CITY OF DULUTH

Site Assessment & Evaluation for Solar PV & Storage

STUDY PHASE FINAL REPORT

May 30, 2024

LHB PROJECT #230690

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INTRODUCTION

The City of Duluth, with the support of federal funding through the Department of Energy Solar Energy Technologies Office, is developing a cold-climate resiliency toolkit for midwestern cities. The funding includes opportunities to evaluate City-owned properties for their suitability for solar photovoltaic (PV) and battery storage. LHB conducted a preliminary evaluation of ten city-owned properties identified by the City as the best potential locations for solar PV and battery storage. Site evaluation included a site visit, desktop analysis of PV potential using PVComplete (Sketch and CAD) design software, preliminary PV and racking selection, and review of existing structural capacity/compatibility for solar PV using readily available information.

The ten locations evaluated were:

1. Middle Pump Water Reservoir located at 131 E 13th Street
2. Bayview Pump Water Reservoir located at 6300 Highland Street
3. Lincoln Park Water Reservoir located at 2798 W 10th Street
4. Water Treatment Plant located at 8141 Congdon Boulevard
5. Police Headquarters located at 2030 N Arlington Avenue
6. Fire Hall 2 located at 2627 W Superior Street
7. City Center West and Fire Hall 8 located at 5830 Grand Avenue
8. Morgan Park Community Center located at 1302 88th Ave W
9. Gary-New Duluth Community Center located at 817 101st Ave W
10. Customer Service/Property Maintenance Building located at 520 Garfield Avenue

The site selection matrix results prepared by the City of Duluth were updated to incorporate LHB's site analysis. This report includes a summary for each location identifying the updated site evaluation score, PV generation potential, equipment selection, structural considerations, battery storage approach, and development risks. Existing power use and costs are the average of 2022 and 2023 recorded data for each site.

STRUCTURAL CONSIDERATIONS

The structural capacity to accommodate solar PV equipment varies at each location evaluated. The Water Treatment Plant is the only location where a ground-mount system has been proposed, utilizing a fixed panel racking solution. The remaining locations include a mix of buildings with either flat or sloped roofs and below grade water reservoirs with flat or sloped roof lids. The flat locations are modeled with ballasted at-grade racking. The sloped roof locations assume direct mounting PV panels to the roofing.

Of the flat roof buildings, several have roof membranes secured by ballast rock. For these locations, there are several possible solutions to accommodate a solar PV system. The most extensive solution involves removing all ballast rock and replacing the roof membrane with a fully adhered or mechanically fastened membrane prior to installing the solar PV system. An alternative solution may be to selectively remove the ballast rock in the footprint of the PV system and mechanically secure the roof membrane.

For this report, the structural evaluation assumes the roof capacity to accommodate the solar PV system is achieved by removal of the existing roof ballast material and modifying the roof system with mechanical fasteners or a fully adhered system.

The preliminary review of the various building sites and structures is based on the 2020 Minnesota State Building Code (MSBC) which adopts the 2018 International Building Code (IBC). The code parameters that determine the

capacity of the existing roof framing or reservoir lid structure include calculating the dead load, roof live load, rain load, snow load, ice load, and wind load. These loads are then applied to the structure in predefined load combinations and compared to the strength of the framing members. If the strength of the framing members exceeds the applied loads, then the PV system may be placed without modification to the existing structure. If the strength of the framing members is less than the applied load, reinforcement of modification to the existing framing system would be required to install the PV system.

Modification of the existing structure may include removal of the roof ballast or changing the fastening method of the roof membrane. Reinforcement of the existing structure may include adding new framing members in between the existing framing members, placement of poles directly over piers or columns, or complete replacement of deteriorated structures. Other considerations in placement of the solar PV systems include locating panels away from high/low roof conditions to avoid snow drift regions, placement of PV systems away from obstructions that may shade the panels and placing panels a minimum distance from the edge of the building to accommodate future maintenance and repairs without requiring fall protection. For the modeled locations, PV equipment has been placed at least three (3) feet from roof edges and three (3) feet from the peak for buildings with roof slopes greater than 2:12 pitch to allow two access routes to the peak (MN Administrative Rules 3111.3.4.1.1 and 3111.3.4.1.2). PV equipment has been placed at least ten (10) feet from roof edges for buildings with roof slopes less than 2:12 (IBC 1013.5), however MN Administrative Rule 3111.3.4.2.1 may allow for equipment placement within six (6) feet of roof edges.

ELECTRICAL CONSIDERATIONS

Two of the ten locations (Bayview and Lincoln Park) evaluated have been modeled to produce solar power significantly exceeding 120% of the annual electrical load. For these locations, an interconnect study and agreement will need to be completed with Minnesota Power for acceptance of the excess power by the distribution system. This will likely include upgrading the existing service to the Bayview site and a new or significantly upgraded service at the Lincoln Park site.

For the remaining locations producing PV power less than 120% of annual load, net metering is the assumed basis of operation for PV generation balanced against real time electrical demand. Additional analysis will confirm sizing and location for electrical equipment to interconnect with the existing power distribution system at each site.

SOLAR PV EQUIPMENT

Solar panels manufactured by Heliene (www.heliene.com) were modeled for all locations. Heliene's US Manufacturing plant is in Mountain Iron, Minnesota. Solar PV racking manufactured by Unirac (www.unirac.com) and power inverters manufactured by SolarEdge (www.SolarEdge.com) were evaluated for all locations (roof mount and ground mount).

Solar panel manufacturers report the expected degradation of energy production over time. The Heliene panels are designed to not degrade by more than 1% of their rated power output through the first year of operation and 0.4% annual degradation thereafter. These performance targets are backed by a 15-year product warranty and a 25-year linear performance guarantee.

MIDDLE PUMP WATER RESERVOIR

131 E 13th Street

The Middle Pump Water Reservoir, initially constructed in 1923 and reconstructed in 1975, includes two round concrete vaults; one fully buried (outline added for reference), and one partially buried with an exposed concrete lid.

Standard Power Rate: **$0.10/kWh**
Avg. Annual Cost: **$143,633**
Avg. Annual Demand Cost: **$50,842**

Preliminary Site Assessment Score: **86**
Revised Site Assessment Score: **75**

Exposed Water Reservoir (facing north)

The exposed concrete on the northernmost reservoir has significant cracking and spalling which will require replacement prior to installing a PV system. The interior of the reservoir will need to be inspected to assess the overall structural integrity.

Buried Water Reservoir (facing northwest)

The fully buried reservoir is anticipated to be in a similar poor structural condition as the exposed top reservoir. The interior of the reservoir will need to be inspected to assess the overall structural integrity.

Middle Pump Water Reservoir

PV Size (kW DC): **805.6**

PV Panels: **1289** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **6** SolarEdge SE110KUS

PV Year 1 Production (kWh): **955,999**

Avg. Annual Load (kWh): **906,692**

PV % of Load: **105%**

Battery Storage

None proposed. City of Duluth has mobile generators that could be deployed in the event of a power outage affecting the facility.

Identified Risks

Full replacement/rehabilitation of the existing water reservoirs needed due to observed concrete deterioration.

BAYVIEW PUMP WATER RESERVOIR

6300 Highland Street

The Bayview Pump Water Reservoir, reconstructed in 2014, is a rectangular partially buried vault with an exposed concrete lid. The site is within security fencing and can be accessed from Highland Street.

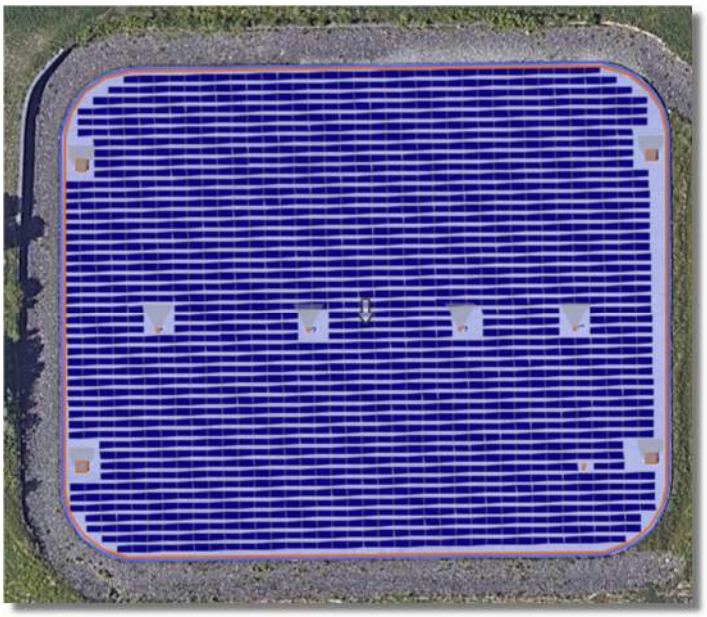
Standard Power Rate: **$0.13/kWh**
Avg. Annual Cost: **$38,625**
Avg. Annual Demand Cost: **$10,143**

Preliminary Site Assessment Score: **90**
Revised Site Assessment Score: **89**

Water Reservoir (facing south)

The reservoir has the structural capacity to accommodate the additional structural load from the PV system. The concrete surface is in excellent condition.

Water Reservoir (facing northeast)



Bayview Pump Water Reservoir

PV Size (kW DC): **1,043**

PV Panels: **1668** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **3** SolarEdge SE330KUS

PV Year 1 Production (kWh): **1,230,878**

Avg. Annual Load (kWh): **225,048**

PV % of Load: **547%**

Battery Storage

None proposed, excess power to be directed to the power distribution system.

Identified Risks

PV generation exceeds electrical load by 547%. An assessment of grid suitability and interconnection with Minnesota Power needs to be completed.

