Moving Beyond Efficiency

NH Wastewater Treatment Facility Solar Array Case Study Summaries

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Case Study Development Background and Purpose

Over the past decade, municipalities have increasingly sought relief from high energy bills through a variety of energy and cost management initiatives. At the same time, they have been approached by an ever greater number of solar photovoltaic (PV) installers and third-party firms offering solar and energy products. In order to provide support for municipal efforts to manage energy use and business offers, Process Energy Services, LLC (PES) distributed a data collection survey in July 2020 to the New Hampshire wastewater treatment facilities (WWTFs) with solar PV arrays currently installed at their sites. The surveys were used to develop a set of NH-based case studies that documents the path that each municipality has followed for their solar PV system. The enclosed information provides background information to help other municipalities navigate the options to install solar PV arrays to determine how best to proceed.

The nine WWTFs that participated in the survey are listed below. These WWTFs were among the first in the state to have taken the initiative to install solar PV systems.

- City of Claremont
- Town of Derry
- Hooksett Sewer Commission
- Town of Lancaster
- Meriden Village Water District
- North Conway Water Precinct
- Town of Peterborough
- Plymouth Village Water & Sewer District
- Warner Village Water District

The questionnaire covered the basics and also encouraged WWTF operators to offer lessons learned on how best to pursue a solar PV array project. The enclosed snapshot profiles of each system provide an overview of the project approach, the simple payback and the cost/kWh.

Although there are fewer incentives available to help reduce the overall project costs than years prior, the total project cost in terms of $/kWh generated annually for solar PV arrays has dropped considerably. This decrease in total project cost has improved overall project cost effectiveness, even as incentives have been phased out.

As always, we strongly encourage energy efficiency projects to be pursued either first or in conjunction with the installation of renewable energy measures, whether they draw from solar, wind, or geothermal sources. By combining energy efficiency to dramatically reduce total energy consumption with renewable energy sources, numerous NH WWTFs have the potential to reach net zero energy use.

The New Hampshire Department of Environmental Services (NHDES) is not endorsing any of the vendors noted in this document. This document serves only to report the information provided for each solar PV system. The solar PV systems case studies appear below in alphabetical order.

NHDES and PES would like to thank the participating solar PV system owners and operators for their willingness to provide and share the information in this document. We also thank them for their willingness to be contacted by other municipal representatives considering similar systems.

City of Claremont

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The City of Claremont made the decision to pursue a solar PV array at the City's WWTF site based on space availability, having three-phase power and being the largest power user in the City. The former Public Works Director, Vic St Pierre, was the energy champion that pursued the project on behalf of the City.

The City set-aside $327,990 from their sewer enterprise fund to pursue the solar PV array at the WWTF site in 2018 and issued an RFP to solar contractors for a turn-key project that included engineering and installation. Standard Solar, Revision Energy and Ameresco submitted proposals.

The City selected ReVision Energy to perform the work as a turnkey project. The project cost was $319,264 for the installation/engineering work and $8,726 for bonding the project. The City received a $48,000 grant from the NHPUC, which reduced the total cost to $279,990. As part of the proposal, ReVision Energy estimated that the new system would produce 190,522 kWh annually. In 2019, the system produced 180,317 kWh. Using a 2019 net $0.12/kWh energy cost (no escalation or carbon credits included), the project was expected to pay for itself in 13 years with a benchmark value of $1.82/ kWh generated.

The installed solar array was rated for 151.2 kW DC (120 kW AC) with 432 solar panels. The new system was interconnected with the WWTF's existing three phase electric service (service provided by Eversource). With the WWTF's annual energy use over 700,000 kWh; the majority of the solar power generated was used on site to offset the WWTF energy use before any surplus energy was sent back to the grid.

Note: The cost/kWh used to evaluate project cost effectiveness should not include demand charges, which are typically not reduced with a solar PV project. In addition, for surplus energy produced, Eversource will not provide a full credit unless the municipality is on the Eversource default energy supply rate schedule.

The City indicated that they received a renewable energy credit of $1,862 (98 RECs @$19.00/MW credit) in 2019. This was lower than the original ReVision cash flow estimate that estimated a first year credit of $5,239 based on 191 RECs (5% de-escalator, ten-year term and $30/MW).

