

Mercer Island Residence

Solar Access Study

Sązän prepared the following Helioscope model and simulation report to evaluate annual energy production estimates, shading impacts, and overall system performance based on the proposed equipment. Shading from trees to the South of the residence are estimated to reduce production by approximately 11% per year, based on the following array layout using a 5 degree tilt angle.

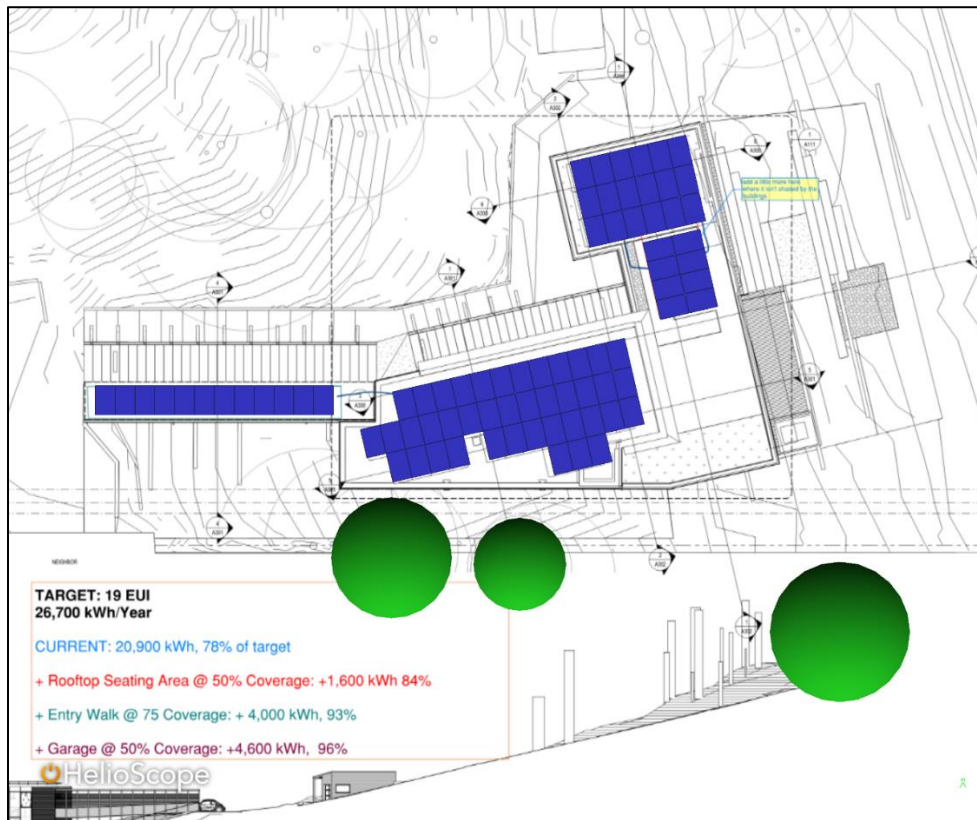


Figure 1: Helioscope Simulation Report Showing PV Array Locations, Modules, and Tree Shading

Solar Electric Generation Study

Annual energy production estimates for the proposed array are summarized in the following table, based on the results of Sązän’s Helioscope model and simulation report for this project:

Array	DC Capacity	Number of PV Modules	Annual Electricity Production
Total	28.4 kW-DC	79	26.46 MWh/year
Permit Credit			3


Solar Electric System Basis of Design Equipment:

The basis of design solar PV module for this estimate is the SunPower X21 350 Watt module.