LINCOLN PARK WATER RESERVOIR

2798 W 10th Street

The Lincoln Park Water Reservoir was originally constructed in 1951 and consists of six cylindrical buried concrete reservoirs (outlines added for reference). The site does not use power other than for minimal monitoring equipment. Therefore, PV generation at this site would be directed entirely to the power grid.

Standard Power Rate: **n/a**
Avg. Annual Cost: **n/a**
Avg. Annual Demand Cost: **n/a**

Preliminary Site Assessment Score: **79.5**
Revised Site Assessment Score: **80**

Buried reservoirs with access points and vents (facing south)

Select removal of the soil cover for inspection of the concrete roof as well as inspection of the interior of the reservoirs will need to be completed to assess the overall structural integrity and corrective measures. Partial or full removal of the soil cover would support installation of a ballasted PV system. Perimeter security fencing would be added.

Buried reservoirs with access points and vents (facing north)

Lincoln Park Water Reservoir

PV Size (kW DC): **819**

PV Panels: **1311** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **2** SolarEdge SE330KUS

PV Year 1 Production (kWh): **961,468**

Avg. Annual Load (kWh): **0**

PV % of Load: **n/a**

Battery Storage

None proposed, all PV generation to be directed to the power distribution system.

Identified Risks

Full replacement/rehabilitation of the existing water reservoirs may be needed to address deterioration and/or insufficient structural capacity.

Excavation to explore structural capacity may be needed. If suitable, landscaping/leveling of surface area for PV array will need to take place.

No on-site power demand for PV generation. An interconnection location and suitability assessment with Minnesota Power has not been initiated.

The site is used as an unofficial community use area along the Superior Hiking Trail

WATER TREATMENT PLANT

8141 Congdon Blvd

The Water Treatment Plant was constructed in 1975 and expanded in 1991. Two areas have been identified for potential solar PV: the treatment plant building roof and a ground-level area northwest of the plant.

Standard Power Rate: **$0.09/kWh**
Avg. Annual Cost: **$830,736**
Avg. Annual Demand Cost: **$232,006**

Water Treatment Plant Roof (facing south)

The treatment plant building roof is a flat rubber membrane overlain with rock ballast and good southerly exposure.

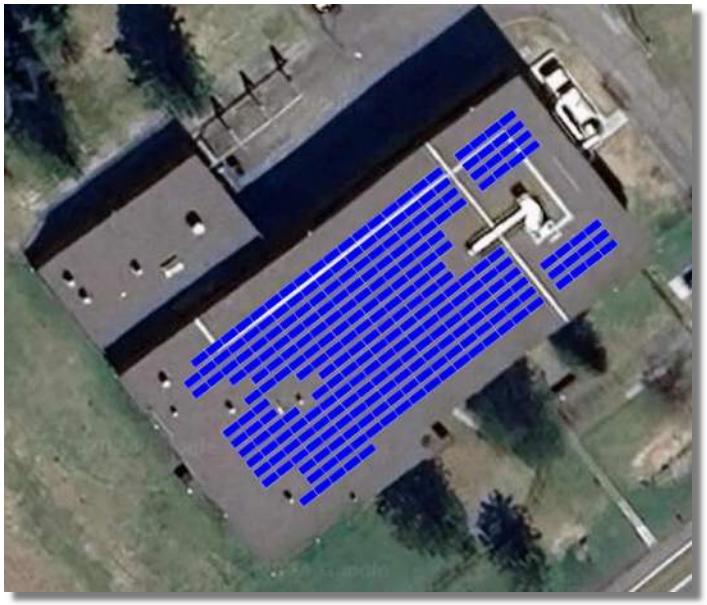
By removing the rock ballast, sufficient structural capacity is achieved to install a ballasted PV system.

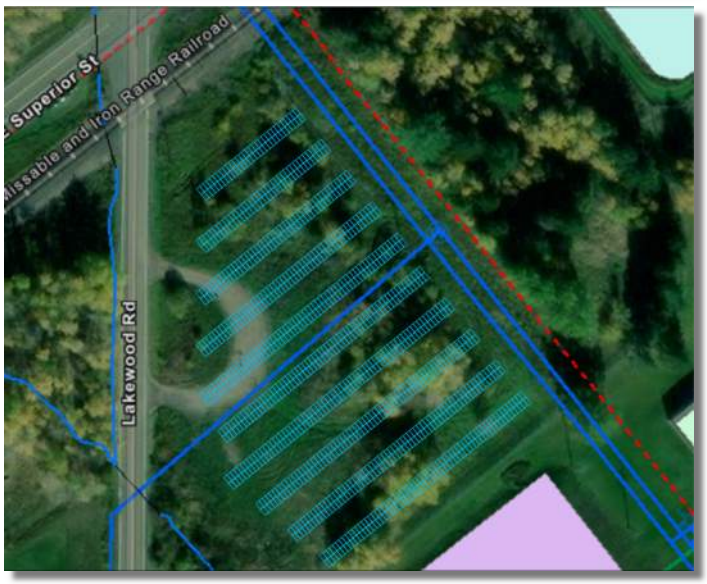
Preliminary Site Assessment Score: **66**
Revised Site Assessment Score: **68**

Water Treatment Plant Ground Mount Area (facing North)

The ground mount area is a mixture of gravel and vegetation bordered by Lakewood Road (west), railroad (north), utility corridor (east), and the treatment plant (south). The ground mount area is gently sloping south.

Preliminary Site Assessment Score: **71**
Revised Site Assessment Score: **66**





Water Treatment Plant (Roof)

PV Size (kW DC): **161**

PV Panels: **257** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **2** SolarEdge SE66.6KUS

PV Year 1 Production (kWh): **186,339**

Avg. Annual Load (kWh): **6,489,000**

PV % of Load: **3%**

Water Treatment Plant (Ground Mount)

PV Size (kW DC): **701**

PV Panels: **1,122** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac Ground Fixed Tilt

Inverters: **5** SolarEdge SE120KUS

PV Year 1 Production (kWh): **859,199**

Avg. Annual Load (kWh): **6,489,000**

PV % of Load: **13%**

Battery Storage

Installation of a large backup generator will be completed before 2026. A battery at this site would be used to offset the high peak power demand charges incurred (~$232,000/yr) to operate the water treatment plant.

Identified Risks

The location and access needs of existing utilities in the vicinity of the ground mount installation needs to be incorporated into the final PV layout.

A geotechnical investigation and a wetland delineation will need to be completed to establish the location and sizing of the ground mount PV racking system. Estimated costs are $30k to complete these studies.

POLICE HEADQUARTERS & SLC BUILDING

2030 N Arlington Avenue

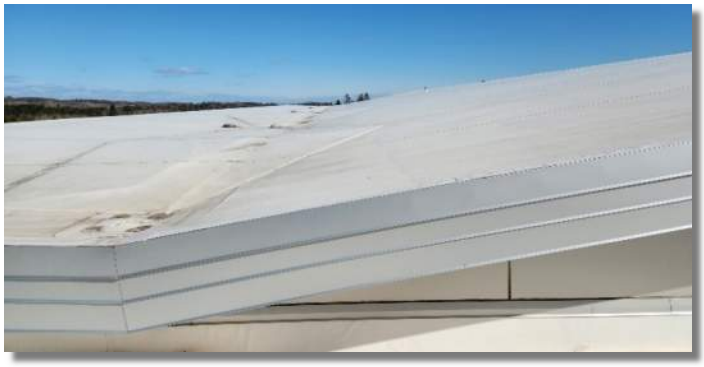
The Police Headquarters was built in 2011 as an addition to the St. Louis County Public Safety Building (SLC). The buildings are primarily flat roof structures including a section of clerestory roof facing north at a 2:12 slope.

Standard Power Rate: **$0.10/kWh**
Avg. Annual Cost: **$81,548**
Avg. Annual Demand Cost: **$17,789**

Preliminary Site Assessment Score: **78**
Revised Site Assessment Score: **68.5**

Police Headquarters (flat roof facing east, clerestory roof left side)

The flat roof sections have an adhered membrane and appear to be in good condition for a ballasted PV installation. However, structural modifications will be required to support the PV system.



Police Headquarters (facing east, clerestory roof with north facing slope)

The clerestory roof has an adhered membrane and appear to be in good condition for a ballasted PV installation. This section does not require structural modifications to accommodate the ballasted PV system.

St. Louis County Building (facing southeast)

The SLC roof is an adhered membrane and appears to be in good condition for a ballasted PV installation. However, structural modifications will be required to support the PV system.

Police Headquarters and SLC Building

PV Size (kW DC): **409**

PV Panels: **654** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

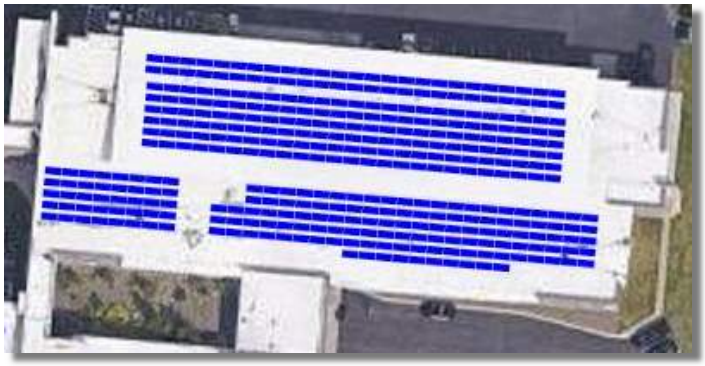
Inverters: **3** SolarEdge SE110KUS

PV Year 1 Production (kWh): **347,982**

Avg. Annual Load (kWh): **624,401**

PV % of Load: **56%**

St. Louis County Public Safety Building



Police Headquarters

Battery Storage

This facility has a large gas-powered backup generator. A battery power solution at this location would be used to offset the peak power demand charges incurred (~$18,000/yr) to operate the police headquarters building.

