Appendix C. SOLAR FEASIBILITY STUDY FINAL

The purpose of this Solar Feasibility Study is to assist Central Wisconsin Airport (CWA) in understanding the opportunities and limitations of potential solar photovoltaic installations at CWA for the generation and use of electricity. By installing solar panels, CWA can offset part of its electrical consumption from the grid. The electrical grid has carbon emissions produced by the generation of electricity, so offsetting some of its electrical consumption with clean solar energy reduces CWA's carbon footprint and contributes to the FAA's Net-Zero goal. This Study identifies potential locations for where photovoltaic power could be generated and used and cost considerations associated with installation and operation of facilities. An important outcome of this Study is to provide Airport Administration with information that will help them make an informed decision on whether to move forward with solar photovoltaic installations and which type of site and location(s) would be most cost-effective and compatible with planned landside development at the Airport.

Based on discussions with CWA, the planning team evaluated three different types of photovoltaic (PV) sites as part of this Study: rooftop, parking lot carports, and ground mounted. CWA identified photovoltaics as carports installed over parking as a primary interest. This would provide vehicle protection from the elements, put renewable energy near proposed electric vehicle (EV) charging, and present an opportunity for the Airport to introduce a premium parking option, allowing for increased parking revenue.

C.1 Data Gathering

Data used in this feasibility study was collected from CWA and site utility records, drawings, and satellite imagery.

C.2 Analysis

The planning team analyzed renewable energy locations for capacity, energy generation, efficiency, first costs, and simple payback, while also considering airport administration input. The annual energy cost savings calculations are based on Wisconsin Public Service 2023 Large General Service rate structure of $0.05511/kilowatt hour (kWh). The analysis assumes no demand savings, as demand is based on the peak value and will likely be unaffected. Assumptions for PV first costs and PV production by Renewable Energy Measure (REM) used in the financial analysis are listed in **Table C-1**.

Table C-1 Assumptions

Renewable Energy Measure (REM)	Photovoltaic First Costs (PV) ($/W)	PV Production (W/sq. ft.)
REM #1 SRE Rooftop	$2.50	10
REM #2 Parking Lot Carports	$3.45	17
REM #3 Ground Mounted	$2.00	5.1

The PV production (watts per square foot or W/sf) assumptions used in **Table C-1** are standard estimates provided by a trusted solar provider with which the planning team has worked. These estimates vary by REM because they account for differences in the way each REM is configured. For example, the carport W/sf is roughly the actual square footage of the PV panels, which are measured directly over the parking spaces, while the ground-mounted and rooftop PV W/sf estimates account for spacing between rows and panels.

Key considerations for PV sites include the following:

- Return on Investment
  - First cost
  - Payback
  - Utility rates
- Physical Considerations
  - Serviceability, accessibility, maintenance
  - Distance from end use
  - Structurally able to support PV arrays
  - Avoids underground utility lines
  - Avoids Runway Protection Zones (RPZs)
  - Located at least 500 feet from any navigational aids (NAVAIDs)
- PV System Efficiency
  - PV module and inverter efficiencies
  - Transmission losses
  - Tilt and azimuth
  - Shading

With these considerations in mind, three primary REMs in specific locations were analyzed: rooftop of the new snow removal equipment (SRE) building; carports installed in the west parking lot (additional capacity is available in the remainder of passenger and rental car parking lots); and a ground-mounted system located in the Airport-owned agricultural lands north of Highway 153 (additional capacity is available further to the north). Results of the analysis are included in **Table C-2** and **Table C-3**. The analysis includes consideration of the percent reduction of the total electricity usage for CWA's main panel (Meter #3, Serial Number: 6006918) as reflected in 2022 metering, which indicates whether the size of the array listed for each REM is sufficient for the Airport's needs.[1] The 2022 annual usage of this panel gathered from the utility data was 2,225,400 kWh.

[1] This panel is located just east of the terminal along CWA Drive and serves the terminal building, air traffic control tower, maintenance facility, rental car building, FBO building, and airfield lighting vault.

