Metro Nashville Solar Evaluation Summary

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Project Background

Nashville has long held an aspiration to become the "greenest city in the Southeast" and over the past year the City has made exciting progress toward that goal. Following the passage of Ordinance BL2019-1600 in 2019, which established a renewable energy portfolio standard for the Metropolitan Government of Nashville and Davidson County (Metro) and renewable energy targets, Metro began an ambitious program to design strategies for 100% renewable power generation for Metro facilities by 2041. To help guide the program Metro enlisted the expertise of Wilmot Inc., a sustainability consultant who had already facilitated groundbreaking solar generation capacity at Nashville's Metro Water, to conduct assessments of the City's entire portfolio of properties across Davidson County and direct development of the City-wide solar program. Final results of the project include physical and financial analysis of over 200 sites, identifying financially viable locations with suitable attributes for immediate solar installation.

The impact of 100% renewable generation for Metro Nashville properties cannot be overstated. 100% solar will reduce the City's electricity consumption from the grid and lock in Metro's energy costs over the long term, while lowering greenhouse gas emissions, creating new green jobs, and strengthening our community's resilience. As energy costs increase and climate considerations make resilience an important municipal priority, renewable generation will be critical for Metro Nashville's future growth.

The first step in the assessment process was to evaluate the approximately 1,400 Metro-owned properties throughout Davidson County. This initial appraisal filtered-out sites with limited or unsuitable space for solar, removing roughly 800 sites from the overall list and leaving about 600, all of which required a more detailed assessment. Wilmot employed a variety of online tools for this second step, including Google Earth, Nashville's Parcel Viewer, and the advanced solar evaluation software, HelioScope, to further filter-out sites based on criteria including:

1. suitable space,
2. floodplain information,
3. land ownership and,
4. shading from trees or nearby buildings.

Wilmot's desktop evaluation cut the list of potential sites from roughly 600 to a total of 280 candidates, and then these were scheduled for a local inspection. Pre-visit assessments using Google Maps provided foundational information for each site that the Wilmot team referenced during these scheduled field inspections. During the site visits, the Wilmot team conducted walkthroughs with departmental facilities personnel, taking photographs and detailed notes for further evaluation. Specific site information gathered included:

1. roof and site conditions,
2. obstructions such as mechanical equipment,
3. sources of shade,
4. topography (for ground-mount and canopy),
5. interconnection voltage and,
6. interconnection location.

Each site was carefully documented with a set of photographs, which provided the team with a visual foundation for drafting accurate solar layouts. All of this material was documented in spreadsheets accessible by the Metro team. Site evaluations showed that the age and condition of on-site electrical infrastructure, such as breaker panels and switch gear, varied considerably from property to property. This information is critical and will be factored in by contractors when they price individual solar installations, as some sites may need electrical equipment upgrades before solar can be installed. Departments will be able to choose whether they would like to execute system upgrades as a separate task or include them in the scope of work for the solar contractor.

Following an internal review of the site visit notes and solar designs, Wilmot compiled all informational details for each site into individual site summaries. These were forwarded to the respective departments for review. Departments included in the evaluation:

1. General Services,
2. Metro Nashville Public Schools (MNPS),
3. Metro Water Services (MWS),
4. Libraries,
5. Parks,
6. Fire,
7. Police, and
8. Fairgrounds.

These site documents included a copy of the site visit notes, as well as a map of the draft solar layout. Wilmot annotated locations of key on-site electrical infrastructure and followed the flow of electricity from an NES service drop to the electrical room. The Wilmot team encouraged feedback on all items, but explicitly solicited notes on the placement of solar panels, the age of the roof, and the plans for future replacements of the roof. Confirmation of structural information helped with the development of a list of high-priority sites, ones that would generate the most value for Metro and could be scheduled for solar installation in the next 3-5 years. Some departments had more detailed roof replacement schedules than others, resulting in a varied level of detail in the cost-benefit analysis (CBA) summary.