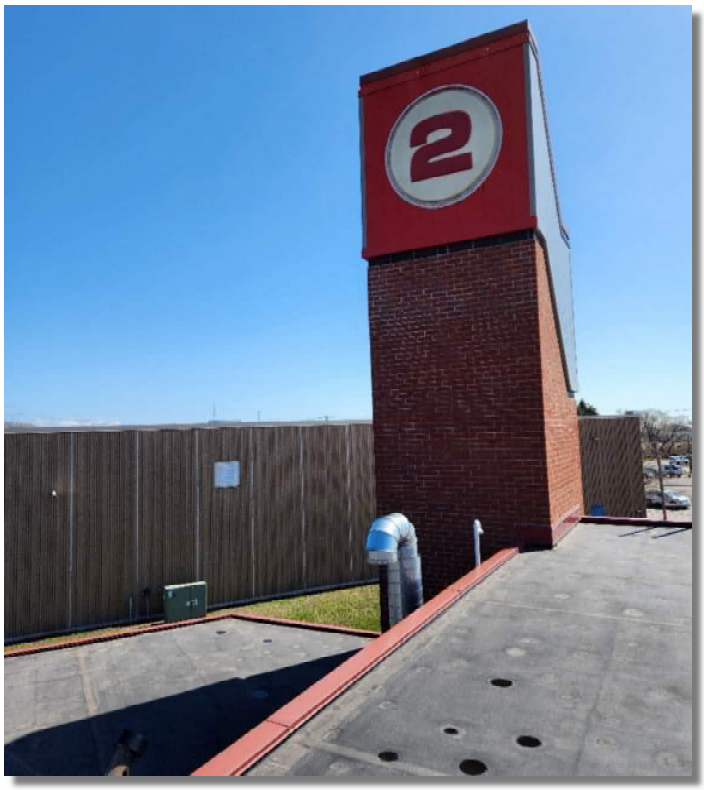
Identified Risks

Structural loading concerns in high snow drift areas south of the clerestory section on the Police Headquarters Building may reduce the available area for PV or require structural improvements to the roof system.

The St. Louis County Building does not have structural capacity to accommodate solar PV without structural modifications.

Shading from adjacent structures onto a majority of the SLC building roof areas and below the clerestory section on the Police Headquarters Building will reduce overall PV generation by approximately 25%. This has been factored into the annual production estimate.

Fire Hall roof (facing southwest)



Fire Hall roof (facing east)

FIRE HALL 2

2627 W Superior Street

Fire Hall 2 was constructed in 1982. The building roof is divided with the north half (office) lower than the south half (garage). A tower on the east side extends above both roof levels.

Standard Power Rate: **$0.05/kWh**
Avg. Annual Cost: **$2,455**
Avg. Annual Demand Cost: **$0**

Preliminary Site Assessment Score: **78**
Revised Site Assessment Score: **71**

The fire hall roof is an adhered rubber membrane with good southerly exposure. The structure has the capacity to support a ballasted PV system.

The north roof has limited sun exposure with shadowing from the south roof and tower.

Fire Hall 2

PV Size (kW DC): **22.5**

PV Panels: **36** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **1** SolarEdge SE17.3KUS

PV Year 1 Production (kWh): **24,752**

Avg. Annual Load (kWh): **50,041**

PV % of Load: **49%**

Battery Storage

The facility has natural gas generators in case of power failure and no peak power demand charges over the past few years, so curtailing peak charges is not necessary. If batteries were designed for this facility, alternative uses such as to support mobile electric equipment or to increase operational resilience could be explored.

Identified Risks

No risks identified.

CITY CENTER WEST & FIRE HALL 8

5830 Grand Avenue

City Center West consists of the Evergreen Senior Center and Library. It is also connected to Fire Hall #8 and the Duluth Police Department.

Standard Power Rate: **$0.12/kWh**
Avg. Annual Cost: **$28,130**
Avg. Annual Demand Cost: **$2,855**

Preliminary Site Assessment Score: **74**
Revised Site Assessment Score: **70**

Library roof (facing northwest)

The senior center, library, and fire hall roof are exposed adhered rubber membrane. The structures can support a ballasted PV system without modification.

Police Department roof (facing southeast)

The police department building is a flat rubber membrane overlain with rock ballast and good southerly exposure.

By removing the rock ballast, sufficient structural capacity is achieved to install a ballasted PV system.

City Center West and Fire Hall 8

PV Size (kW DC): **104**

PV Panels: **166** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-5 7.5 ballasted

Inverters: **3** SolarEdge SE30KUS

PV Year 1 Production (kWh): **114,360**

Avg. Annual Load (kWh): **213,664**

PV % of Load: **54%**

Battery Storage

Fire Hall 8 (and the adjacent Duluth Police Department building) has a natural gas generator in case of power failure. The facility incurs approximately $3,000/year in peak power demand charges, so battery storage could be used to reduce these charges as well as alternative uses such as to support mobile electric equipment or to increase operational resilience.

City Center West and the Library do not have back up power, so battery storage could be designed as a power supply during an electrical outage.

Identified Risks

No risks identified.

MORGAN PARK COMMUNITY CENTER

1302 88TH Ave W

The Morgan Park Community Center (originally named the Goodfellowship Building) was constructed in 1982.

Standard Power Rate: **$0.13/kWh**
Avg. Annual Cost: **$4,726**
Avg. Annual Demand Cost: **$935**

Preliminary Site Assessment Score: **88**
Revised Site Assessment Score: **89**

Community Center (facing northwest)

The Community Center has a metal standing seam roof at a 4:12 pitch. The roof is divided with a south facing section and a north facing clerestory section. Solar panels can be direct mounted to the metal roof without additional structural modifications.

Community Center (facing north)

Community Center (facing west)

Morgan Park Community Center

PV Size (kW DC): **31**

PV Panels: **50** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Direct mount to metal roofing

Inverters: **5** SolarEdge SE5000H-US

PV Year 1 Production (kWh): **33,594**

Avg. Annual Load (kWh): **29,116**

PV % of Load: **115%**

Battery Storage

A battery storage solution for the Morgan Park Community Center could serve as back-up power in the case of grid failure, allowing the facility to serve the community as a resilience hub. Peak power demand costs are low so battery storage would not be used to reduce total power costs.

Identified Risks

No risks identified.

Community Center (facing north)

Community Center (facing west)

Community Center (facing southwest)

GARY NEW DULUTH COMMUNITY CENTER

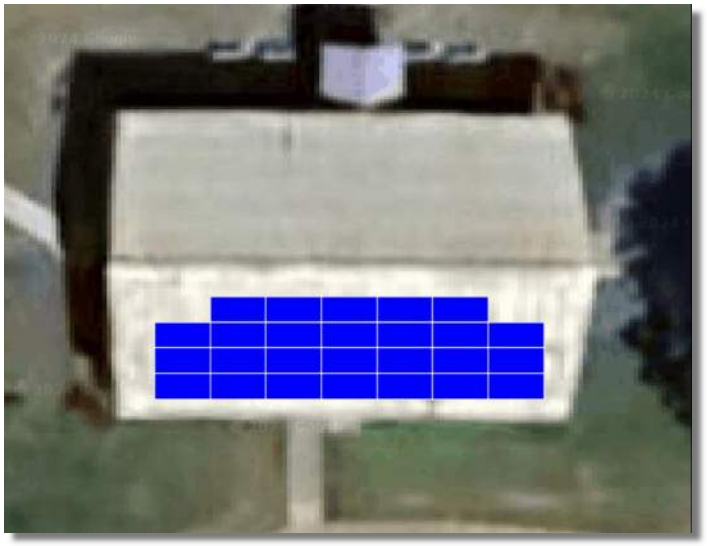
817 101ST Ave W

The Gary-New Duluth Community Center was constructed in 1972.

Standard Power Rate: **$0.17/kWh**
Avg. Annual Cost: **$2,492**
Avg. Annual Demand Cost: **$0**

Preliminary Site Assessment Score: **78.5**
Revised Site Assessment Score: **76.5**

The Community Center has a metal roof at a 2:12 pitch with good southern exposure. Solar panels can be direct mounted to the metal roof, however additional analysis is required to confirm whether structural modifications are needed to accommodate the solar panels.



Gary-New Duluth Community Center

PV Size (kW DC): **16.2**

PV Panels: **26** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Direct mount to metal roofing

Inverters: **1** SolarEdge SE3US and SE11.4KUS

PV Year 1 Production (kWh): **17,611**

Avg. Annual Load (kWh): **14,460**

PV % of Load: **122%**

Battery Storage

A battery storage solution for the Gary-New Duluth Community Center could serve as back-up power in the case of grid failure, allowing the facility to serve the community as a resilience hub. Peak power demand costs are low so battery storage would not be used to reduce total power costs.

Identified Risks

Structural reinforcement of the building roof purlins is likely needed to accommodate the additional load from the solar PV panels.

CUSTOMER SERVICE / PROPERTY MAINTENANCE BUILDING

520 Garfield Avenue

The Duluth Customer Service / Property Maintenance Building was constructed in 2002. The building houses Duluth Public Works and Comfort Systems.

Standard Power Rate: **$0.10/kWh**
Avg. Annual Cost: **$56,815**
Avg. Annual Demand Cost: **$15,202**

Preliminary Site Assessment Score: **72**
Revised Site Assessment Score: **78**

Service Center (facing south)

The Service Center roof is a flat rubber membrane overlain with rock ballast and good southerly exposure.

By removing the rock ballast, sufficient structural capacity is achieved to install a ballasted PV system.

