ON-SITE SOLAR GENERATION AT METRO OPPORTUNITIES & IMPLEMENTATION
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Metro’s Sustainability Agenda was launched in 2014 to recognize and strengthen Metro’s role in supporting regional sustainability. The Agenda sets concrete, ambitious performance targets that guide the Authority and the region on the path to becoming the most sustainable in the nation.

As part of the Sustainability Agenda, Metro committed to achieving 30% of its electricity from renewable resources, where financially feasible, by 2025. Given the Authority’s significant real estate assets, Metro has a unique opportunity to generate solar energy on-site in support of this target. By leveraging many of its existing real estate assets, the Authority can reduce electricity costs, reduce its risk exposure to energy pricing, and provide significant impetus to accelerate renewable energy production in the D.C. region.

This report seeks to quantify how investment in on-site solar energy production can benefit both the Authority and the region and determine the optimal level of solar deployment Metro should pursue. The report has been divided into four sections that outline why solar power deployment is timely for Metro:

1) How implementing solar helps Metro move towards achieving its Sustainability Agenda target
2) What solar typology would be appropriate
3) Where to prioritize solar sites offered to the market for investment
4) A timeline and process for how to implement solar installations on Metro’s properties
It is estimated that by pursuing the priority sites identified in this report and achieving commercial operation by the end of 2016, Metro’s potential electricity cost savings could total nearly $3.2 million over a 20-year PPA term.¹

THE OPPORTUNITY
Installing solar on Metro’s assets is financially advantageous and can contribute to Metro’s Sustainability Agenda. Clean on-site electricity promotes the maximum value of Metro station areas and focuses development on otherwise underutilized rooftops and air rights to generate clean energy.

PPA STRUCTURE
Metro can achieve cost savings and mitigate development risks through a Power Purchase Agreement (PPA) to purchase on-site solar energy generated on Metro property. This contract structure has been successfully implemented by both public and private sectors, including the Department of Defense, the Government of the District of Columbia, and Montgomery County. Through a PPA, the opportunity to maximize renewable power generation and electricity costs savings can be combined with a well-managed risk profile. Under a PPA project financing, construction, operation, and maintenance are executed by a third-party developer/operator. This allows Metro to maximize the financial benefits of on-site solar technology with the support of an experienced solar developer. Specifically, a PPA would result in:

- Long-term electricity cost savings from Metro’s operating budget with a hedge against unpredictable brown power rates. It is estimated that on-site solar development can deliver electricity cost savings of $3.2 million over the next 20 years.¹ The final value of operating savings to Metro depends on price and escalation terms negotiated in the PPA agreement.
- Limited to no capital investment required from Metro, as capital investments are made by a third party.
- A firm electricity price for the contracting period, typically 20 years and protection against unpredictable price increases for Metro.
- Lower electricity prices for Metro compared to financing and owning solar installations, as certain tax incentives and credits are only available to the private sector.
- Ability to benefit from economies of scale and expedient project delivery by contracting with a firm that specializes in solar installation and operations.

¹ Bluefin LLC Solar Assessment, January 2015 - values presented in 2015 dollars
The sole compensation for a third party developer/operator for financing, designing, constructing, and maintaining the solar system is the income generated based on the kilowatt-hours of electricity produced. As host, Metro would agree to purchase all power generated from the system during the contract term. Metro would have no payment obligations during the design or construction phases of the project and would only begin making electricity payments after the system is fully operational. Solar PPA contracts are typically structured to provide the third party operator with ownership of any solar renewable energy credits (SRECs) for a defined term. Private developers typically benefit from any available federal energy investment tax credit. These terms bring down the overall cost of development and allow the provider to offer lower energy prices through the PPA. The Federal Incentive Tax Credit (FITC) currently provides a significant financial incentive to potential development partners by allowing developers to deduct 30% of the capital costs of solar installation from their tax liability. FITC is currently set to expire on December 31, 2016. The subsequent reduction in the tax credit from 30% to 10% will significantly impact providers’ ability to deliver low energy prices. The solar energy industry is lobbying to extend this tax credit, however, the outcome remains uncertain. Delivering projects before December 31, 2016 presents a significant opportunity for Metro to obtain a reduced PPA rate over the term of a contract that will not be as favorable after the credit is reduced.