28.4 kW Array - 5 Degree Tilt Mercer Island Residence, 6838 96th AVE SE

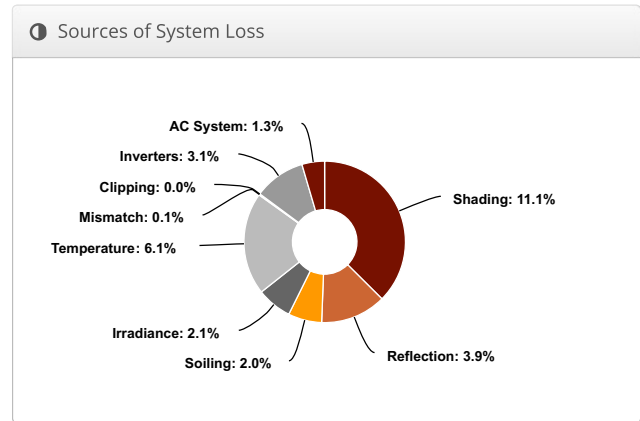
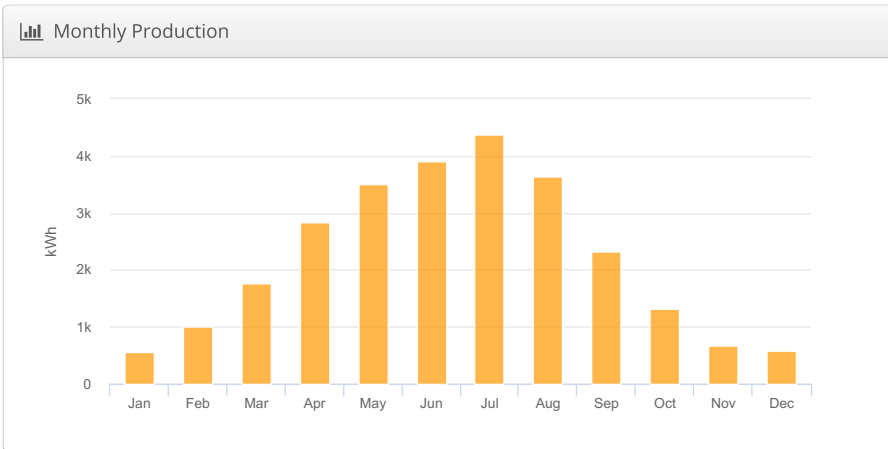
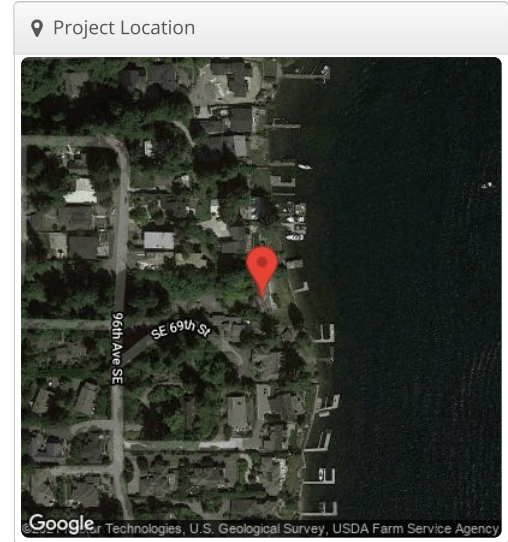
Report

Project Name	Mercer Island Residence
Project Address	6838 96th AVE SE
Prepared By	Jack Newman ses-marketing@sazan.com



System Metrics

Design	28.4 kW Array - 5 Degree Tilt
Module DC Nameplate	28.4 kW
Inverter AC Nameplate	25.3 kW Load Ratio: 1.13
Annual Production	26.46 MWh
Performance Ratio	71.5%
kWh/kWp	930.4
Weather Dataset	TMY, 10km Grid (47.55,-122.25), NREL (prospector)
Simulator Version	cf7d18f001-481affdcb9-7d93dbfa9b-7df5457593