Town of Derry

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The Town of Derry political leaders sought to reduce costs and reap the environmental benefits of installing a solar PV array at the municipal WWTF. DPW staff and volunteer board members from the Town's NetZero Committee initiated the project at the Department of Public Works (DPW) site (same electric meter with the WWTF). With the WWTF's annual energy use over two million kWh annually; the power generated will offset the energy use of the WWTF and other DPW Buildings.

In May 2018 the solar array was installed. The total project cost was $282,400 and after a $58,812 rebate, the remaining $223,588 was financed from the capital reserve municipal funds budget. The Town structured the project to use renewable energy credits (RECs) accumulated each year to reimburse the capital reserve account. Based on the total project cost, the system benchmark value was determined to be $1.84/ kWh generated.

The Town pursued a competitive bid process and selected Granite State Solar to perform the project. The installed solar array is rated for 86.4 kW DC with 240 solar panels (360 watts each). One unique feature of this project is that the panel arrays are mounted on dual axis solar tracking mounts (all other systems included in this memo report have fixed panel arrays).

Production has met the promised annual target of 150,000 kWh. The system produced 153,740 kWh in 2019 and in the first nine months of 2020, the panels produced 131,000 kWh, which will exceed the original power production estimates for 2020.

The project size was limited to less than 100 kW DC due to current net metering rules. As constructed, the solar array satisfies about 2% of the Town of Derry's project goals for renewable energy (schools and municipal). The Town also has a 10-acre landfill site available and sought bids for a 1 MW DC system that would have been developed via a Power-Purchase Agreement (PPA). However, due to current limitations with New Hampshire net metering regulations, the project was cancelled due to uncertainty over pending legislation. With the current net metering size limitations, the project provided a marginal business case for the first 5 years of energy purchases from the 3rd party supplier. The Town has space at the landfill for up to a 5 MW DC project, which would enable 100% of the Town's electricity requirements to be met but until legislation is passed to justify a larger system, this project is on hold.

Hooksett Sewer Commission

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The Hooksett Sewer Commission (HSC) is currently installing a solar PV array at the Hooksett WWTF. The system is expected to be on-line in November 2020. The HSC pursued the project to achieve energy cost savings and environmental benefits. The new solar array is expected to generate 85% of the WWTF's annual energy use.

ReVision Energy was selected as the contractor and installed 1,902 375-watt PV panels with a total capacity rating of 713.25 kW DC. Annual power production has been estimated to be 819,000 kWh.

Total project cost was approximately $1,350,000 and was financed by HSC Trust Funds. Based on this cost, the system benchmark value is estimated to be $1.65/ kWh generated based on the preliminary power generation estimate of 819,000 kWh.

Note: Staff indicated that more details on the plans would have been helpful during system construction. Although the HSC did not hire an energy consultant, they indicated that this task would be worthwhile.

Town of Lancaster

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The Town of Lancaster installed solar PV arrays in 2016 at the WWTP and Transfer Station. The Town pursued the project to achieve energy savings, environmental benefits, and cost savings. This project was unique since town staff performed the installation instead of contracting the work to a private solar company.

The Town worked with a local renewable energy nonprofit, Plymouth Area Renewable Energy Initiative (PAREI), and Seacoast Consultant Engineers to navigate utility interconnection agreements, state incentive programs, and provide assistance with selecting the panels, racking, inverters, and other hardware. The cost for the consulting services was approximately $7,100. Staff indicated that the consulting services were an essential task to develop the project internally.

The installed systems are rated for 107 kW DC and consist of 3 arrays (9 kW, 18 kW, 80 kW). The arrays include 420 panels with each of the individual panels rated for 285 Watts.

The $288,678 total project cost was municipally funded through a bond approved in 2016 (no grants were available when the project was developed). The Town paid off the debt from the bond in 2017. Based on the total project cost, the system benchmark value was estimated to be $2.14/ kWh generated (based on an estimated 135,000 kWh generated in 2019).

The Town hopes to expand the arrays at the wastewater lagoons and the transfer station and has been receiving calls from Berlin, Twin Mountain, Franconia, Milan, to inquire about project costs and development. In April 2019 two other North Country municipalities, Berlin and Whitefield, issued requests for proposals soliciting bids to install municipal solar systems.

Meriden Village Water District

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In 2018, the Meriden Village Water District (MVWD) contracted with Norwich Solar technologies to install a solar PV array at the WWTF under a seven-year PPA. The PPA is a third party ownership option that requires no upfront capital investment and immediate savings. The Towns of Meriden/Plainfield have a goal of achieving 100% renewable energy by 2050.