Table C-2 Renewable Energy Measure Analysis

Renewable Energy Measure (REM)	Approximate Array Area (sq. ft.)	Annual Production (kWh)	Photovoltaic (PV) Capacity (kW-DC*)	% Reduction in Electrical Usage	Emissions Offset (metric tons CO2)***
REM #1 SRE Rooftop	32,000	396,000	320	18%	280
REM #2 Parking Lot Carports	90,000	1,891,000	1,530	85%**	1,350
REM #3 Ground Mounted	275,000	1,891,000	1,402.5	85%**	1,350

Notes: * Kilowatts calculated on the basis of direct current.
** To avoid oversizing the arrays, the reduction in electrical usage was capped at 85% of annual consumption drawn from 2022 full year meter data (2,225,400 kWh). There is more space available in REMs #2 and #3 if more capacity is desired.
***Assumed 1,582.1 lbs/MWh from grid; conversion sourced from the EPA eGRID

Table C-3 summarizes PV costs and two potential funding and incentive scenarios along with payback periods for those scenarios. Because Airport Improvement Program (AIP) funding for solar projects is highly competitive and solar projects have historically ranked low on the FAA's priority ranking system, payback was calculated for the Investment Tax Credit (ITC) only as well as AIP funding plus the ITC.

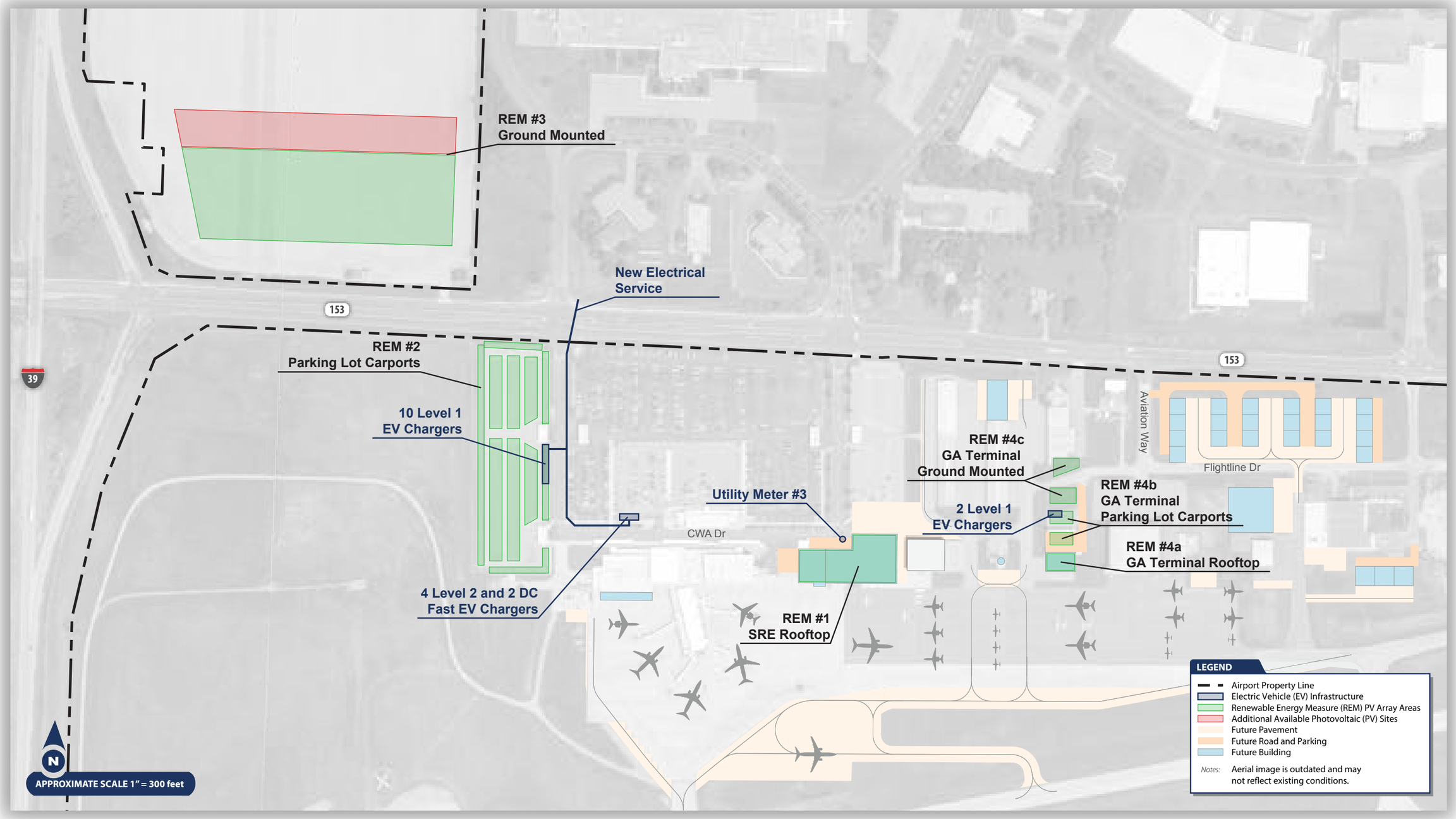
Table C-3 Renewable Energy Measure Financial Summary

