APWA Nomination Questions

City of Tacoma Biogas Wastewater Plant | TACOMA, WASHINGTON

Please see below for the direct responses to be address via the nomination for consideration of the American Public Works Association (APWA) Project of The Year, Washington State Chapter. Following the question responses is a project profile outlining the specifics of the project in more detail.

1. Use of good construction management techniques and completion of the project on schedule.

This project included implementation of highly complex technologies, coordination with local utility authorities, and ensuring plant operation during construction was one of the first implementations of this type of organic to energy technology in the nation, all completed during a global pandemic.

Major highlights of construction management techniques to meet project schedule included:

- Critical for plant to maintain full operations while in construction as the only wastewater resource in the community, coordination with project team allowed for no disruptions and realistic schedule expectations.
- Utilization of Performance Contracting allowed the team to be able to order equipment ahead of completion of design, locked in pricing, established vendor as a partner, and got order into vendor's queue ahead of other projects (ultimately saving the project time and money).
- When faced with increasing and uncertain lead times, the project team assessed alternative materials and methods (with approval from design engineers) to stay on track.
- Leverage of industry partnerships to navigate procurement and staffing challenges in the face of unexpected market conditions.
- Thorough development of the project and collaboration with impacted local utilities ensured that prior to mobilization, all parties were aligned, and project implementation could proceed without interruptions.
- Coordinate with another major project occurring simultaneously at the plant.

2. Safety performance and demonstrated awareness of the need for a good overall safety program for workers and the public during and after construction, where applicable.

With full operations of the plant maintained, the safety of operations staff and project personnel was critical for all parties involved. Constant onsite supervision and coordination with the City Safety team was provided which allowed for any breaches in safety to be readily identified and corrected, specific examples of the major safety precautions implemented are as follows:

- The civil contractor was not correctly shoring their trenching efforts, work was immediately stopped, and the situation corrected before trenching could continue.
- Utility pressure testing was being performed in an unsafe manner, this was identified and stopped. An updated plan was created to ensure plant, public and contractor safety.
- For the work that was performed in the plant's digester, the access via a ladder would originally have qualified as a confined space. By upgrading to scaffolding in place of a ladder, this allowed for safer

access, downgraded from confined space requirements, and created a more effective means for emergency exit or retrieval in case of emergency.

- Due to the large number of vehicles and pieces of equipment accessing the site, spill kits were kept readily available in case of fluid leaks.
- When demolition was underway in the blower-room, an unknown organic material began to off-gas and produce smoke when introduced to atmosphere. Immediate work stoppage and safety assessment was performed by the contractor as well as the city. A new method-of-procedure was developed before work could continue, and all staff were cleared.
- The gas treatment system required media to be loaded into the large vessels, which was done via a crane and forklift. This was a safety challenge but was addressed with prior planning and submission of crane pick plans to ensure all team members were aligned.
- As the plant was fully operational for the duration of construction, strong coordination of lock-out-tag-out (LOTO) and method-of-procedures (MOPs) allowed for safe gas inertion and electrical work. This also meant that construction personnel needed to be vigilant while onsite and wear the required personal protective equipment to be visible for the many moving vehicles and plant staff.
- Prompt communication and implementation of safety measures ensured safety for both the public and personnel onsite throughout the Covid-19 pandemic. In addition to local requirements, McKinstry and the Plant maintained strict guidelines to minimize safety risks, including facial masks, onsite orientation and training, site access logs for exposure tracing, and social distancing of onsite personnel.

3. Community relations as evidenced by efforts to minimize public inconvenience due to construction, safety precautions to protect public lives and property, provision of observation areas, guided tours, or other means of improving relations between agency and the public.

As a novel implementation of new technology, inclusion of the community and ensuring their safety was a priority for the project team. This was accomplished by the following:

- The project was planned and coordinated in a way to allow for plant operations to continue without interruption, ensuring the wastewater resources remained available to the surrounding community.
- Precautions were implemented to ensure any visiting contractors and local staff were safe while supporting and observing the project progress. This included provision of constant onsite supervision, work stoppages to correct for safety concerns, and a high level of coordination between all parties.
- The contractor made sure to work with the City of Tacoma to utilize the Local Employment and Apprenticeship Training Program (LEAP) as well as Women and Minority Owned Businesses (WMBE). The LEAP program was adopted to provide employment opportunities for the City of Tacoma residents, including apprentices and veterans.
- At the completion of the project, the plant hosted an open house and provided tours to educate community members and surrounding peers on the project technologies & success.
- This project serves as a blueprint for other wastewater projects around the nation, showcasing this project's success and continuing to offer the project as a resource for future work has continued to foster the trend of innovation.