During the next step in the process, the various departments reviewed the site summaries. At this point, Wilmot used proprietary models to estimate hourly site energy use and size a behind-the-meter solar system for each location, then projected energy savings based on NES rate schedules. Each building demands electricity from the grid at a rate which is measured in kilowatts (kW). Consumption is defined as the sum of that demand over a specified time period and is measured in kilowatt-hours (kWh). A kilowatt-hour is defined as consuming electricity at a rate of one kilowatt for one hour. The planned on-site solar systems will generate electricity the building can consume, offsetting kWh purchased from the grid and potentially shaving peak electricity demand for the site, both resulting in monthly savings.

When the solar system for a site generates more electricity than the building demands, unused electricity is sent to the grid. By overlaying building electricity demand and solar generation data, Wilmot calculated the quantity and timing of excess generation for a given solar system size as well as the largest solar system size needed to avoid significant excess generation. That system size is referred to as the behind-the-meter (BTM) size. Wilmot targeted 0-1% annual excess generation when determining the BTM size. The other solar system size presented, referred to as the “max size,” corresponds to the maximum solar potential of the site after considering shade, obstructions, and department input. After overlaying demand and generation data, Wilmot applied the average rates of the NES General Power Rate Schedule (GSA) from January through May 2023 and the prices from NES’s Flexibility 2.0 program to determine the value of energy offsets and exports, respectively. These savings were combined with cost calculations, which are described later in the financial analysis breakdown to determine the financial performance of all sites. NES rates and flexibility prices were assumed to increase by 2% annually, which is in line with historical rate data and the US Energy Information Administration’s long-term energy outlook.

After calculating the solar savings for each site, Wilmot used market trends and pricing from recent local solar projects to estimate capital and maintenance costs. Wilmot evaluated two different ownership models for all sites:

1. Metro-Owned - Metro purchases the system upfront and is responsible for maintenance.
2. Third Party Solar Services Agreement - a vendor finances and owns the system and charges Metro for the energy generated monthly. There are no upfront or maintenance costs.

The results from both scenarios are shown in detail in the CBA summary document.

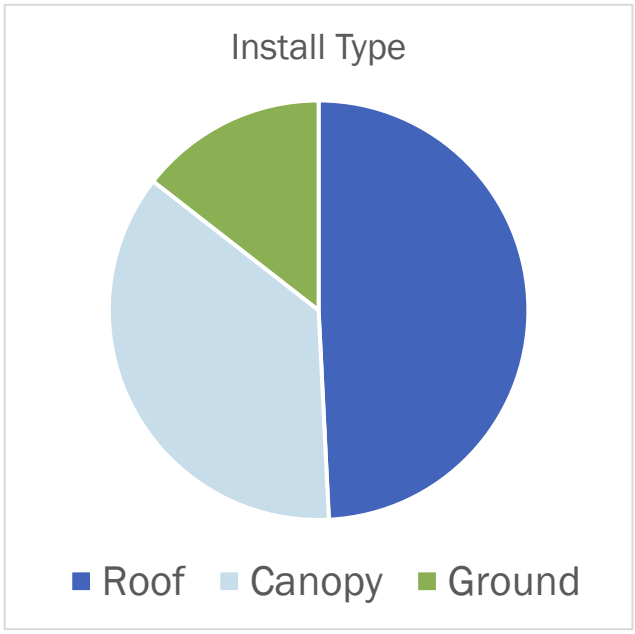
As a final step in the process, individual departments are reviewing the building assessments and financial analysis. Wilmot concurrently drafted procurement documents for Metro, including:

1. Indefinite delivery, indefinite quantity (IDIQ) contract – Metro-Owned.
2. Request for qualifications (RFQ) – Third-Party.