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m ²)	Annual Global Horizontal Irradiance	1,253.2	
	POA Irradiance	1,301.8	3.9%
	Shaded Irradiance	1,157.1	-11.1%
	Irradiance after Reflection	1,112.0	-3.9%
	Irradiance after Soiling	1,089.7	-2.0%
	Total Collector Irradiance	1,088.7	-0.1%
Energy (kWh)	Nameplate	30,111.3	
	Output at Irradiance Levels	29,484.5	-2.1%
	Output at Cell Temperature Derate	27,688.5	-6.1%
	Output After Mismatch	27,672.8	-0.1%
	Optimal DC Output	27,672.8	0.0%
	Constrained DC Output	27,667.6	0.0%
	Inverter Output	26,820.2	-3.1%
	Energy to Grid	26,459.2	-1.3%
Temperature Metrics			
	Avg. Operating Ambient Temp		12.9 °C
	Avg. Operating Cell Temp		24.9 °C
Simulation Metrics			
	Operating Hours	4649	
	Solved Hours	4649	

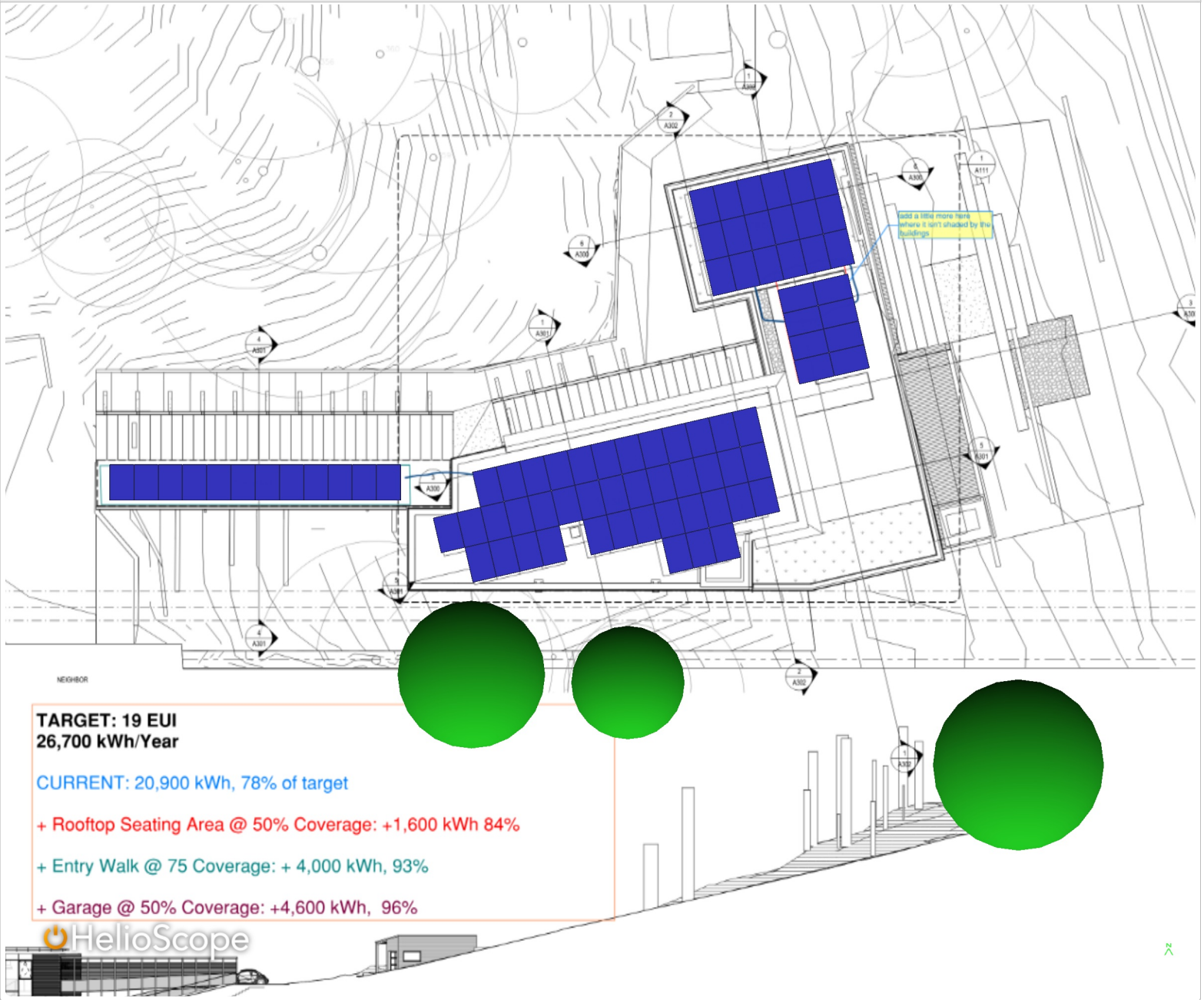
Condition Set													
Description	Condition Set 1												
Weather Dataset	TMY, 10km Grid (47.55,-122.25), NREL (prospector)												
Solar Angle Location	Meteo Lat/Lng												
Transposition Model	Perez Model												
Temperature Model	Sandia Model												
Temperature Model Parameters	Rack Type	a		b		Temperature Delta							
	Fixed Tilt	-3.56		-0.075		3°C							
	Flush Mount	-2.81		-0.0455		0°C							
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D	
	2	2	2	2	2	2	2	2	2	2	2	2	
Irradiation Variance	5%												
Cell Temperature Spread	4° C												
Module Binning Range	-2.5% to 2.5%												
AC System Derate	0.50%												
Module Characterizations	Module		Uploaded By		Characterization								
	SPR-X21-350-BLK-deprecated (SunPower)		Folsom Labs		Sunpower_SPR_X21_350_BLK.pan, PAN								
Component Characterizations	Device		Uploaded By		Characterization								
	IQ7X-96-x-INT (Enphase)		Folsom Labs		Default Characterization								