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4. Demonstrated awareness for the need to protect the environment during the project. This includes any special considerations given to particular environmental concerns raised during the course of the project, as well as climate change and/or resiliency components for long-term community benefit.

The catalyst for this project was based on the City of Tacoma's project goals: 1. Reduce greenhouse gas emissions, 2. Efficiently use plant and community resources, and 3. Generate revenue. This project was unique in the sense that it was able to accomplish all three of these goals. By harvesting bio-gas (methane) from the digestion process that was typically flared (burned as a waste –product) and converting it to renewable vehicle fuel; the plant reduced greenhouse gas emissions, recovered valuable energy, and created a revenue source. During the normal operation Tacoma RNG produces the equivalent of approximately 35,000 gallons of diesel fuel. This project exemplifies the philosophy of *Circular Economy* by realizing value in a waste and transforming it into a valuable product. Specific project measures also included:

- Ensure that all contractors and personnel who set foot onsite received training and understood the "Environmental & sustainability Management System" (ESMS), on top of the standard Washington State and McKinstry construction requirements. The intent of this program is to protect the environment and prevent water pollution through continual evaluation of processes and education.
- The project team was sensitive and proactive to any spills or vehicle leaks onsite. The few times a vehicle leaking oil was identified, the spill kits kept readily onsite were deployed to ensure no impacts to the surface water sources.
- Regarding resiliency, the scope for the operation of the boilers was considered and the decision was made to enable them to run on multiple fuel sources (Natural Gas, Digester Gas, or Blended Gas). This added resiliency to plant operations and efficient use of resources.
- Looking ahead, the community can already expect to see the benefits of the payback from Tacoma RNG as a revenue source, as well as have peace of mind that the project reduces greenhouse gas emissions, increases resilience by diversifying energy production.
- Reduced total greenhouse gas emissions by 919 tons per year by creating a renewable fuel that offsets the use of carbon intensive diesel fuel for heavy vehicles.

5. Unusual accomplishments under adverse conditions including, but not limited to, age or condition of the facility, adverse weather, soil or other site conditions over which there is no control.

As a first of its kind adoption of this technology in the region the project faced a number of inherent hurdles, this was overlain by the challenges of the global pandemic and related supply chain issues, this project team also faced its own unique set of challenges. The following measures were implemented to address these challenges:

- The timing of the project allowed for replacement of system when it had reached its end of useful life. This ensures that the investment of the plant into its resources occurred at the optimal time for maximum benefit of new equipment. The age of the facility led to addition of scope to ensure existing infrastructure could support the new system, and guarantee efficiency of process.
- Communication and consensus were difficult due to reach with all stakeholders as everyone had to learn how to work in a new virtual environment. The team overcame this with rapid adoption of virtual

meeting capability to allow regular communications and group meetings to continue robust information exchange and collaboration.

- The plant recognized that they hold themselves and their contractors to a high level of performance. At the completion of the project, it was noted that the team was able to perform to meet and exceed these standards.
- As previously mentioned, a major unforeseen condition was the global Covid-19 pandemic. This impacted equipment lead-time and pricing, resources for staffing and manpower, as well as personnel morale and concerns for safety. Through proactive and thoughtful approach, these concerns were mitigated resulting in successful project delivery.
- Because of the project's novelty there were not model agreements that could be used in Washington State regarding the transport of gas. This required effective collaboration and creativity between the gas utility PSE and the City to develop agreements that ensured public safety and efficient transport of the gas to end users. These agreements can now serve as a basis for other wastewater treatment plants entering into this arena.

6. Additional conditions deemed of importance to the public works agency, such as exceptional efforts to maintain quality control and, if value engineering is used, construction innovations as evidenced by time and/or money saving techniques developed and/or successfully utilized.

Quality control was a critical consideration for the project given the highly technical nature of the equipment. Considerations were made through both the development and execution of the project to maintain quality, and some examples of these measures include:

- Coordination of working sessions with design engineers, vendors, contractors and the plant staff to align the new system with plant operations. These discussions encouraged a strong working relationship, and the long-term satisfaction with the end deliverable that was amenable to all parties.
- The team planned to improve digester mixing to maximize gas production (resulting in the most profitable project outcomes). The original equipment was found to be insufficient (linear motion mixing), and the team was able to pivot to a more effective method (pumped mixing) while also negotiating a fair return of the equipment previously purchased.
- Performed thorough review of change order requests with contractor and project management teams to ensure fairness and agreement prior to proceeding. The team held weekly meetings to review contingency plans and risks to the project with mindful approach to use of project funds.
- Because of the complexity and critical need for efficient operation of the system a "Transition to Sustainable Operations" (TSO) was executed to maximize training and ensure that safe, standard operating procedures were fully developed, communicated, and understood by maintenance and operations staff. The TSO sets the project up for long term success.