The installed array is 57.8 kW DC and consists of 170 panels. Each of the individual panels is rated for 340 Watts. In 2019, the array generated 59,244 kWh, which was applied to the WWTF energy use at a discounted rate with excess power delivered to the power grid.

Norwich Solar paid for the initial $150,000 total project cost. During the course of the PPA, the MVWD may purchase the system at specific dates in the contract for the fair market value. Based on the total project cost, the system benchmark value was determined to be $2.53/ kWh generated.

North Conway Water Precinct

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The North Conway WWTF was one of the first WWTFs in New Hampshire to install a large solar array in 2011 and is now working with ReVision Energy to expand their system.

In 2011, the North Conway Water Precinct (NWCP) hired CDM to investigate the cost effectiveness of installing a solar array. The Preliminary Design Report (PDR) identified potential electricity savings of 181,000 kWh and compared various installation options. The NWCP pursued the project as a traditional design-bid-build type project with a total budget of $1.123M. The project was built by Waterline Industries (General Contractor (GC)), GroSolar (PV), and Glen Builders (site work). The total cost included approximately $240,000 for engineering costs and qualified for an ARRA grant that covered 50% of the project costs with the remaining portion covered by a Clean Water State Revolving Fund (CWSRF) Loan.

The CDM PDR estimated 181,000 kWh in annual energy savings with $30,000 per year in electricity savings (based on $0.166/kWh). The solar array was 142.7 kW DC (after change orders), which included 696 panels at a rated capacity of 205 watts/panel. In 2019 the system generated 240,631 kWh. Based on NCWP costs of $561,500, after the application of the ARRA grant funding, and 2019 kWh production data, the project simple payback is expected to be approximately 14 years. This payback did not include renewable energy credits (RECs).

NCWP made the decision to set aside the REC cost savings in a capital reserve account for future efficiency/energy cost saving projects. As of last year, the account had accumulated $100,000. In 2019, NCWP received 229 RECs @ $12.50 /REC ($2,863) from the local utility (NH Electric Coop).

2020 System Expansion
In 2020, NCWP made the decision to expand their solar PV array. Revision Energy was chosen to develop the project based on their demonstrated regional success with designing and building systems of this scale. The $2M project will have a capacity of 1008 kW DC (7 times the size of the original system) and is expected to generate 1,307,470 kWh ($133,421) annually with $26,149 in first year REC credits. Based on the proposed cash flow, the project will pay for itself in 13 years and will be funded with existing NWCP reserves. The project is estimated to yield a 20-year rate of return of 5.55% and a 40-year rate of return of 8.42% on the initial investment – far greater than what could be provided by traditional investment strategies like CDs or bonds.

The total cost of solar PV array projects has decreased significantly over the years. The 2011 project was $4.67/kWh generated compared to the 2020 project, which will come out to $1.53/kWh generated.

Note: One recommendation from the NWCP to other utilities considering solar is to choose your development partner wisely. Many solar developers "sell" projects to investors and the success of those projects often hinges on forces beyond the utility's (or developer's) control. When someone promises you huge savings without any effort or cost on your part, be sure to do your due diligence on the company making those promises.

Town of Peterborough WWTF

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In 2015, the Town of Peterborough's 942 kW DC solar system came on line. The system is located on five acres formerly used for a portion of the wastewater lagoons. At one time, the system was the largest in the state. The Town pursued the project primarily for the environmental benefits and cost savings.

Total project cost was approximately $2.5 million before a $1.2 million grant was applied from the Public Utilities Commission. Based on the total project cost, the pricing was determined to be $2,654/installed kW. With financing provided through a 20-year PPA, the Town was able to implement the project with no up-front costs. The PPA included a fixed power cost of $0.08/kWh for 20 years. Project cost savings is estimated to be between $25,000 and $50,000 per year, or nearly $500,000 to $1 million over the term of the PPA.

The 942 kW DC array consists of 3,088 panels that are 305 Watts each. The PV array provided approximately 30% of the WWTP's total power consumption in 2019 following implementation of energy efficiency measures.

Plymouth WWTF

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The Plymouth Village Water & Sewer District installed a solar PV array in 2014 at the Plymouth WWTF. The Plymouth Area Renewable Energy Initiative (PAREI), a non-profit solar energy consultant provided technical and financial project assistance from start to finish. PAREI provided the District with knowledge regarding all of the incentives and project management that allowed the project to be constructed.