SOLAR LEASE/LICENSE REVENUE

An alternative to a PPA is a solar lease/license agreement. While the market for lease/license contracts remains nascent, this type of agreement would also provide Metro with a low-risk opportunity to take advantage of assets that can accommodate solar systems. Through this structure, any electricity generated on vacant or underutilized roof space, land, and parking locations would be sold to a commercial, community, or wholesale off-taker and Metro would be compensated with a lease/license payment. Metro would not commit to consuming the power produced while still benefiting from fixed payments. This revenue stream could bring significant value to Metro by financing site infrastructure upgrades such as parking lot lighting.

2 An SREC is created upon generation of one megawatt hour (MWh) of renewably-sourced energy. SRECs signify the environmental benefits of solar and can be sold on open market in some states. SREC market prices vary widely and are dependent upon jurisdictional laws which mandate Renewable Portfolio Standards (RPS) – a mandate for utilities to procure renewable energy.

3 Within a PPA agreement, the off-taker is the entity purchasing the power generated by the solar panels.

In December 2015 the FITC tax credit was extended at 30% through 2019 and will then drop to 26% in 2020, 22% in 2021, and 10% thereafter. This FITC extension provides a significant opportunity for Metro to continue to obtain a favorable PPA rate through future solar projects as the solar marketplace continues to grow.
Metro’s assets provide a variety of opportunities for solar system installations to achieve economies of scale that would attract competitively priced contracts or lease/license payments. Differing solar typologies can fit seamlessly within a variety of Metro properties and land assets, including:

- Ground mount systems, used for open spaces such as underutilized brownfield sites with constraints that would prevent typical development.
- Rooftop systems, which include fixed-mount technologies for the tops of buildings and existing structures.
- Canopy structures for parking lots/parking structures, which are structures that are raised above the vehicles to generate solar power. In addition to shading and protection from the elements, canopy structures include lighting and may provide opportunities for electric vehicle charging stations.
- Canopy structures for service and inspection Metrorail yards, which are structures above the rail right-of-way. Once installed they would also provide protection from weather impact to switches, railcars and track equipment.

**Ground Mount**

Ground mounts are used for open spaces and areas. These systems can be fixed-tilt or tracking and often use 72-cell modules. Row to row spacing is determined by lot size, lot configuration, and access needs. This typology is more expensive than the rooftop systems but less expensive than the canopy structures.
Rooftop Systems

Rooftop systems are built on the rooftops of buildings and structures. These systems are fixed-tilt generally using 60-cell modules mounted to the roofs of existing buildings and structures. This typology is the least expensive of the three types.

Canopy Structures

Canopy structures are used for parking lots and parking structure roofs. This typology is the most expensive of the three types. Two subtypes of canopy structures would be appropriate for Metro.

1. Double cantilevered canopy. Also known as a “T frame,” this type of structure is most efficient for cars parked in rows head-to-head. The width of a double cantilevered canopy is constructed to stretch the entire length of the parking row.

2. Single cantilevered canopy. This structure is appropriate where cars are parked in a single row. This type can stretch to nearly the length of the row.

Similar to parking lots, canopies can be installed on the rooftop (top deck) of parking structures. This requires more engineering compared to a canopy system in a ground level parking lot to connect the steel structure of the canopy to an existing concrete parking structure. Otherwise, the systems are similar. An ancillary benefit of canopy structures is the shading and general weather protection provided to cars parked beneath them. Both parking lot and parking structure canopies are typically fixed tilt, and can make use of either 60- or 72-cell module formats.