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7. Use of Alternative materials, practices or funding that demonstrates a commitment to sustainability, climate change/resiliency, and/or use of sustainable infrastructure rating system or the equivalent.

The entire structure of this project, from funding and payback to the technology itself, is revolutionary to the industry and an encouraging look at the future for renewable energy. Fundamentally, the project is about the use of alternative materials to mitigate climate change and enhance Tacoma's sustainability by repurposing a GHG emitting waste product to become a low carbon renewable fuel. Major items to note are:

- Utilization of the Renewable Identification Number (RIN) / Renewable Natural Gas (RNG) market to fund the project creatively and effectively.
    - Tacoma RNG is able to produce RNG using the digester biogas (methane) that is a natural and unavoidable waste product of anaerobic waste treatment.
    - RINs are an environmental attribute that are carefully monitored by EPA to ensure that they are produced in a way that reduces GHG emissions. When RNG that is certified by EPA is sold as a vehicle fuel, RINs are generated which can be sold to as a commodity to generate additional revenue.
    - The plant is able to receive the RNG commodity value, as well as the RIN value.
    - Going forward, the project will have paid for itself (a benefit of using performance contracting) and continue to be a revenue resource for the plant.

Project Overview

City of Tacoma Biogas Wastewater Plant | TACOMA, WASHINGTON

DELIVERY METHOD
Design/Build Energy Performance

PROJECT SIZE
1 Building

CONTRACT VALUE
Total: $15M
Biogas Plant: $6.2M

FUNDING SOURCES
State Grant: $500K
Tax Credit: $750K
Utility Rebate: $50K
WA LOCAL Loan: $12.7M

OWNER FINANCING TERMS
Financed of 15-year loan $400K+ YOY Positive Cash Flow

PROJECT DATES
Audit/Design: 2015-2017
Construction: 02/2020-05/2022

SERVICES PROVIDED
- Project development
- Funding development
- Estimating support
- Commissioning
- Measurement and verification

PROJECT OVERVIEW
The City of Tacoma Central Wastewater Treatment Plant serves roughly 20,000 residents in Tacoma, Fife, Fircrest and unincorporated Pierce County and treats about 15 million gallons of wastewater per day. The plant produces approximately 300 SCFM of biogas which must be consumed onsite or flared. While this practice is common among the water treatment community, the City saw an opportunity to reduce greenhouse gas emissions, conserve energy, and recover value from a waste product (resource) from the wastewater treatment process by creating renewable natural gas (RNG) from traditionally unusable organic waste (methane). The City of Tacoma worked with the McKinstry team and PSE to develop multiple implementation scenarios which would drastically reduce flaring while offsetting other energy use.

The project team worked together to assess, plan, and implement energy efficiency measures within the facility. The plant needed digester mixing components replaced, upgraded site lighting— and most importantly, a new, industry-leading treatment facility to harvest biogas for renewable natural gas (RNG) vehicle fuel.

Because wastewater facilities are typically the largest energy consumers in a municipality's portfolio, City officials have trended towards decommissioning cogeneration equipment in favor of cleaner and more sustainable energy sources. However, by combining the City's vision with McKinstry's deep sustainability expertise, we developed a process for harvesting waste methane created through the existing wastewater treatment process and turned it into a usable commodity (RNG). The resulting biofuel can be used directly for municipal vehicles or injected directly into the pipeline to generate revenue.

Tacoma, McKinstry, and PSE formed a collaborative team that helped the City succeed and achieve the project's goals to reduce greenhouse gas emissions, use plant resources more efficiently, and create a long-term revenue stream.

Project Overview

SYSTEMS INSTALLED

- Boiler burner upgrades
- Plant facility HVAC
  - Sludge Heat Recovery
- LED lighting upgrades
- Digester mixer upgrades
  - Linear Motion Mixer
- Biogas treatment plant
  - BioCNG Pipeline Injection Compression System
  - Hydrogen Sulfide Removal System
  - Gas Compression/ Moisture/CO2 Removal System
  - Siloxane/VOC Removal System
  - Glycol Chiller

PROCESS & SCOPE

The project team came to the table with an understanding of the City's goals and aspirations, and from there we worked together to find feasible, budget-conscious ways to enable favorable outcomes for the City to connect the right people to the project, and ultimately deliver a quality end result for the City of Tacoma. Outside of the general project scope, the City relied heavily on McKinstry to support negotiations in addition to the development of project funding solutions.