Service Center (facing west)

Customer Service / Property Maintenance Building

PV Size (kW DC): **427**

PV Panels: **687** Heliene 156 Half-Cut Monocrystalline 605W - 625W Bifacial Modules

PV Racking: Unirac RM-10 ballasted

Inverters: **3** SolarEdge SE110KUS

PV Year 1 Production (kWh): **491,239**

Avg. Annual Load (kWh): **402,438**

PV % of Load: **122%**

Battery Storage

This facility has gas-powered backup generators. A battery power solution at this location would be used to offset the peak power demand charges incurred (~$15,000/yr) to operate the facility.

Identified Risks

No risks identified.

APPENDIX

1. SITE SOLAR EVALUATION SUMMARY
2. HELIENE 156HC M10 TPC SL BIFACIAL MODULE
3. UNIRAC FLAT ROOF SOLUTIONS COMPARISON GUIDE
4. UNIRAC GROUND FIXED TILT
5. SOLAREDGE INVERTERS

Site Solar Evaluation Summary

Site Use/Name	Address	Assessment	Score	PV Array Size (kW DC)	Estimated Cost (@ $3.13/W)	Annual PV (kWh)	Annual Load (kWh)	PV % of Load %	Annual Electric Cost $	Potential Annual Savings* $	Possible IRA Rebate %	Rebate Amount $	Simple Payback (years)
Pump: Middle	131 E 13th St	Initial	86	1025	$ 3,208,250	1,339,971	906,692	148%	$ 143,633.35	$ 165,297.30	50%	$ 1,604,125.00	9.7
		Revised	75	805.6	$ 2,521,528	955,999	906,692	105%	$ 143,633.35	$ 151,444.30	50%	$ 1,260,764.00	8.3
Pump: Bayview	6300 Highland	Initial	90	818	$ 2,560,340	1,065,471	225,048	473%	$ 38,625.47	$ 80,646.62	70%	$ 1,792,238.00	9.5
		Revised	89	1043	$ 3,264,590	1,230,878	225,048	547%	$ 38,625.47	$ 88,916.97	70%	$ 2,285,213.00	11.0
Reservoir: Lincoln Park	2798 W 10th St	Initial	79.5	838	$ 2,622,940	1,044,841	-	n/a	$ -	$ 52,242.05	60%	$ 1,573,764.00	20.1
		Revised	80	819	$ 2,563,470	961,468	-	n/a	$ -	$ 48,073.40	60%	$ 1,538,082.00	21.3
Water Treatment Plant (Bldg)	8141 Congdon Blvd	Initial	66	126	$ 394,380	157,090	6,489,000	2%	$ 830,735.61	$ 20,111.00	40%	$ 157,752.00	11.8
		Revised	68	161	$ 503,930	186,339	6,489,000	3%	$ 830,735.61	$ 23,855.52	40%	$ 201,572.00	12.7
Water Treatment Plant (Site)	8141 Congdon Blvd	Initial	71	1099	$ 3,439,870	1,441,439	6,489,000	22%	$ 830,735.61	$ 184,536.09	40%	$ 1,375,948.00	11.2
		Revised	66	701	$ 2,194,130	859,199	6,489,000	13%	$ 830,735.61	$ 109,996.49	40%	$ 877,652.00	12.0
Police Headquarters	2030 N Arlington Ave	Initial	78	485	$ 1,518,050	408,361	624,401	65%	$ 81,547.55	$ 53,332.46	40%	$ 607,220.00	17.1
		Revised	68.5	409	$ 1,280,170	347,982	624,401	56%	$ 81,547.55	$ 45,446.88	40%	$ 512,068.00	16.9
Fire Hall 2	2627 W Superior St	Initial	78	34	$ 106,420	43,410	50,041	87%	$ 2,454.82	$ 2,129.53	60%	$ 63,852.00	20.0
		Revised	71	22.5	$ 70,425	24,752	50,041	49%	$ 2,454.82	$ 1,214.24	60%	$ 42,255.00	23.2
City Center West / Fire Hall 8	5830 Grand Ave	Initial	74	166	$ 519,580	210,588	213,664	99%	$ 28,129.55	$ 27,724.58	60%	$ 311,748.00	7.5
		Revised	70	104	$ 325,520	114,360	213,664	54%	$ 28,129.55	$ 15,055.86	60%	$ 195,312.00	8.6
Morgan Park Community Center	1302 88th Ave W	Initial	88	30	$ 93,900	38,864	29,116	133%	$ 4,726.20	$ 5,213.60	50%	$ 46,950.00	9.0
		Revised	89	31	$ 97,030	33,594	29,116	115%	$ 4,726.20	$ 5,453.08	50%	$ 48,515.00	8.9
Gary-New Duluth Community Center	817 101st Ave W	Initial	78.5	6	$ 18,780	5,784	4,820	120%	$ 830.67	$ 996.80	40%	$ 7,512.00	11.3
		Revised	76.5	16.2	$ 50,706	17,611	14,460	122%	$ 2,492.00	$ 2,649.55	40%	$ 20,282.40	11.5
Customer Service (Property Mntce)	520 Garfield Ave	Initial	72	447	$ 1,399,110	543,452	402,438	135%	$ 56,815.39	$ 63,866.09	60%	$ 839,466.00	8.8
		Revised	78	427	$ 1,336,510	491,239	402,438	122%	$ 56,815.39	$ 61,255.44	60%	$ 801,906.00	8.7

*assumes PV generation in excess of 120% of annual load purchased by utility for $0.05/kWh

HELIENE

156HC M10 TPC SL Bifacial Module

156 Half-Cut Monocrystalline 605W – 625W

22.4%

Utilizes the latest M10 size super high efficiency TOPCon N-type cells. Half cut design further reduces cell to module (CTM) losses.

Stability & Looks

Enhanced frame design to withstand higher wind, snow, and other mechanical stresses. Framed Glass–Backsheet aesthetic is ideal for high visibility installation.

High Energy Yield

Highest Efficiency, Excellent Bifaciality & Low temperature coefficient of N-type TOPCon Solar Cells enable High Energy yield

High Reliability

TOPCon cells, based on N-type silicon result in low LID, reducing annual degradation and guaranteeing more power throughout the lifetime.

ISO 9001:2015 Certified

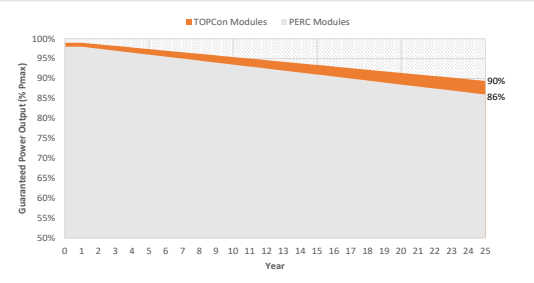
Highly efficient N-type Solar Cells based on TOPCon technology

Low LCOE enabled by High Power Output & Low BOS Cost

1% First year degradation & 0.4% Annual Power degradation

No Compromise Guarantee

15 Year Product Warranty
25 Year Linear Performance Guarantee



World-class Quality

- Heliene's fully automated manufacturing facilities with state-of-the-art robotics and computer aided inspection systems ensure the highest level of product quality and consistency
- All manufacturing locations are compliant with international quality standards and are ISO 9001 certified
- Heliene modules have received Top Performer rankings in several categories from PV Evolution Labs (PV EL) independent quality evaluations

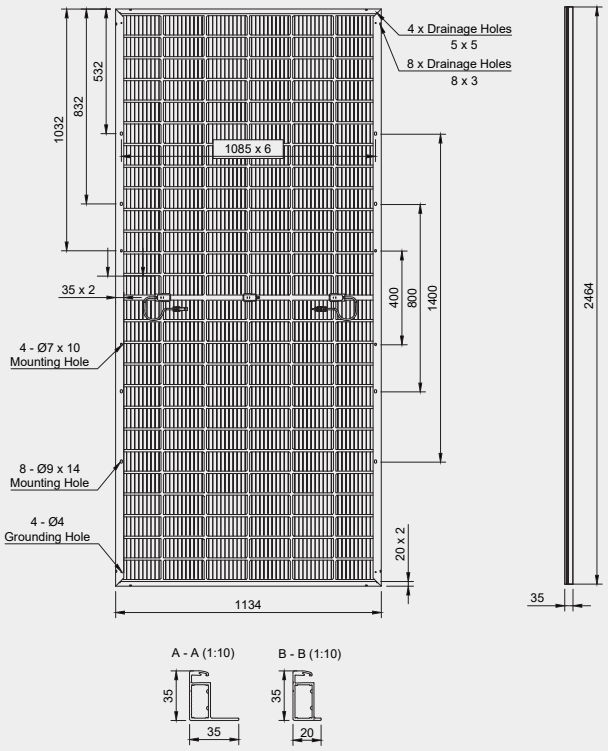
Bankable Reputation

- Established in 2010, Heliene is recognized as highly bankable Tier 1 manufacturer of solar modules and has been approved for use by the U.S. Department of Defense, U.S. Army Corps of Engineers and from numerous top tier utility scale project debt providers
- By investing heavily in research and development, Heliene has been able to stay on the cutting edge of advances in module technology and manufacturing efficiency