In the case of Metro, railyard tracks could be covered with a steel frame and PV modules could be mounted to the frame in a fashion similar to traditional roof-mounted systems. There are fewer limitations regarding interior and perimeter access pathways compared to a rooftop or a ground-mounted system which require interior and perimeter access pathways.
WHERE SHOULD SOLAR BE DEVELOPED?

This study identified 138 Metro owned sites (21 in Washington D.C., 74 in the State of Maryland, and 43 in the Commonwealth of Virginia) suitable for solar installation. If fully actuated, these installations could yield a combined total of 169 MW of solar power. This represents approximately 25% of Metro’s electricity load.

Two solar development strategies were identified to chart a high-level path to deliver Metro’s 30% renewable energy target by the target date of 2025. The first scenario was to identify the total on-site generation potential at all Metro sites based on the constraints of system size, solar orientation, and development. This shows the long-range possibilities for solar deployment and will allow sites to be evaluated on an ongoing basis as utility regulations and regional incentives evolve over the next decade. The second scenario evaluated by the study isolated the near term market-ready solar opportunities that can be executed immediately by Metro.

ON-SITE SOLAR CAPACITY

The study identified 138 Metro-owned sites (21 in Washington D.C., 74 in the State of Maryland, and 43 in the Commonwealth of Virginia) that could host solar installation (Table 1). If fully actuated, these installations could yield a combined total of 169 MW of solar power. This represents approximately 25% of Metro’s electricity load.

Combined, the greenhouse gas savings from installing solar power on all 138 sites would total 214 million pounds of carbon dioxide per year. This is equivalent to approximately 17 percent of Metro’s 2014 carbon dioxide emissions, or 80,000 acres of forest.

**TABLE 1**: Site Capacity

<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
<th>DC</th>
<th>MD</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sites</td>
<td>281</td>
<td>87</td>
<td>105</td>
<td>89</td>
</tr>
<tr>
<td>Sites with Solar Potential</td>
<td>138</td>
<td>21</td>
<td>74</td>
<td>43</td>
</tr>
<tr>
<td>System Size (kW)¹</td>
<td>169,000</td>
<td>13,000</td>
<td>111,000</td>
<td>45,000</td>
</tr>
<tr>
<td>Annual GHG Savings (lbs CO2)²</td>
<td>214,186,000</td>
<td>16,799,000</td>
<td>140,526,000</td>
<td>56,861,000</td>
</tr>
</tbody>
</table>

¹: kW: Kilowatt. A standard unit of energy.
²: Annual GHG Savings is the average value per year over the project lifespan (20 years). Total system cost estimated at $532 million.
TABLE 2: Greenhouse Gas Impact Analysis

<table>
<thead>
<tr>
<th>Sites with Solar Potential (190)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual GHG Savings (lbs CO2)(^1)</td>
<td>214,186,000</td>
</tr>
<tr>
<td>Metro Total GHG Emissions, 2013(^2)</td>
<td>1,284,279,000</td>
</tr>
<tr>
<td>Potential GHG Savings</td>
<td>17% - Equivalent to the annual GHG emissions from 20,800 vehicles</td>
</tr>
</tbody>
</table>

\(^1\) Annual GHG Savings is the average value per year over the project lifespan

MARKET-READY SITES

Following an extensive roof condition study across all Metro facilities, nine (9) sites have been identified that demonstrate significant potential for near-term, positive economic returns for Metro. These Phase 1 sites provide the best short-term opportunity for Metro. Crucially, they could provide electricity at prices equal to or below Metro's current rates, offer limited or no escalation in costs over a 20-year period, generate positive economic returns for a prospective third-party provider, and form the first phase of Metro's on-site solar investment strategy. These sites comprise a total of eight (8) to twelve (12) megawatts of solar capacity, are estimated to provide approximately $3 million in savings over the next 20 years, and will save 4,000 metric tons of greenhouse gas emissions per year when fully operational. These sites should be considered Metro’s highest priority for moving forward with a near-term solar implementation strategy.