Renewable Energy Measure (REM)	Energy Use Reduction (kWh/yr)	Energy Cost Reduction ($/yr)	Photovoltaic Cost	Investment Tax Credit (ITC) (30%)*	AIP Funding** + ITC	Simple Payback With ITC Only (years)	Simple Payback With AIP + ITC (years)
REM #1 SRE Rooftop	721,000	$21,800	$800,000	$240,000	$744,000	26	2.6
REM #2 Parking Lot Carports	1,891,000	$104,000	$5,270,000	$1,580,000	$4,909,000	35	3.5
REM #3 Ground Mounted	1,891,000	$104,000	$2,800,000	$840,000	$2,608,000	19	1.9

Notes: * Meeting ITC prevailing wages requirement needed to receive 30% tax credit; if not met, credit will be 6%.
** For the purpose of this analysis, AIP funding is assumed to be 90%. AIP funding would be through a competitive grant process and is not guaranteed.

Figure C-1 shows the potential locations assessed for the installation of solar photovoltaic infrastructure.

Figure C-1 **Proposed Electric Vehicle Infrastructure & Potential Solar Sites**



During the Terminal Area Master Plan (TAMP), the Airport expressed a desire to achieve net-zero with its proposed new GA terminal building. As the GA terminal is in the planning stage and has not yet progressed into design, it is difficult to accurately estimate the building's energy use intensity (EUI), which is a metric that expresses a building's energy use as a function of its size or other characteristics. During the design stage, the project team will be able to hone in on the energy demand of the new facility with greater specificity. For this solar feasibility report, the GA terminal was assumed to have a conservative EUI of 130, which was converted to an annual energy consumption of about 190,500 kWh. This Study then identified and evaluated a number of potential solar array sites (REMs #4a, #4b, and #4c) that could contribute to the GA terminal building achieving net-zero. As solar is typically only used to offset a building's electrical usage, the Airport will consider additional renewable energy sources during preliminary design or project design to achieve their net-zero goal. The project team anticipates the new GA terminal rooftop alone would not accommodate a PV system large enough to fully offset the building's estimated energy consumption, so additional carport and ground-mounted PV array options were also identified, as shown in **Tables C-4** and **C-5** and **Figure C-1**. The percent reduction in electrical usage indicates the anticipated amount each REM may contribute to offsetting the GA terminal's estimated electrical usage.