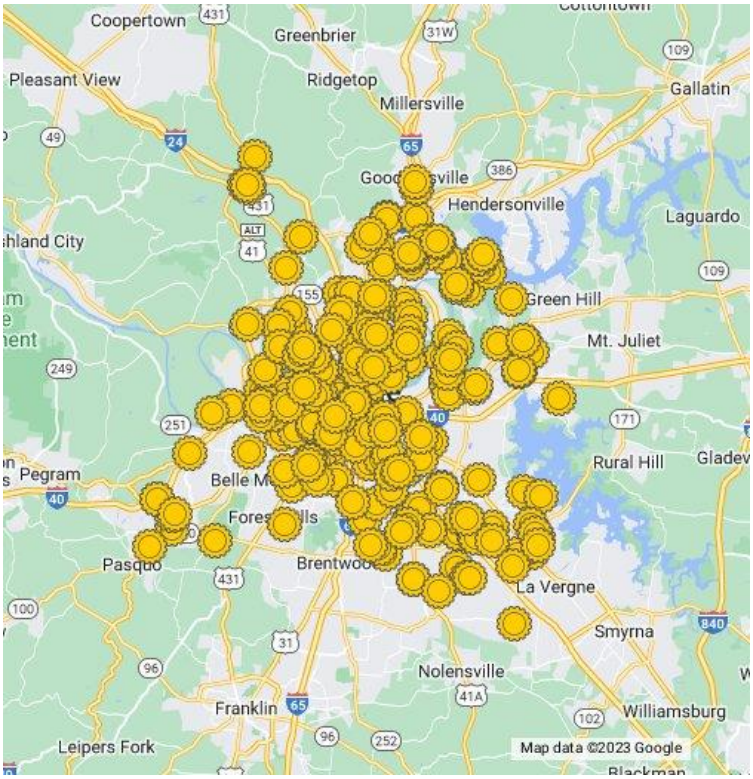
In both procurement scenarios, three vendors will be pre-qualified. Departments are able to solicit bids from these vendors and execute contracts for installation.

Results

The results of the project are exciting and show 235 Metro-owned sites with a combined solar potential of 76.5 MW-DC. This generation potential corresponds toa projected net lifetime savings of over $50 million under Metro ownership. One hundred percent renewable generation can save the City a substantial amount on current energy outlays, and those savings can then be used for other Metro priorities.



Department	No. Of Sites	BTM kW	Total kW	Total Savings
MNPS	133	17,897.9	44,499.5	$30,735,443
General Services	27	3,050.5	9,412.3	$2,939,933
Library	10	406.2	1,171.8	($80,666)
Fire	10	133.5	465.2	$338,134
Parks	30	617.0	20,904.8	$20,987,054
Fairgrounds	1	0.0	1315.8	$1,342,917
MWS	24	5,928.2	21,880	$22,793,595
Total	235	28,033.2	99,649.8	$79,056,411



This solar program will encourage Metro departments to participate in the energy transition away from fossil fuels and share in the benefits. These benefits include lower, more predictable energy bills, reduced community emissions, and greater electric grid resiliency through voltage regulation. The project will also generate opportunities for hands-on renewable energy education and career development programs for Nashville's next generation. The benefits scale with deployment, so it is important that departments use this program to the greatest extent possible.

Cost Benefit Analysis

The results of the solar Cost Benefit Analysis (CBA) are included in a spreadsheet that was provided to departments. The CBA provides Metro Schools, Parks, Libraries, Fire, and General Services, and Police with the information that may be used to make decisions when pursuing on-site solar generation. This companion document explains all the information found in the CBA, how to interpret the data, and the next steps for installation.

Spreadsheet Overview

1. General Information - The first two columns provide basic site information: department and site name. Departments can filter the results to only see their properties by using the dropdown in Column or type-out specific building types, such as "Community Center," "Police," "Elementary," etc. in the Site dropdown. Note that several sites are marked with an asterisk ("*"), indicating that roof replacement plans were not confirmed before results were complete.

2. Roof Age - The next two columns indicate the year the roof was last replaced and any planned future replacements. It is a rule of thumb that solar should be installed on a roof that is less than 5 years old because the panels are under a 25-year warranty. If the roof requires replacement before the panels have reached the end of their useful life, roofing contractors will have to remove and re-install the panels, leading to additional costs. Solar panels help extend the life of roof by protecting it from the elements. Departments may sort or filter the values in Column D to craft a short- or long-term installation plan, using the planned install year and project savings to identify immediate, high-priority sites.

3. Installation Size - Columns E, F, and G show the possible sizes of installation. All sizes are in kilowatts, or kW. The BTM, or "behind-the-meter," size is fit to the site's energy use and minimizes excess generation. The Max size is the total solar capacity of the site after considering shading, department preferences, and financial performance. The Flex size is the difference between the BTM size and the Max size, roughly equating the wattage contributing to NES's Flexibility 2.0 Each sizing scenario has a different financial payback.