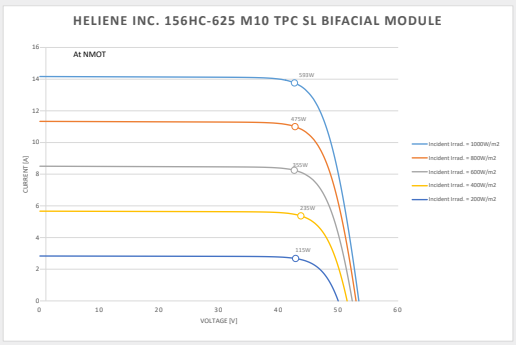
Local Sales, Service, and Support

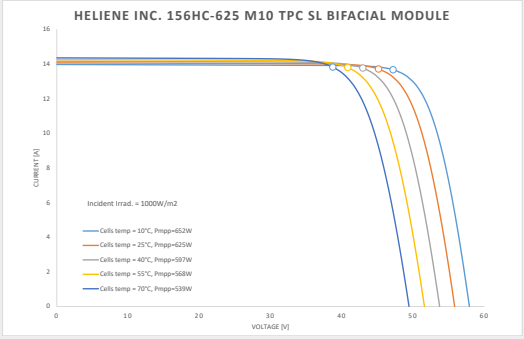
- With sales offices across the U.S. and Canada, Heliene prides itself on unsurpassed customer support for our clients. Heliene has become the brand of choice for many of the leading residential installers, developers and Independent Power Producers due to our innovative technology, product customization capability and just in time last-mile logistics support
- Local sales and customer support means answered phone calls and immediate answers to your technical and logistics questions. We understand your project schedules often change with little warning and endeavor to work with you to solve your project management challenges

Dimensions for 156HC M10 TPC SL Bifacial Series Modules



I-V Curves for 156HC M10 TPC SL Bifacial Series Modules





Electrical Data (STC)

Peak Rated Power*	P_{mpp} (W)	625	620	615	610	605
Maximum Power Voltage	V_{mpp} (V)	47.01	46.75	46.48	46.20	45.92
Maximum Power Current	I_{mpp} (A)	13.29	13.25	13.21	13.17	13.13
Open Circuit Voltage*	V_{oc} (V)	55.80	55.65	55.50	55.35	55.22
Short Circuit Current**	I_{sc} (A)	14.06	14.02	13.99	13.95	13.92
Module Efficiency	Eff (%)	22.37	22.19	22.01	21.83	21.65
Maximum Series Fuse Rating	MF (A)	30	30	30	30	30
Power Sorting Range			[- 0/+3%]			
Bifaciality Factor***			80 ± 5%			

STC - Standard Test Conditions: Irradiation 1000 W/m² - Air mass AM 1.5 - Cell temperature 25 ºC,
*P_{mpp} Production Tolerance ± 3%, V_{oc} Production Tolerance ± 3%, **I_{sc} Production Tolerance ± 4% ,
***Bifaciality Factor= $Pmpp_{rear}$/$Pmpp_{front}$ where $Pmpp_{rear}$ and $Pmpp_{front}$ are tested at STC

Electrical Data (NMOT)

Maximum Power	P_{mpp} (W)	475	471	467	463	459
Maximum Power Voltage	V_{mpp} (V)	45.01	44.76	44.50	44.24	43.97
Maximum Power Current	I_{mpp} (A)	10.54	10.52	10.49	10.47	10.45
Open Circuit Voltage	V_{oc} (V)	53.43	53.29	53.15	53.00	52.87
Short Circuit Current	I_{sc} (A)	11.33	11.30	11.27	11.25	11.22

NMOT - Nominal Module Operating Temperature:
Irradiance at 800W/m², Ambient Temperature 20°C, Wind speed 1m/s

Mechanical Data

Solar Cells	156 Half Cut, M10, 182mm, TOPCon N-type Cells
Module Construction	Framed Glass–Backsheet
Backsheet	Transparent Backsheet with White Pattern
Dimensions (L x W x D)	2464 x 1134 x 35 mm (97.01 x 44.65 x 1.38 inch)
Weight	31 kg (68.34 lbs)
Frame	Double Webbed 15-Micron Anodized Aluminum Alloy
Glass	3.2mm Low-Iron Content, High-Transmission, PV Solar Glass with Anti Reflective Coating
Junction Box	IP-68 rated with 3 bypass diodes
Output Cables	4mm² (12 AWG), 0.3-meter Symmetrical Cables
Connectors	Multi-Contact/ Stäubli MC4

Certifications

UL Certification UL61215, UL61730 pending

Temperature Ratings

Nominal Module Operating Temperature (NMOT)	+42°C (±2°C)
Temperature Coefficient of P_{max}	-0.30%/°C
Temperature Coefficient of V_{oc}	-0.25%/°C
Temperature Coefficient of I_{sc}	0.045%/°C

Maximum Ratings

Operational Temperature	-40°C to +85°C
Max System Voltage	1500V
Mech. Load Test (Front)	113 psf / 5400 Pa
Mech. Load Test (Back)	50 psf / 2400 Pa
Fire Type	Type 1

Warranty

15 Year Product Warranty

25 Year Linear Power Guarantee

Packaging Configuration

Modules per Pallet 40' Container:	31 pieces
Modules per 40' Container:	620 pieces
Modules per Pallet 53' Trailer:	28 pieces
Modules per 53' Trailer:	588 pieces

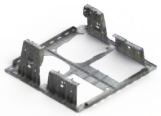
FLAT ROOF SOLUTIONS | COMPARISON GUIDE

UNIRAC
BETTER SOLAR STARTS HERE

Every project has unique requirements – let the Unirac Commercial Team help optimize the right solution to match your specific project parameters. Our design experts can identify the product solutions that satisfy your specific site variables and project goals.

SUBMIT A QUOTE!

SCAN HERE

	ROOFMOUNT				ECOFOOT		GRIDFLEX	
	Reliable Simplicity				Upgrade in Aesthetics and Aerodynamics		Grid Based For Lower Ballast Weight	
	Flat roof's workhorse offers a 10°, 5°, and Dual Tilt solution with minimal SKUs. As simple and easy as ballasted solar can be.				A great-looking flat roof solution with integral wind deflectors to reduce uplift. Preassembled clamps and stackable bays are ready for modules in seconds.		Grid-based structure provides load sharing to reduce system weight. Preassembled, universal components for install speed and flexibility.	
								
	RM10	RM10 EVO	RM5	RMDT	EcoFoot2+	EcoFoot5D	GridFlex 5°	GridFlex 10°
SYSTEM ADVANTAGE	Bay + Clamps #1 Bifacial Solution Validated Install Speed	Bay + Clamps #1 Bifacial Solution CPP Wind Tunnel Tested Module density at 10°	2 Row Space Options Wind Deflector to Reduce Ballast	Max Module Density Lowest Cost Best Aerodynamics	3 SKUs Validated Install Speed Landscape and Portrait	Each Module Supported by 6 Connection Points	2 Row Space Options Fewer Components than other Grid Systems	3 Row Space Options Fastest Grid System
LIGHTEST SYSTEM WEIGHT (PSF)	3	3	3	5	3	3	5	5
OPTIMAL FOR WIND LOADS	3	4	3	5	4	4	5	5
OPTIMAL FOR SNOW LOADS	3	3	3	3	4	5	3	3
INSTALL EASE	5	5	3	3	5	3	3	5

KEY: 3 ICONS = GOOD
5 ICONS = BEST

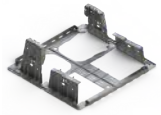
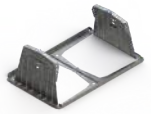
EVERYTHING YOU NEED FOR A QUICK, PROFESSIONAL INSTALLATION

FOR QUESTIONS OR CUSTOMER SERVICE VISIT UNIRAC.COM OR CALL (505) 248-2702

FLAT ROOF SOLUTIONS | COMPARISON GUIDE

UNIRAC
BETTER SOLAR STARTS HERE





	ROOFMOUNT					ECOFOOT		GRIDFLEX				
	RM10	RM10 EVO	RM5		RMDT	EcoFoot2+		EcoFoot5D	GridFlex 5°		GridFlex 10°		
TILT AND ORIENTATION	10° South Landscape	10° South Landscape	5° South Landscape		8° East/West Landscape	10° South Landscape 5° South Portrait		5° South Landscape	5° South Landscape		10° South Landscape		
ROW SPACE	18.5”	13”	7.5”	11”	8.3” Valley 1.1” Peak	18.9”		9.8”	7.5”	11”	11”	14”	17”
SHADE ANGLE	20°	27.5°	25°	18°	8°	20°		20°	24°	18°	37°	27°	22°
MODULE DENSITY	66%	76%	83%	77%	89%	67% Land	80% Port	79%	83%	78%	78%	74%	78%
MODULE FRAME COMPATIBILITY	Universal Return Flange Clamp	Universal Return Flange Clamp	Top Clamp 2 SKUs 30-40mm 41-45mm		Top Clamp 2 SKUs 30-40mm 41-45mm	Universal Top Clamp 30-50mm		Universal Top Clamp 30-50mm	Universal Return Flange Clamp		Universal Return Flange Clamp		
MATERIAL	Al Basket and Clip SS Hardware	Al Basket and Clip SS Hardware	Galvanized Steel SS Hardware		Galvanized Steel SS Hardware	PC/ASA Base Al Clamp SS Hardware Galvanized Steel or Al Deflector		PC/ASA Base Al Clamp SS Hardware Galvanized Ballast Tray	Galvalume Rails Galvanized Ballast Tray Al Clamps SS Hardware		Galvalume Rails Al Clamps SS Hardware Galvanized Ballast Tray Galvanized Deflector		
BALLAST BLOCK CAPACITY	4 per Bay	3.5 per Bay	2 per Bay		6 per Ridge Bay 2 per Valley Bay	3 per Base without Shade		5 per 72-cell Module 4 per 60-cell Module	4 per 72-cell Module 3 per 60-cell Module		5 per 72-cell Module 4 per 60-cell Module		