Table C-4 GA Terminal Renewable Energy Measure Analysis

Renewable Energy Measure (REM)	Approximate Array Area (sq. ft.)	Annual Production (kWh)	Photovoltaic (PV) Capacity (kW-DC*)	% Reduction in Electrical Usage**	Emissions Offset (metric tons CO2)***
REM #4a GA Terminal Rooftop	4,000	49,500	40	26%	36
REM #4b GA Terminal Parking Lot Carports	8,100	171,000	138	90%	123
REM #4c GA Terminal Ground Mounted	8,100	56,000	41.4	29%	40

Notes: * Kilowatts calculated on the basis of direct current.
** The GA Terminal was assumed to have an EUI of 130, converting to an annual consumption of about 190,500 kWh.
***Assumed 1,582.1 lbs/MWh from grid; conversion sourced from the EPA eGRID

Table C-5 GA Terminal Renewable Energy Measure Financial Summary

Renewable Energy Measure (REM)	Energy Use Reduction (kWh/yr)	Energy Cost Reduction ($/yr)	Photovoltaic Cost	Investment Tax Credit (ITC) (30%)*	AIP Funding** + ITC	Simple Payback With ITC Only (years)	Simple Payback With AIP + ITC (years)
REM #4a GA Terminal Rooftop	49,500	$2,700	$100,000	$30,000	$93,000	26	2.6
REM #4b GA Terminal Parking Lot Carports	171,000	$9,400	$476,000	$143,000	$443,000	35	3.5
REM #4c GA Terminal Ground Mounted	56,000	$3,000	$83,000	$25,000	$77,000	19	1.9

Notes: * Meeting ITC prevailing wages requirement needed to receive 30% tax credit; if not met, credit will be 6%.
** For the purpose of this analysis, AIP funding is assumed to be 90%. AIP funding would be through a competitive grant process and is not guaranteed.

The photovoltaic costs do not include the cost of connecting the array(s) to the point of use. This cost will be most significant in REM #3 Ground Mounted, due to the distance between the array site and the airport. The Carport cost estimate includes the carport structure and all associated sitework.

C.3 Funding and Incentives

There are a variety of funding sources and other financial incentives that can be used to support solar development. Some applicable programs to explore and consider are described below.

C.3.1 FAA Airport Improvement Program (AIP) Grants

These grants serve as a crucial funding source for airport infrastructure enhancements. Allocations of AIP funding are determined annually, contingent upon passenger volume. In cases where airport capital initiatives surpass entitled funds, the FAA supplements them with discretionary funding. Projects involving rehabilitation, reconstruction, replacement, and new construction qualify for AIP assistance.

Chapter 3, Section 70 of the AIP Handbook pertains to the Criteria for Energy Efficiency Improvement Costs. For energy efficiency improvement costs to be deemed permissible:

a) Expenses must be incurred for measures enhancing the efficiency of an airport building, aligning with criteria defining high-performance green buildings as outlined in the Energy Independence and Security Act of 2007.
b) Any increments in initial project costs must be counterbalanced by anticipated lifecycle savings, necessitating adherence to FAA guidelines for lifecycle cost assessment.

c) Costs for building projects must relate to eligible and warranted airport building projects, rather than being solely justified by energy efficiency enhancements.
d) Expenses should only encompass essential project components such as design, construction, testing, and inspection, excluding expenses tied to obtaining LEED or comparable certification.
e) Costs must be proportioned when applicable to both eligible and ineligible areas within a building, as well as adhering to guidelines regarding the inclusion of non-AIP funded work in contracts.
f) Project sponsors must furnish initial project costs, projected lifecycle savings, lifecycle cost calculations, and proration calculations to the FAA Airports District Office (ADO).
g) Redesign or modification expenses for integrating energy efficiency measures into ongoing construction are allowable only to the extent that preceding design costs are excluded from AIP-funded projects.

While eligibility for PV-only projects unrelated to a specific building is not fully apparent in these guidelines, more recently, stand-alone solar projects, including solar carports, have been awarded Supplemental Appropriation discretionary AIP funds[2] [3]. These discretionary funds are competitive (as compared with entitlements that are a set amount each year), and because of the highly competitive nature may not ultimately amount to 90 percent of total project funding. Because of this potential funding gap, the Airport should consider other funding and incentive programs alongside potential discretionary AIP funding.