The 121 kW DC array consists of 440 panels that are 275 Watts each (limited by the space available at the WWTF site). The array was constructed by District Staff, PAREI staff, Mauchaly Electric, Fraize Electric, and ME Latulippe Construction. The PV array as designed provided approximately 25% of the District WWTF's 2014 annual power consumption.

Note: PVWSD staff recommends that municipalities consider component replacement, technical assistance, and maintenance costs (panels, inverters, software, connection to monitoring network, etc...). As part of the project contract, the PVWSD requested a 5-year parts and service warranty from the electrician and PV vendor.

The total project cost was approximately $450,000. PAREI applied for a PUC grant that covered 80% ($360,000) of project costs with the remaining $90,000 paid with District funds. With this grant, the environmental and financial return on investment (ROI) was achieved in less than 4 years. Based on the total project cost, the system benchmark value was determined to be $3.00/ kWh generated.

In 2019, the array generated 150,243 kWh, which represented approximately 30% of the WWTF's annual energy use following implementation of energy efficiency measures. This can be compared to the 150,000 kWh that was originally estimated in the project proposal. The New Hampshire Electric Co-op will be releasing the renewable energy credit (REC) rights to the District in December 2020 (according to staff, a 6 year generating period is required before RECs can be released and sold). RECs are valued at $35 per 1,000 kWh produced annually which amounts to a $5,250 annual credit for the District.

Warner Village Water District

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In 2016, the Warner Village Water District (WVWD) installed a solar PV array at the WWTF. The WVWD pursued the project to achieve energy savings, environmental benefits, and cost savings.

The WVWD worked with an energy consultant to evaluate site requirements, array size and develop an RFP for the project. The WVWD believes this effort was worthwhile and helped reduce the overall project cost.

Harmony Energy Works was selected as the contractor and provided (378) 300-watt PV panels with 10 sub-arrays connected to 5 inverters. The maximum power of the system is 113 kW with an estimated annual production of 142,000 kWh. In 2019 the system generated be 139,833 kWh or 90% of the total power used at the WWTF. When the facility was not able to use all the daily power generated by the PV array, a total 2019 net metering credit of $2,850 was received from Eversource. In addition, the WVWD received 231 solar renewable energy credits through Knollwood Energy, which provided an annual credit of $1,500 to the WVWD.

Total project cost was approximately $347,700. Based on this cost, the system benchmark value was determined to be $2.04/ kWh generated. After receiving a PUC grant of $75,000, the net cost to the WVWD was $272,700, which was financed by the WVWD.

NH WWTF Solar Array Summary Table

Location	Year of Install	Number of Panels	Watts/ Panel	Design kW, DC	Predicted kWh	Actual 2019 kWh	Total Project Cost, $	Cost/2019 kWh Generated, $	Grant Awarded, $	Simple Payback, Years[1]	Renewable Energy Credits	Funding Source
Claremont	2018	432	350	151	190,522	180,317	327,990	1.82	48,000	12	98	Sewer Enterprise
Derry	2018	240	360	86	150,000	153,740	282,400	1.84	58,812	12	153	Capital reserve
Hooksett Sewer Commission[2]	2020	1,902	375	713	819,000	--	1,350,000	1.65 (est)	--	14	--	Municipal funds
Lancaster	2016	420	285	107	--	135,000 (est)	288,678	2.14 (est)	--	18	--	Municipally funded bond
Meriden Village Water District	2018	170	340	58	73,000	59,244	150,000	2.53	--	Immediate	--	PPA
North Conway Water Precinct	2011	696	205	143	181,000	240,631	1,123,000	4.67	561,500	19	229	CWSRF loan w/ARRA
North Conway Water Precinct[2]	TBD	--	--	1,008	1,307,470	--	2,000,000	1.53 (est)	--	13	--	Municipal funds
Peterborough	2015	3,088	305	942	--	--	2,500,000	--	1,200,000	Immediate	--	PPA
Plymouth Village W&S District	2014	440	275	121	150,000	150,243	450,000	3.00	360,000	5	150	District funds
Warner Village Water District	2016	378	300	113	142,000	139,833	347,700	2.49	75,000	16	231	Municipal funds

Notes:

1. Simple payback estimate includes the cost reduction from grants and was estimated using $0.12/kWh (NH utility average for power applied at site and surplus kWh sold back to utility). Renewable energy credits (RECs) were not included.
2. NCWP and the Hooksett Sewer Commission are installing arrays in 2020/2021. Cost/kWh is based on the predicted kWh.