The system size of individual Phase 1 sites allow for construction completion in 6 months or less per site, so that all sites can be placed into service prior to December 31, 2016 and claim the 30% FITC.

It is recommended that Metro continue to leverage roof condition data collected as impacts of the tax credit changes on the regional solar market pricing is more fully understood as the renewable energy market evolves.

TABLE 3: Summary of Phase 1 Sites

<table>
<thead>
<tr>
<th>Sites Located in D.C.</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sites Located in MD</td>
<td>8</td>
</tr>
<tr>
<td>Total System Size</td>
<td>8-12 MW</td>
</tr>
<tr>
<td>Annual GHG Savings*</td>
<td>4,000 metric tons of greenhouse gas emissions</td>
</tr>
<tr>
<td>Potential Operating Cost Savings to Metro*</td>
<td>Estimated at $3.2 million</td>
</tr>
</tbody>
</table>

\(^*\) Final value will be determined by PPA contact terms

OFF-SITE SOLAR

Though solar generation potential at Metro is extensive, Metro’s on site solar development locations are not all currently developable. Construction and siting constraints, a lack of solar market drivers such as a renewable portfolio standards, and net metering in some jurisdictions significantly will limit full on-site solar deployment at some locations. Given these constraints, it is recommended that the remainder of Metro’s 30% target be evaluated as off-site utility grade renewable energy generation.

The solar market has recently seen the emergence of an approach that locates commercial-scale solar within the same regional utility transmission organization in order to take advantage of economies of scale. Using this approach, George Washington University, American University, and the George Washington University Hospital combined to secure 52MW of off-site solar in a dedicated utility scale solar plant specifically commissioned for them. Other dedicated utility scale sites have been developed by private sector entities, such as Google and Amazon. Metro should consider conducting a detailed financial evaluation of this option in parallel with the development of financially feasible on-site locations as it seeks to achieve its 30% renewable target by 2025.
IMPLEMENTATION

Through the deployment of on-site solar, Metro will generate electricity cost savings, update critical customer facing infrastructure, create employment and training opportunities, and make measurable progress towards meeting Metro’s Sustainability Initiative goals.

In order to implement the solar plan outlined above, Metro will:

1. Identify priority sites that are unconstrained by development potential as identified in this report.
2. Issue an RFP in the fall of 2015 focused on the most valuable sites for PPA or license returns.
3. Negotiate and award solar PPA or lease/license contract(s) in late 2015 and early 2016.
4. Begin construction on first sites in early 2016 to maximize the number of sites that are operational by December 31, 2016 ahead of the expiring solar tax.
5. Evaluate the impact of the expiration of the FITC on the solar market pricing and deliver additional phase(s) of solar sites to the market for development in 2017-2020.
ON-SITE SOLAR GENERATION AT METRO: OPPORTUNITIES & IMPLEMENTATION

EXECUTIVE SUMMARY

ELECTRICITY USAGE EVALUATION

- Chart historical electricity usage
- Check net energy metering and interconnection limits
- Assess panels
- Estimate solar energy performance

DETERMINE CONTRACTING VEHICLE

- Based on Metro’s:
  - Appetite for capital expenditures and ability to access financial incentives
  - Experience with solar power installation, operations, and maintenance
  - Level of site consolidation or distribution

PHYSICAL EVALUATION

- Identify usable area(s)
- Identify environmental and physical constraints
- Narrow field to usable sites

FINANCIAL & PACKAGING EVALUATION

- Confirm financial targets
- Update assumptions as new information is available
- Model financial returns of each site
- Test scenarios
- Sort and group sites into near-, mid-, and longer-term packages
- Optimize packages based on Metro’s goals

START

UNDEARTAKE SOLAR PROCUREMENT PROCESS

- Develop RFP content
- Issue RFP
- Evaluate proposals
- Award, design and construct the project
- Monitor performance
- Issue RFP for next package