C.3.2 FAA Energy Efficiency AIP Grants (Section 512)

Section 512 of the FAA Modernization and Reform Act of 2012 (Section 512) is an AIP discretionary program. Funding is awarded by Region and Section 512 projects are focused on energy savings, which could include projects related to energy efficiency, integration of renewable energy, or similar projects. The Section 512 Program was established to increase energy efficiency of airport power sources by making these types of projects eligible for AIP funding. Under a Section 512 grant, an energy efficiency project would be scored against other discretionary projects in the Region, and it would compete against other projects for which the sponsor may be requesting discretionary funding. While the FAA has not issued formal guidance for the Section 512 Program, the FAA has funded several types of projects including the purchase and installation of solar PV systems at airports. Under Section 512, an "energy assessment" would need to be performed that includes an ROI, comprehensive energy consumption audits, and solar energy production (if applicable) and allocation estimates to support the grant application. These are stand-alone grants but require comprehensive assessment to prove the energy savings. Design would need to identify targeted energy efficiency projects to pursue these grants. Section 512 funding may be most applicable for the proposed net-zero GA terminal as it can be used for part of a larger project but is not able to be used for standalone solar projects. If the Airport is interested in pursuing Section 512 funding, early

[2] FAA Invests Nearly $92 Million to Help Airports Reach President's Goal of Net Zero-Emissions by 2050 | Federal Aviation Administration. https://www.faa.gov/newsroom/faa-invests-nearly-92-million-help-airports-reach-presidents-goal-net-zero-emissions-2050#.
[3] Airport Improvement Program (AIP) 2022-2024 Supplemental Appropriation | Federal Aviation Administration (faa.gov). https://www.faa.gov/airports/aip/aip_supplemental_appropriation.

coordination with the FAA ADO and Wisconsin BOA about the potential for funding under this program is recommended.

C.3.3 FAA AIP Supplemental Appropriation Discretionary Funds

In March 2022, the President signed into law "Further Consolidated Appropriations Act, 2022," which included an additional $547 million of discretionary grants. Approximately half of this was specified for Community Project Funding/Congressionally Directed Spending. The remaining $268 million was part of the Supplemental Grant Program commonly referred to as the "Climate Challenge." Applicants seeking funding under the Climate Challenge were required to document how their projects reduced emissions and improved access for disadvantaged communities. Grants were awarded in summer of 2023. Examples of projects that were funded include solar panels and associated infrastructure, electric buses, charging stations and electrification studies. It is anticipated that FAA may do a Climate Challenge each year, so this is a funding source CWA should continue to track.

C.3.4 FAA Bipartisan Infrastructure Law (BIL) Grants

For a period of five years, beginning in 2022, FAA is awarding nearly $1 billion annually from the Bipartisan Infrastructure Law (BIL) Airport Terminal Program (ATP) to airports across the US to improve terminals, including increasing energy efficiency. During this same period, the FAA is also awarding $3 billion annually from the BIL Airport Infrastructure Grant Program (AIG) for "runways, taxiways, safety and sustainability projects, as well as terminal, airport-transit connections and roadway projects." If CWA intends to pursue BIL funding for a solar project, early coordination with the FAA ADO and Wisconsin Bureau of Aeronautics (BOA) is recommended.

C.3.5 Inflation Reduction Act (IRA)

The Inflation Reduction Act (IRA) (H.R.5376) was signed into law on August 16, 2022, providing an unprecedented $369 billion of federal funding for energy and climate provisions. This legislation fundamentally revises the tax code to incentivize the deployment of low-carbon technologies. The IRA allows taxpayers, in some situations, to elect a direct pay option instead of a tax credit, or the option to monetize the credits by transferring them to another entity. So even if a public or governmental entity represents an airport, that entity can directly benefit from the incentives without having to go to a third party such as a power purchase financier for developments, who may or may not pass on the entire tax incentives directly to the owner. This applies to alternative vehicle fueling, renewable electricity production, carbon sequestration, clean hydrogen, zero-emission nuclear power, and more. Battery storage and geothermal also apply in addition to solar and wind systems.