EVERYTHING YOU NEED FOR A QUICK, PROFESSIONAL INSTALLATION

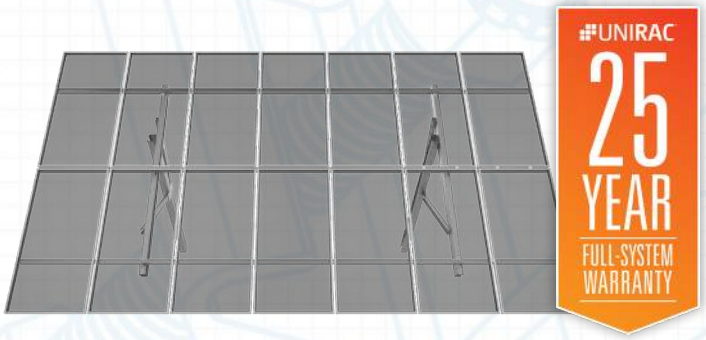
FOR QUESTIONS OR CUSTOMER SERVICE VISIT UNIRAC.COM OR CALL (505) 248-2702

GROUND FIXED TILT

UNIRAC
BETTER SOLAR STARTS HERE

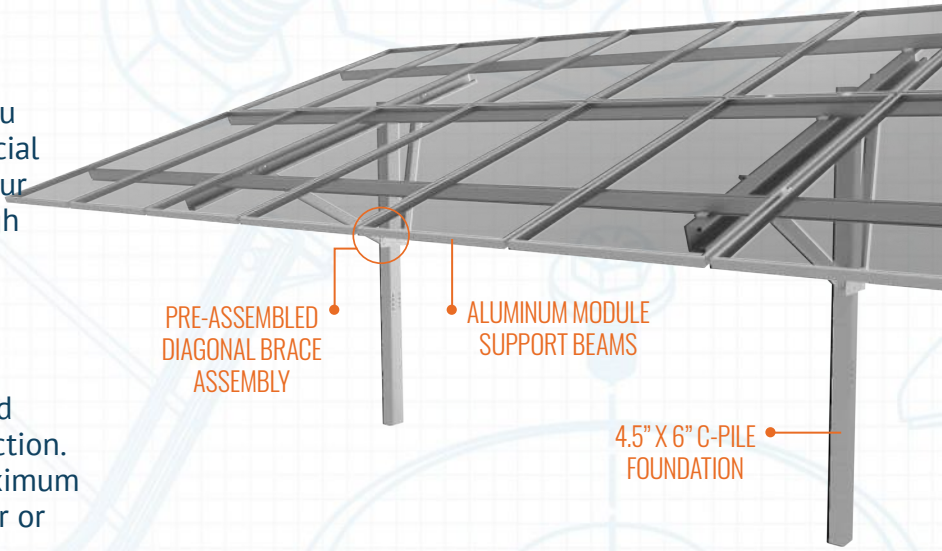
IN STOCK AND READY TO SHIP

- Standardized components and kitted hardware bring ease of stocking and repeatability from 2KW to multi-MW.
- North America's largest ground mount distributor network ensures the fastest lead times and empowers you to finish your projects on schedule.



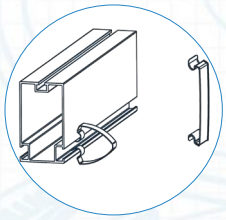
PERMIT - READY

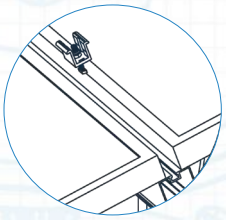
- Pre-engineered regional designs save you valuable time. Industry-leading commercial customer service supports you across your project, from design and logistics through installation.



INSTALLATION EXPERIENCE

- Kitted hardware, integrated bonding, and pre-assembled parts streamline construction. Straightforward connections ensure maximum strength and require no specialized labor or training.
- Lightweight components allow for one or two-person assembly.
- System flexibility enables you to mount all the most common residential and commercial modules on shared rails or at standard module quarter points.
- Choose from multiple foundations and 3, 4, 5, or 6-rail designs to optimize your projects.


SNAP ON WIRE
MANAGMENT


TOP MOUNTING MODULE CLAMPS
W/ INTEGRATED BONDIN

ABOUT PRODUCT

GROUND FIXED TILT (GFT) is a single post geometry system with 20 and 30 tilt options. It's engineered using standard lightweight ground mount components that are in stock and ready to ship from North America's largest ground mount distribution network. UNIRAC's unmatched commercial project support makes construction easy, from permitting through installation, including region specific engineering. GFT's refined solution, including a new shared rail design, delivers enhanced system and labor optimization. Plus, enjoy peace of mind with SOLARMOUNT Mounting Technology and UNIRAC's industry-leading 25-year warranty.

FOR QUESTIONS OR CUSTOMER SERVICE CONTACT:
505-242-6411 | SALES@UNIRAC.COM | WWW.UNIRAC.COM
PUB2024JAN01-V1

CONFORMS TO
UL2703

ISO 9001:2015
14001:2015
CERTIFIED

INVERTERS

Single Phase Inverter with HD-Wave Technology

for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US /
SE7600H-US / SE10000H-US / SE11400H-US

12-25 YEAR WARRANTY

Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)

/ Single Phase Inverter with HD-Wave Technology for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US/ SE7600H-US / SE10000H-US / SE11400H-US

	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	SE10000H-US	SE11400H-US	
OUTPUT								
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA
Maximum AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	✓	Vac
AC Frequency (Nominal)	59.3 - 60 - 60.5[1]							Hz
Maximum Continuous Output Current @240V	12.5	16	21	25	32	42	47.5	A
Maximum Continuous Output Current @208V	-	16	-	24	-	-	48.5	A
GFDI Threshold	1							A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							
INPUT								
Maximum DC Power @240V	4650	5900	7750	9300	11800	15500	17650	W
Maximum DC Power @208V	-	5100	-	7750	-	-	15500	W
Transformer-less, Ungrounded	Yes							
Maximum Input Voltage	480							Vdc
Nominal DC Input Voltage	380				400			Vdc
Maximum Input Current @240V[2]	8.5	10.5	13.5	16.5	20	27	30.5	Adc
Maximum Input Current @208V[2]	-	9	-	13.5	-	-	27	Adc
Max. Input Short Circuit Current	45							Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	99	99.2						%
CEC Weighted Efficiency	99						99 @ 240V 98.5 @ 208V	%
Nighttime Power Consumption	< 2.5							W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)							
Revenue Grade Data, ANSI C12.20	Optional[3]							
Rapid Shutdown - NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect							
STANDARD COMPLIANCE								
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07							
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)							
Emissions	FCC Part 15 Class B							
INSTALLATION SPECIFICATIONS								
AC Output Conduit Size / AWG Range	1" Maximum / 14-6 AWG					1" Maximum /14-4 AWG		
DC Input Conduit Size / # of Strings / AWG Range	1" Maximum / 1-2 strings / 14-6 AWG					1" Maximum / 1-3 strings / 14-6 AWG		
Dimensions with Safety Switch (HxWxD)	17.7 x 14.6 x 6.8 / 450 x 370 x 174					21.3 x 14.6 x 7.3 / 540 x 370 x 185		in / mm
Weight with Safety Switch	22 / 10		25.1 / 11.4	26.2 / 11.9		38.8 / 17.6		lb / kg
Noise	< 25				<50			dBA
Cooling	Natural Convection							
Operating Temperature Range	-13 to +140 / -25 to +60[4] (-40˚F / -40˚C option)[5]							˚F / ˚C
Protection Rating	NEMA 4X (Inverter with Safety Switch)							

[1] For other regional settings please contact SolarEdge support
[2] A higher current source may be used; the inverter will limit its input current to the values stated
[3] Revenue grade inverter P/N: SExxxxH-US000NNC2
[4] For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf
[5] -40 version P/N: SExxxxH-US000NNU4

RoHS

Three Phase Inverters for the 120/208V Grid

For North America

SE10KUS / SE17.3KUS

INVERTERS

The best choice for SolarEdge enabled systems

- Specifically designed to work with power optimizers
- Quick and easy inverter commissioning directly from a smartphone using SolarEdge SetApp
- Fixed voltage inverter for superior efficiency and longer strings
- Built-in type 2 DC and AC Surge Protection, to better withstand lightning events
- Small, lightest in its class, and easy to install outdoors or indoors on provided bracket
- Integrated arc fault protection and rapid shutdown for NEC 2014 – 2023, per article 690.11 and 690.12
- Built-in module-level monitoring with Ethernet, wireless or cellular communication for full system visibility
- Integrated Safety Switch
- UL 1741 SA and SB certified, for CPUC Rule 21 grid compliance

Three Phase Inverters for the 120/208V Grid[1]

