank, MBR equipment enclosure, and system controls. Pennoni provided the engineering services from initial planning through detailed design and construction oversight and field inspection. For the pre-purchase of equipment, our team was tasked with working out the final equipment scope with the MBR vendor and then incorporating changes into the design to accommodate the final MBR plant design.

**RESULTS**

The MBR system allowed for the upgrade of an aging treatment plant to its full capacity within a tight restrictive project site and with an added environmental benefit. The same technology had the additional advantage of producing a better-quality effluent discharge, compared to a conventional approach. Being able to treat at the plant’s rated capacity at the new discharge limits will allow for ETS to significantly expand their operations and work force in the years to come.
Vision Zero is a strategy to eliminate traffic fatalities and severe injuries among all road users, and to ensure safe, healthy, equitable mobility for all. Each year in the U.S., almost 40,000 people — an average of 100 people per day — are needlessly killed, and many more are injured, in traffic crashes. While often referred to as “accidents,” the reality is that we can prevent these tragedies by taking a proactive, preventative approach that prioritizes traffic safety as a public health issue.

By acknowledging that people will sometimes make mistakes, and by bringing together multiple stakeholders, Vision Zero provides a different approach to traffic safety. More than 35 cities in the United States have committed to Vision Zero. One of the main components of Vision Zero is to reduce vehicular speeding, as speed results in a higher percentage of injuries and deaths. However, just as important is the increased safety of pedestrians and bicyclists, as they are more likely to be seriously injured in a crash.

Over the next three years, the Smarter Cities 2025 report found that cities in the United States expect walking and bike share to each increase in use by almost 30%. When streets are designed to promote pedestrian and bicyclist safety, more people will turn to walking and biking.

Making Our Streets Safer

WHAT IS VISION ZERO?

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Traffic Safety Improvements for Bridges over I-676

As part of the larger Bridge Replacement project over I-676 in Philadelphia, PA, Pennoni redesigned the complex intersection of 20th Street with Vine Street, Winter Street, and the Ben Franklin Parkway to improve pedestrian safety along the crossing from the Franklin Institute to the Free Library. The 10-lane arterial that serves a high volume of pedestrian traffic was the location of two pedestrian accident clusters. Pennoni’s revised design significantly reduced crossing times through the realignment of Winter Street, the addition of mid-block crosswalks at high-volume crossing locations, the installation of median refuge islands on the Parkway, and curb bump-outs. These improvements were incorporated without reducing service levels for vehicles at the intersection.
As the appointed traffic engineer in Lansdale, PA, we have designed and implemented numerous traffic and pedestrian improvements. One of the most impactful projects involved establishing an alternate route between West Main and South Board streets. These two roads, along with SEPTA’s regional rail corridor, are part of a triad of vehicular and rail corridors that PennDOT has identified as one of the most complex interactions of train and vehicular traffic in the northeastern United States. By allowing drivers to bypass the Broad/Main Street intersection and the SEPTA rail crossings, the newly established, stop-sign-free route involving reconfigured Vine and Wood streets has provided an alternate course for northbound and eastbound traffic. The new connector enhanced vehicular capacity, improved traffic circulation and enhanced pedestrian safety at the Main Street/Broad Street intersection, through roadway and sidewalk lighting, decorative crosswalks, a new sidewalk with Americans with Disabilities Act-compliant curb ramps, and a flashing beacon for crossing Main Street.

Evidence shows that narrowing the roadway leads to drivers traveling at lower speeds, which reduces the crash frequency and severity. Pedestrians and bicyclists also benefit from the reduced speeds, as well as improved sight distance and shorter roadway crossings.