The IRA includes provisions to expand the Federal Tax Credit for Solar Photovoltaics, otherwise known as the Investment Tax Credit (ITC). Those who install a PV system between 2022 and 2032 are eligible for a 30 percent tax credit. Tax-exempt entities are eligible to receive the ITC themselves in the form of a direct payment. This financial incentive provides renewable technologies to airports to accelerate their sustainability and net-zero initiatives and reduce operating budgets. The initial 30 percent incentive will

allow airports to consider implementing renewable energy (including solar and battery storage) at low costs. As a government unit, an airport can still use these tax credits and own the renewable technology.

The ITC also offers two bonus credits[4] for which CWA may be eligible that can be stacked on top of the 30 percent tax credit. According to the U.S. Department of Energy's Energy Community Tax Credit Bonus mapping tool, CWA is located within an IRA-defined "energy community," as it is in a directly adjoining census tract to a census tract in which a coal mine was closed after 1999 or in which a coal-fired electric generating unit was retired after 2009[5]. This means CWA could qualify for an additional 10 percent tax credit. Further, if a project qualifies for the domestic content bonus, it is eligible for an additional 10 percent tax credit. Layering these two bonus credits means CWA could potentially achieve up to a 50 percent tax credit for a solar energy project; however, eligibility should be confirmed on a project-by-project basis.

The ITC is claimed by submitting IRS Investment Credit form 3468 with the annual tax return. The 30 percent ITC credit was included in the payback calculations.

C.3.6 Focus on Energy

Focus on Energy is a Wisconsin statewide program for energy efficiency and renewable energy that helps eligible businesses save energy and money while protecting the environment. Focus on Energy information, resources, and financial rebates help to implement energy efficiency and renewable energy projects. Rebates are based on PV system size. See 2023 solar rebates and incentives in **Table C-6**.

Table C-6 Business Customer Solar PV Incentives

System Size in kW (DC)	Incentive	Maximum Incentive
Up to 5 kW	$200 per kW	$1,000
5-10 kW	$1,000 + $150 per kW above 5 kW	$1,750
10-100 kW	$1,750 + $125 per kW above 10 kW	$13,000
100-300 kW	$13,000 + $100 per kW above 100 kW	$33,000
300-500 kW*	$33,000 + $85 per kW above 300 kW	$50,000

Source: Focus on Energy.
Notes: *Solar PV systems 500 kW and above will be capped at the maximum incentive of $50,000.

Focus on Energy's New Construction Online Tool for businesses offers technical and financial support to design teams, owners, builders, and developers throughout all stages of the design and construction process through energy design assistance and energy design review. This tool can be used for new buildings as well as for substantial renovations or major additions to existing buildings. Through this tool, Focus on Energy also offers financial incentives for designing solar-ready buildings.

[4] https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses
[5] https://energycommunities.gov/energy-community-tax-credit-bonus/

As Federal funding sources are becoming increasingly more competitive, it is recommended that CWA strongly consider local funding for the projects evaluated in this Study.

C.4 Recommendations

Based on the solar feasibility analysis and the available incentives, recommendations for CWA include:

1. Complete an Ocular Impact (Solar Glare) Analysis: FAA Policy, *Review of Solar Energy System Projects on Federally-Obligated Airports*, encourages airport sponsors to "conduct an ocular analysis of potential impacts to air traffic control tower (ATCT) cabs prior to submittal of a Notice of Proposed Construction or Alteration Form 7460–1." With the submittal of this form, the sponsor confirms it has analyzed the potential for glint (a momentary flash of bright light) and glare (a continuous source of bright light) and "determined there is no potential for ocular impact to the airport's ATCT cab." The FAA is then able to evaluate the PV system, "with assurance that the system will not impact the ATCT cab."
2. Leverage AIP Grants: CWA should take full advantage of the FAA Airport Improvement Program (AIP) grants. Ensure that the energy efficiency improvements align with the AIP guidelines outlined in Chapter 3 of the AIP handbook to make them eligible for funding.
3. Explore Federal Investment Tax Credit (ITC): With the availability of the 30% ITC credit, CWA should consider claiming this credit to further reduce the initial costs of the solar energy project. This incentive significantly improves the project's financial viability and accelerates the return on investment.
4. Engage with Focus on Energy, Utility Provider (WPS), and Local Government: The Focus on Energy program can provide additional financial support and expertise for implementing energy efficiency and renewable energy projects. In partnership with Focus on Energy, CWA can explore photovoltaic system rebates and other incentives to reduce project costs further. CWA should also coordinate with its utility provider (WPS) and local government units to understand and comply with all state and local building codes, ordinances, and requirements.
5. Monitor Energy Efficiency: In parallel with the solar project, continue to monitor and assess energy efficiency measures within airport buildings. Ensure that energy efficiency improvements align with the criteria for energy efficiency improvement costs, as outlined in the Energy Independence and Security Act of 2007. These improvements can complement the renewable energy initiatives and further reduce overall energy expenses.
6. Long-Term Sustainability: As CWA moves forward with solar energy integration, it's essential to consider long-term sustainability and maintenance plans.
7. Consider additional PV opportunities: As CWA continues the build-out of its Terminal Area Master Plan, it should assess the feasibility of adding PV panels to any new roof throughout the Airport campus.

The pros and cons of each REM are included in **Table C-7**.

Table C-7 Pros and Cons

Renewable Energy Measure (REM)	Pros	Cons
REM #1 SRE Rooftop	• Located nearest to terminal (shortest distance to the end use) • Only slightly longer payback period than REM #3	• Not as much capacity available as the other options
REM #2 Parking Lot Carports	• Provides an opportunity for increased revenue from premium parking • Close to terminal (end use) • Capacity to serve full electrical needs of the Airport and expand, if needed • Spatially efficient layout	• Most expensive option • Longest payback period
REM #3 Ground Mounted	• Shortest payback period (without connection costs included) • Capacity to serve full electrical needs of the Airport and expand, if needed	• Furthest from terminal (end use) • Will require connecting to terminal, which will add costs • Potential loss of revenue from leases for non-aeronautical uses • Location outside of currently developed airport area may require more in-depth environmental review than other options
REM #4 GA Terminal	• Supports CWA and FAA net-zero goals • Greater PV funding opportunities as part of a larger project	• Limited capacity on the proposed building rooftop, may need mix of roof-mounted, carports, and ground-mounted

C.5 Conclusion

The solar feasibility analysis for CWA presents several opportunities for the integration of PV systems into the airport's infrastructure. Three distinct solar strategies, including rooftop installations, parking lot carports, and ground-mounted arrays, were evaluated based on various parameters such as energy generation, cost savings, and efficiency.

The results indicate that each of the three strategies could significantly reduce the airport's electrical usage, with the highest reductions achieved through either the carport or ground-mounted strategies. These energy savings could reduce the annual energy cost for the terminal by up to $104,000 for either the carports or ground-mounted arrays, and by up to $21,800 for the rooftop installation. For the GA terminal, the rooftop installation could save an estimated $2,700 annually. With the addition of carport and/or ground-mounted PV installations to contribute to the GA terminal’s net-zero goal, CWA could realize additional savings.

Financially, the investment in these renewable energy measures demonstrates reasonable payback periods, ranging from 19 to 35 years with the ITC rebate applied, and 1.9 to 3.5 years with both the AIP grants (assuming 90 percent AIP funding) and the ITC applied.

CWA can not only enhance its environmental sustainability but also realize significant cost savings and contribute to the broader goal of reducing carbon emissions in the aviation industry.