For North America

SE10KUS / SE17.3KUS

Model Number	SE10KUS	SE17.3KUS	
Applicable to inverters with part number	SEXXK-USX2IXXXX		
OUTPUT			
Rated AC Power Output	10000	17300	W
Maximum Apparent AC Output Power	10000	17300	VA
AC Output Line Connections	3W + PE, 4W + PE		
AC Output Voltage Minimum-Nominal-Maximum[2] (L-N)	105 – 120 – 132.5		Vac
AC Output Voltage Minimum-Nominal-Maximum[2] (L-L)	183 – 208 – 229		Vac
AC Frequency Minimum-Nominal-Maximum[2]	59.3 – 60 – 60.5		Hz
Continuous Output Current (per Phase)	27.8	48.25	Aac
GFDI Threshold	1		A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes		
THD	≤ 3		%
Power Factor Range	+/- 0.85 to 1		
INPUT			
Maximum DC Power (Module STC)	17500	30275	W
Transformer-less, Ungrounded	Yes		
Maximum Input Voltage DC+ to DC-	600		Vdc
Operating Voltage Range	370 – 600		Vdc
Maximum Input Current	27.8	48.25	Adc
Maximum Input Short Circuit Current	55		Adc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolation Detection	167kΩ Sensitivity[3]		
CEC Weighted Efficiency	97	97.5	%
Night-time Power Consumption	< 4		W
ADDITIONAL FEATURES			
Supported Communication Interfaces	2 x RS485, Ethernet, Cellular (optional)		
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection		
Rapid Shutdown	NEC 2014 – 2023, built-in		
RS485 Surge Protection Plug-in	Supplied with the inverter, built-in		
AC, DC Surge Protection	Type II, field replaceable, built-in		
DC Fuses (Single Pole)	25A, built-in		
Smart Energy Management	Export Limitation		
DC SAFETY SWITCH			
DC Disconnect	Integrated		
STANDARD COMPLIANCE			
Safety	UL 1741, UL 1741 SA, UL 1741 SB, UL 1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07		
Grid Connection Standards	IEEE 1547-2018, Rule 21, Rule 14 (HI)		
Emissions	FCC Part 15 Class A		
INSTALLATION SPECIFICATIONS			
AC Output Conduit size /AWG range	¾" or 1" / 6 - 10 AWG		
DC Input Conduit size / AWG range	¾" or 1" / 6 - 12 AWG		
Number of DC inputs pairs	4		
Dimensions with Safety Switch (H x W x D)	31.8 x 12.5 x 11.8 / 808 x 317 x 300		in / mm
Weight with Safety Switch	78.2 / 35.5		lb / kg
Cooling	Fans (user replaceable)		
Noise	< 62		dBA
Operating Temperature Range	-40 to +140 / -40 to +60(4)		˚F / ˚C
Protection Rating	NEMA 3R		
Mounting	Bracket provided		

(1) For 277/480V inverters refer to the Three Phase Inverters for the 277/480V Grid for North America datasheet.
(2) For other regional settings please contact SolarEdge support.
(3) Where permitted by local regulations.
(4) For power derating information refer to the Temperature Derating technical note for North America.

CE

Three Phase Inverters

For the 277/480V Grid for North America

SE10KUS / SE20KUS / SE30KUS / SE33.3KUS

INVERTERS

The best choice for SolarEdge enabled systems

- Specifically designed to work with power optimizers
- Superior efficiency (98.5%)
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- Small, lightweight, and easy to install outdoors or indoors on provided bracket
- Fixed voltage inverter for longer strings
- Integrated Safety Switch
- Supplied with RS485 Surge Protection Device, to better withstand lightning events

solaredge

/ Three Phase Inverters

For the 277/480V Grid[1] for North America

SE10KUS / SE20KUS / SE30KUS / SE33.3KUS

	SE10KUS	SE20KUS	SE30KUS	SE33.3KUS	
OUTPUT					
Rated AC Power Output	10000	20000	30000	33300	VA
Maximum AC Power Output	10000	20000	30000	33300	VA
AC Output Line Connections	4-wire WYE (L1-L2-L3-N) plus PE				
AC Output Voltage Minimum-Nominal-Maximum[2] (L-N)	244-277-305				Vac
AC Output Voltage Minimum-Nominal-Maximum[2] (L-L)	422.5-480-529				Vac
AC Frequency Min-Nom-Max[2]	59.3 - 60 - 60.5				Hz
Max. Continuous Output Current (per Phase)	12	24	36.5	40	A
GFDI Threshold	1				A
Utility Monitoring, Islanding Protection, Country Configurable Set Points	Yes				
INPUT					
Maximum DC Power (Module STC)	13500	27000	40500	45000	W
Transformer-less, Ungrounded	Yes				
Maximum Input Voltage DC to Gnd	490				Vdc
Maximum Input Voltage DC+ to DC-	980				Vdc
Nominal Input Voltage DC to Gnd	420				Vdc
Nominal Input Voltage DC+ to DC-	840				Vdc
Maximum Input Current	13.5	26.5	39	40	Adc
Maximum Input Short Circuit Current	45				Adc
Reverse-Polarity Protection	Yes				
Ground-Fault Isolation Detection	1MΩ Sensitivity		350kΩ Sensitivity[3]		
CEC Weighted Efficiency	98		98.5		%
Night-time Power Consumption	< 3		< 4		W
ADDITIONAL FEATURES					
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional)				
Rapid Shutdown – NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect				
RS485 Surge Protection	Supplied with the inverter				
STANDARD COMPLIANCE					
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07				
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)				
Emissions	FCC part15 class B				
INSTALLATION SPECIFICATIONS					
AC output conduit size / AWG range	3/4" minimum / 12-6 AWG		3/4" minimum / 8-4 AWG		
DC input conduit size / AWG range	3/4" minimum / 12-6 AWG				
Number of DC inputs	2 pairs		3 pairs[4]		
Dimensions (H x W x D)	21 x 12.5 x 10.5 / 540 x 315 x 260				in / mm
Dimensions with Safety Switch (H x W x D)	30.5 x 12.5 x 10.5 / 775 x 315 x 260				in / mm
Weight	73.2 / 33.2		99.5 / 45		lb / kg
Weight with Safety Switch	79.7 / 36.2		106 / 48		lb / kg
Cooling	Fans (user replaceable)				
Noise	< 50		< 55		dBA
Operating Temperature Range	-40 to +140 / -40 to +60[5]				˚F / ˚C
Protection Rating	NEMA 3R				

[1] For 208V inverters refer to: http://www.solaredge.com/files/pdfs/products/inverters/se-three-phase-us-inverter-208V-datasheet.pdf
[2] For other regional settings please contact SolarEdge support
[3] Where permitted by local regulations
[4] Field replacement kit for 1 pair of inputs P/N: DCD-3PH-1TBK; Field replacement kit for 3 pairs of fuses and holders P/N: DCD-3PH-6FHK-S1
[5] For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf

CE RoHS

Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / SE100KUS / SE110KUS / SE120KUS

INVERTER

Powered by unique pre-commissioning process for rapid system installation

- Pre-commissioning feature for automated validation of system components and wiring during the site installation process and prior to grid connection
- Easy 2-person installation with lightweight, modular design (each inverter consists of 2 or 3 Synergy units and 1 Synergy Manager)
- Independent operation of each Synergy unit enables higher uptime and easy serviceability
- Built-in thermal sensors detect faulty wiring, ensuring enhanced protection and safety
- Built-in arc fault protection and rapid shutdown
- Built-in PID mitigation for maximized system performance
- Monitored* and field-replaceable surge protection devices, to better withstand surges caused by lightning or other events
- Built-in module-level monitoring with Ethernet or cellular communication for full system visibility

*Applicable only for DC and AC SPDs

solaredge

/ Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / SE100KUS / SE110KUS / SE120KUS

MODEL NUMBER	SE80KUS	SE100KUS	SE110KUS	SE120KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER	SExxK-USx8Ixxxx				UNITS
OUTPUT					
Rated AC Active Output Power	80000	100000	110000	120000	W
Maximum AC Apparent Output Power	80000	100000	120000	120000	VA
AC Output Line Connections	3W + PE, 4W + PE				
Supported Grids	WYE: TN-C, TN-S, TN-C-S, TT, IT; Delta: IT				
AC Output Voltage Minimum-Nominal-Maximum(1) (L-N)	244 – 277 – 305				Vac
AC Output Voltage Minimum-Nominal-Maximum(1) (L-L)	422.5 – 480 – 529				Vac
AC Frequency Min-Nom-Max(1)	59.5 – 60 – 60.5				Hz
Maximum Continuous Output Current (per Phase, PF=1)	96.5	120	144.3		Aac
GFDI Threshold	1				A
Utility Monitoring, Islanding Protection, Configurable Power Factor, Country Configurable Thresholds	Yes				
Total Harmonic Distortion	≤ 3				%
Power Factor Range	±0.85 to 1				
INPUT					
Maximum DC Power (Module STC) Inverter / Synergy Unit	140000 / 70000	175000 / 58300	210000 / 70000		W
Transformer-less, Ungrounded	Yes				
Maximum Input Voltage DC+ to DC-	1000				Vdc
Operating Voltage Range	850 – 1000				Vdc
Maximum Input Current	2 x 48.25	3 x 40	3 x 48.25		Adc
Reverse-Polarity Protection	Yes				
Ground-Fault Isolation Detection	167kΩ sensitivity per Synergy Unit(2)				
CEC Weighted Efficiency	98.5				%
Nighttime Power Consumption	< 8	< 12			W
ADDITIONAL FEATURES					
Supported Communication Interfaces(3)	2 x RS485, Ethernet, Wi-Fi (optional), Cellular (optional)				
Smart Energy Management	Export Limitation				
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection				
Arc Fault Protection	Built-in, User Configurable (According to UL1699B)				
Photovoltaic Rapid Shutdown System	NEC 2014 – 2023, built-in				
PID Rectifier	Nighttime, built-in				
RS485 Surge Protection (ports 1+2)	Type II, field replaceable, integrated				
AC, DC Surge Protection	Type II, field replaceable, integrated				
DC Fuses (Single Pole)	25A, integrated				
DC SAFETY SWITCH					
DC Disconnect	Built-in				
STANDARD COMPLIANCE					
Safety	UL1699B, UL1741, UL1741 SA, UL1741 SB, UL1998, CSA C22.2#107.1, Canadian AFCI according to T.I.L. M-07				
Grid Connection Standards	IEEE 1547-2018, Rule 21, Rule 14 (HI)				
Emissions	FCC part 15 class A				

(1) For other regional settings please contact SolarEdge support.
(2) Where permitted by local regulations.
(3) For specifications of the optional communication options, visit the Communication product page or the Knowledge Center to download the relevant product datasheet.