Capital Improvements

During the wastewater treatment process, influent wastewater is treated by separating solids from liquids in various stages and disposing of the organic products and the inorganic products properly. After the solids are removed from the liquids, they are heated and assimilated (or decomposed) into a useful organic composition in the plant's anaerobic digesters.

The design team analyzed the use of biogas with the best lifecycle net present value, including re-evaluation of onsite boiler use. The plant's digester mixing components were nearing 30 years of age and were in need of replacement. Due to mixer equipment age, the City needed to upgrade them in order to increase efficiency. This provided an opportunity for the City to gain additional efficiency by installing new digester mixers, via pumps. In the end, the plant creates additional biogas which can be used in the treatment equipment to offset more fuel.

Each of these energy conservation measures are interconnected and collectively function to convert waste to actualized energy and operational savings. To drive additional savings, the project also identified cost-effective lighting improvements at the site.

Renewable Natural Gas (RNG) Project

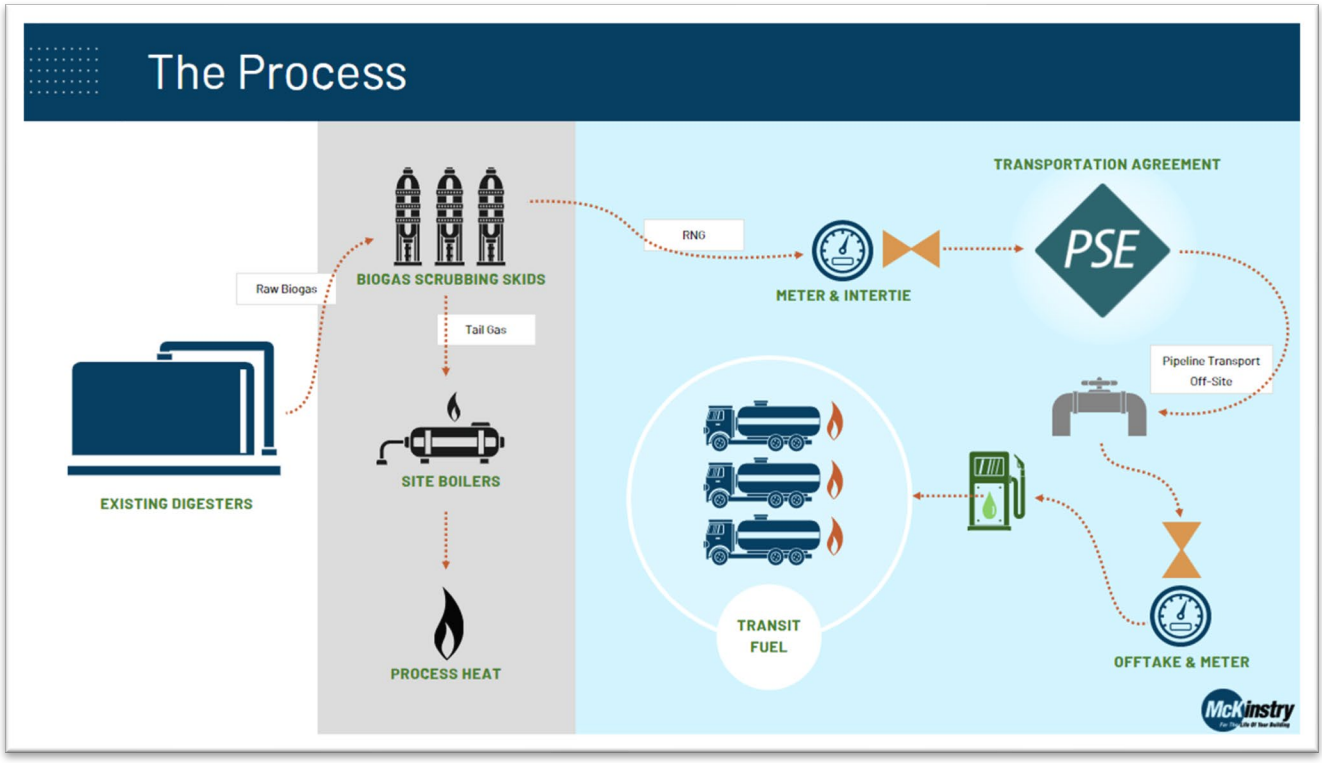
A critical goal of this project was to find ways to produce renewable natural gas from waste methane in order to reduce emissions while gaining a revenue stream.

RNG can be used for vehicle fuel as compressed natural gas (CNG) which carries high marketplace value.