4. Flexibility Program - Column H shows the applicable NES Flexibility program, which affects the quantity and value of energy exported to the grid. All sites below 250 kW are categorized in "Small Flex" and all sites above 250 kW are categorized as "Large Flex." The "Large Flex" program is a "front-of-meter," option meaning all generated power is sold and exported to the grid. On-site solar generation would not offset electricity consumption from the grid in this scenario. In the "Small Flex" program, only excess generation is sold to the grid. Kilowatt-hours generated as part of the "Large Flex" program are sold at a higher rate to NES due to a greater value placed on their scale and reliability. Regardless of flexibility program, Metro will retain the renewable energy credits (RECs) attributed to the systems for these installations and contribute to the renewable energy goal.

5. Investment Tax Credit - Column I shows the "ITC Utilization." The base credit is 30%, but sites located in low-income or energy communities, as defined by the IRS, are eligible for a 40% or 50% credit, depending on if they meet one or both criteria. The low-income community credit is a competitive program, requiring additional application materials, presenting a potential risk of not earning the additional credit. The specific program eligibility is shown in Column J. Metro is eligible to take this tax credit as a direct payment. Metro Water Services has already engaged Metro Finance to handle the direct pay from the ITC and earning bonus credit through additional incentives. Departments should coordinate with Metro Finance to ensure ITC direct pay is utilized to the full extent possible for each site. While the CBA was conducted with the most up-to-date information, programs and definitions may evolve with time. It is important to confirm site eligibility before investing capital into a project if there are expectations to earn additional ITC.

6. Capital Cost – For the Metro-Owned scenario, departments would need to budget for the cost of solar installations (Note: There is potential for exploring a Metro-wide capital budget ask for solar

installations that would be separate from an individual department's request.). Pre-ITC cost is the required capital to build the system, while the post-ITC cost is the cost after receiving direct payment of the ITC. Capital costs are included for both the BTM and Max size scenarios.

7. Savings - Columns X through AA show the lifetime (25-year) net savings for both metro-owned and third-party BTM and Max system sizes. The savings take into account all maintenance costs, expected energy generation, and a 2% increase in energy costs. More detail on assumptions used in the CBA are included in the Assumptions tab in the spreadsheet

Using The Spreadsheet

1. Filter by department(s) [Column A] and sites [B] of interest
2. Sort planned install year [D] by smallest to largest or filter for years of interest
3. Create an annual install bundle by combining the different scenarios (Metro-owned [X, Y] vs. third-party [Z, AA], BTM [Y, AA] vs. Max [X, Z])
    a. Maximize solar generation by bundling sites.
        i. EX: Martin Luther King Jr. Magnet High School is projected to save $180,000 under third-party ownership with the max size (152 kW). This can be bundled with Glencliff High School, which is projected to cost $31,000 under third-party ownership with the max size (1,042 kW). When these sites are bundled, the net savings are close to $150,000 and the total installed kW is close to 1,200.
    b. Departments can use the projected capital cost [K, M] of a project when submitting annual capital budgets. A combination of Metro and third-party ownership increases savings and total installed solar without while reducing the upfront cost.
    c. Some planned installation years are more flexible than others.
        i. If the roof was replaced in 2018 or 2019, it is important to install solar in 2023 or 2024.
        ii. If the roof will be replaced in 2024, it would be best to install solar in 2024 with the roof replacement, but the appropriate window for install is through 2029. Departments are encouraged to adjust or update the table for planning purposes as they see fit.

Next Steps

Departments are under no obligation to participate in this program. They are invited to review the cost benefit analysis and decide which installations make good business sense. Departments may select the sites they prefer for installation and a preferred ownership model, from there they will engage Metro Purchasing and submit the sites by letter either to the Metro Solar Direct Buy IDIQ or Solar Services Agreement RFQ. The bid process may take up to 2 months, and the turnaround for the contractor to break ground at the site is generally between 2 to 6 months. For installation, many sites will take between 2 to 6 weeks, while larger (>1 MW) sites may take 12 months or more.

Wilmot is honored to be part of this exciting program and is available to help facilitate the process for each Metro Department. The Nashville Solar Evaluation is a groundbreaking effort to move the City to 100% renewables, a step that will improve our community's livability and provide a more sustainable and resilient environment for everyone who lives and works in the greater Metro area.