/ Three Phase Inverter with Synergy Technology

For the 277/480V Grid for North America

SE80KUS / SE100KUS / SE110KUS / SE120KUS

MODEL NUMBER		SE80KUS	SE100KUS	SE110KUS	SE120KUS	
APPLICABLE TO INVERTERS WITH PART NUMBER		SExxK-USx8Ixxxx				UNITS
INSTALLATION SPECIFICATIONS						
Number of Synergy Units per Inverter		2	3			
Ac Max Conduit Size		2 ½"				in
Max AWG Line / PE		4/0 / 1/0				
DC Max Conduit Size		1 x 3"; 2 x 2"				in
DC Input Inverter/ Synergy Unit	Multi-input (SExxK-USxxxxxZ4)	8 / 4 pairs; 6-12 AWG	12 / 4 pairs; 6-12 AWG			
	Combined input (SExxK-USxxxxxW4)	2 pairs / 1 pair, Max 2 AWG; copper or aluminum	3 pairs / 1 pair, Max 2 AWG; copper or aluminum			
Dimensions (H x W x D)		Synergy Unit: 22 x 12.9 x 10.75 / 558 x 328 x 273 Synergy Manager: 14.17 x 22.4 x 11.6 / 360 x 560 x 295				in / mm
Weight		Synergy Unit: 70.4 / 32 Synergy Manager: 39.6 / 18				lb / kg
Operating Temperature Range		-40 to +140 / -40 to +60(4)				˚F / ˚C
Cooling		Fan (user replaceable)				
Noise		< 67				dBA
Protection Rating		NEMA 3R				
Mounting		Brackets provided				

(4) For power de-rating information refer to the Temperature Derating Technical Note for North America.

SolarEdge is a global leader in smart energy technology. By leveraging world-class engineering capabilities and with a relentless focus on innovation, SolarEdge creates smart energy solutions that power our lives and drive future progress.

SolarEdge developed an intelligent inverter solution that changed the way power is harvested and managed in photovoltaic (PV) systems. The SolarEdge DC optimized inverter maximizes power generation while lowering the cost of energy produced by the PV system.

Continuing to advance smart energy, SolarEdge addresses a broad range of energy market segments through its PV, storage, EV charging, UPS, and grid services solutions.

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Cautionary Note Regarding Market Data and Industry Forecasts: This brochure may contain market data and industry forecasts from certain third-party sources. This information is based on industry surveys and the preparer's expertise in the industry and there can be no assurance that any such market data is accurate or that any such industry forecasts will be achieved. Although we have not independently verified the accuracy of such market data and industry forecasts, we believe that the market data is reliable and that the industry forecasts are reasonable.

CE

SolarEdge TerraMax™ Inverter & H1300 Power Optimizer

For North America

SolarEdge TerraMax™ Inverter
330kW

H1300 Power Optimizer

Specially designed for ground mount installations, featuring a unique virtual central topology with single DC input architecture and module-level MPPTs

- **More Energy**
  - 99% efficiency
  - 200% DC oversizing
  - 100% power at high temperature levels
  - Granular MPPT with DC optimization
- **Higher BoS Savings**
  - Longer and fewer strings, with up to 80 modules per string
  - Enables virtual central topology
  - Up to 50% BoS savings
- **Lower O&M Costs**
  - Fewer truck rolls with continuous and granular monitoring
  - 100% visibility into system issues
  - Reduced project schedule risks with pre-commissioning feature
- **Safe and Secure**
  - Designed with cybersecurity features and multilayered protection from inverter to cloud
  - Built-in SafeDC™: designed to automatically reduce high DC voltage to touch-safe levels in the event of faults and maintenance activities

/ Inverter Technical Specifications

SE330KUS

	SE330KUS	Unit
OUTPUT		
Rated AC Active Output Power	330,000 @ 45°C / 113°F	W
Maximum Apparent AC Power Output	330,000 @ 45°C / 113°F	VA
AC Output Voltage - Line to Line (Nominal)	690	Vac
AC Output Voltage - Line to Line (Range)	587 – 759	Vac
AC Frequency	60 ± 5%	Hz
Maximum Continuous Output Current (per Phase) @Nominal Voltage	276.1	Aac
AC Output Line Connections	3PH 3W + PE	
Total Harmonic Distortion	≤3	%
Utility Monitoring, Islanding Protection, Configurable Power Factor, Country Configurable Thresholds	Yes	
Power Factor Range	0 – 1 / leading, lagging	
INPUT		
Maximum DC Power (Module STC)	660,000	W
Maximum Input Voltage DC+ to DC-	1500	Vdc
Nominal DC Input Voltage DC+ to DC-	1250	Vdc
Maximum Input Current	266.7	Adc
Module-Level Optimization	Yes	
EFFICIENCY		
Maximum Efficiency / CEC Efficiency	99.2 / 99.0	%
PROTECTION FEATURES		
DC Reverse Polarity Protection	Yes	
Ground Fault Isolation Detection	Yes	
AC Surge Protection	Type 2, monitored and field replaceable	
DC Surge Protection	Type 2, monitored and field replaceable	
RS485 Surge Protection	Optional	
DC Disconnect	Yes, integrated	
ADDITIONAL FEATURES		
Supported Communication Interfaces	CAN bus, RS485, Ethernet, WiFi, Cellular (optional)	
PID Protection	PID Rectifier	
Inverter Commissioning	With the SetApp mobile application using built-in Wi-Fi access point for local connection	
Pre-Commissioning	Inverter activation and validation powered by PV modules	
Central Commissioning	Automated easy commissioning for several inverters at once	
VAR at Night	Yes	
STANDARD COMPLIANCE		
Safety	UL 1741, UL 1998, CSA C22.2#107.1	
Grid Connection Standards	UL 1741SA, UL 1741SB, IEEE 1547, Rule 21, Rule 14	
Emissions	FCC Part 15, Class A	
Advanced Grid Support Capabilities	L/HFRT, L/HVRT, VOLT-VAR, VOLT-Watt, Frequency-Watt, Ramp Rate Control, Fixed Power Factor, Fixed Q, Cos(Phi)/Watt	
RoHS	Yes	
GENERAL DATA		
Dimensions (W x H x D)	1090 x 903 x 409 / 42.9 x 35.6 x 16.1	mm / in
Weight	175 / 386	kg / lb
Operating Temperature Range(1)	-40 to +60 / -40 to +140	°C / °F
Cooling	Fans (field replaceable)	
Noise Emission	< 72	dBA
Protection Rating	IP66	
Mounting	Bracket provided	
Topology	Transformerless, ungrounded	
AC Connection(2)	Up to 2 x 2.5'' conduit, terminal lugs, max. 600 kcmil per wire, Al or Cu	
DC Connection(3)(4)	Up to 2 x 3'' conduit, terminal lugs, max. 600 kcmil per wire, Al or Cu	

(1) For ambient temperatures above +45°C / 113°F power derating is applied. Refer to the Temperature Derating Technical Note for more details.
(2) Two AC terminals per line are available.
(3) Up to two DC terminals (+, -) are available.
(4) A DC input with MC4 connectors supporting up to 20 strings is available upon request.

CE RoHS

/ Power Optimizer Technical Specifications

H1300

	H1300 (FOR CONNECTION TO TWO PV MODULES)	Unit
INPUT		
Rated Input DC Power[1]	1300	W
Connection Method	Single input for series connected modules	
Absolute Maximum Input Voltage (Voc at lowest temperature)	125	Vdc
MPPT Operating Range	12.5 – 105	Vdc
Maximum Short Circuit Current per Input (Isc)	15	Adc
Maximum Efficiency	99.5	%
Weighted Efficiency	98.8	%
Overvoltage Category	II	
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)		
Maximum Output Current	20	Adc
Maximum Output Voltage	75	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED TO OPERATING SOLAREDGE)		
Safety Output Voltage per Power Optimizer	1 ± 0.1	Vdc
STANDARD COMPLIANCE		
EMC	FCC Part 15 Class A	
Safety	UL 1741, CSA C22.2#107.1, CSA C22.2#330	
Material	UL 94 V-0, UV resistant	
RoHS	Yes	
Fire Safety	VDE-AR-E 2100-712:2013-05	
INSTALLATION SPECIFICATIONS		
Compatible SolarEdge Inverters	SE330KUS	
Maximum Allowed System Voltage	1500	Vdc
Dimensions (W x L x H)	129 x 155 x 59 / 5.08 x 6.10 x 2.32	mm / in
Weight (including cables)	1170 / 2.6	g / lb
Input/Output Connector[2]	MC4	
Input Wire Length	1.6, 1.6 / 5.25, 5.25	m / ft
Output Wire Length	0.1, 5.3 / 0.32, 17.39	m / ft
Operating Temperature Range[3]	-40 to 65 / -40 to 149	°C / °F
Protection Rating	IP68 / NEMA6P	
Relative Humidity	0 – 100	%

(1) The rated power of the module at STC will not exceed the power optimizer's Rated Input DC Power. Modules with up to +5% power tolerance are allowed.
(2) For other connector types please contact SolarEdge.
(3) For ambient temperatures above +65°C / 149°F power derating is applied. Refer to the Temperature Derating Technical Note for more details.

		SE330KUS	
Minimum String Length[4] (Power Optimizers/Modules)	Module Power		
	400 – 450W	27 / 54	
	455 – 550W	24 / 48	
	555 – 650W	22 / 44	
Maximum String Length (Power Optimizers/Modules)		40 / 80	
Maximum Continuous Power per String		25,000	W
Maximum Allowed Connected Power per String[5]		33,000	W
Maximum Allowed Difference between the shortest and longest string connected to the same inverter		5 Power Optimizers	

(4) Design your project using SolarEdge Designer use a lower minimum string length and/or connect more STC power per string.
(5) A minimum of 14 strings must be connected. For 13 strings or less, 29,000W is allowed.

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