As the existing Gas Utilization Facility (GUF), neared the end of its useful life, the team saw an opportunity to retrofit this facility in conjunction with other capital improvements. The installation of the new Unison BioCNG equipment will include the capability to treat up to 300 SCFM of digester gas.

The success of this project means the City can reject the traditional and harmful practice of flaring methane on-site. They can now capture this methane and use a BioCNG scrubbing system to remove any organic compounds. This creates a purified renewable natural gas (RNG) that can be directly injected into the utility pipeline offsite, decreasing the community's dependency on fossil fuels.

Project Overview



RIN Credit Program

Because the department foresaw budget gaps in the coming years, they enlisted the development team to help find a financial solution which would offset capital improvement costs through biogas revenue and operational savings. McKinstry identified a federal program, Renewable Identification Number (RIN) credits, as a way to increase revenue. RIN credits will provide a monetary return to the City in exchange for biofuel. The City will profit by creating a renewable resource, and in turn generating additional revenue.

Project Overview

While the City may create a fueling station onsite in the future, they are currently piping the RNG into the utility pipeline allowing fuel to be pumped at existing CNG fueling stations. In order to do this, the City sells renewable natural gas and associated RIN credits to a third-party broker which then sells the transportation fuel on their behalf for the RNG commodity value. **Due in part to the thorough development investigations, the City fully-funded the capital improvements using RNG revenue and will be cash-flow positive within the first year of operations.**

Challenges and Complex Negotiations

For the RIN credit program to work, the City had to install and operate equipment to process biogas and meet pipeline quality standards. Setting standards with the local utility, Puget Sound Energy to distribute biofuel regionally required a rigorous and complex set of deals between the City and dozens of external stakeholders.

EXPERTISE NAVIGATING COMPLEX STAKEHOLDER AGREEMENTS

Perhaps the most challenging aspect was achieving quality standards that were workable able and protective of PSE's pipeline and customers. The agreement outlined biogas quality standards to be achieved prior to injection into the pipeline and **encompasses the strictest gas quality receipt standards in the United States.**

Due to the highly complex deals and funding mechanisms, the City needed a single point of accountability they could trust. McKinstry had the expertise and resources required to create a knowledgeable team of engineers and builders, to foster collaboration and efficiency, and manage internal and external stakeholder agreements.

This project created replicable standards for each additional project complexity listed below:

Guaranteeing Revenue in a Volatile Marketplace

The success of this project relied on several major components which often fluctuate: RIN credit trading value, market price for RNG and dependability of the supply chain in the domestic gas sector. Due to these factors, quantifying and guaranteeing the energy and cost benefits of this project was difficult. However, the team's subject matter expertise & attention to detail ensured we provided credible financial predictions to which the City could confidently budget from.

Because the revenue from RNG is highly dependent on what the RIN value is traded at, there is no absolute certainty on the City's revenue. However, they can expect to generate roughly $1.4M in net revenue.

The renewable natural gas project not only paid for itself entirely, but it also drove enough savings to pay for the other major capital improvements at the plant necessary to keep operations running such as the digester mixing upgrades and HVAC systems without any upfront costs.

PROJECT IMPACT

Using a triple bottom line approach, this project was fiscally, environmentally, and socially beneficial to the City and the broader community. The utility agreements allow the City and community to use clean fuel locally, while the RIN credit program allows the City sell excess biofuel to the market.

Although this was not the first wastewater biogas installation in the Pacific Northwest, McKinstry developed an innovative delivery model which can be replicated across the country. By using this delivery model, we created a proven, sustainable, zero-pollution waste management process which also bolsters broader community and fiscal health.

Project Overview

With our vast company resources and service offerings, along with our proven success in delivering these complex renewable natural gas (RNG) projects and creating lucrative revenue streams for municipalities, McKinstry proved a trusted client advocate to navigate complicated projects and deliver favorable outcomes for the City of Tacoma.

RESULTS

The project's guaranteed maximum allowable cost was $6,196,001. In the end, the project's annual net savings cash flow is between $600,000 and $700,000 per year. The estimated one-time grants and rebates for the project are $450,000, including a competitive energy efficiency grant awarded through the State of Washington Department of Commerce.

- Yearly revenue: $2M per year
- RIN credit revenue: ~$1.6M/year*
- Gas revenue: $375K/year*
- Total NET revenue: $1.4M/year*

**Revenue is net, after brokerage and other costs, but fluctuates*

In total, the project was successful reaching the City's sustainability initiatives through the following metrics:

$1.4 million per year net revenue

919 tons of greenhouse gas emissions per year

Equivalent to **215** acres of trees planted

Or **Up to 420,000** gallons of diesel not used

Or **76** homes removed from the grid

Or **151** trucks removed from the road