Components		
Component	Name	Count
Inverters	IQ7X-96-x-INT (Enphase)	79 (25.3 kW)
AC Branches	8 AWG (Copper)	4 (654.5 ft)
Module	SunPower, SPR-X21-350-BLK-deprecated (360W)	79 (28.4 kW)

Wiring Zones			
Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	1-1	Along Racking

Field Segments									
Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Portrait (Vertical)	5°	180°	0.0 ft	1x1	12	12	4.32 kW
Field Segment 2	Flush Mount	Portrait (Vertical)	5°	167°	0.0 ft	1x1	41	41	14.8 kW
Field Segment 3	Flush Mount	Portrait (Vertical)	5°	167°	0.0 ft	1x1	18	18	6.48 kW
Field Segment 4	Flush Mount	Landscape (Horizontal)	5°	167°	0.0 ft	1x1	8	8	2.88 kW

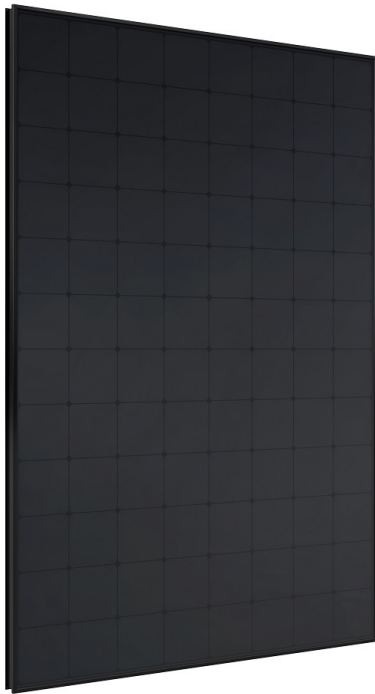
Detailed Layout





SunPower X-Series: X21-350-BLK

SunPower® Residential DC Panel



SunPower X-Series panels combine the top efficiency, durability and warranty available in the market today, resulting in more long-term energy and savings.^{1,2}



Premium Aesthetics

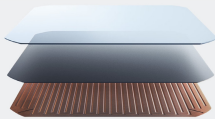
SunPower® Signature™ Black X-Series panels blend harmoniously into your roof. The most elegant choice for your home.



Highest Lifetime Energy and Savings

Designed to deliver 60% more energy in the same space over 25 years in real-world conditions like partial shade and high temperatures.²

Fundamentally Different. And Better.



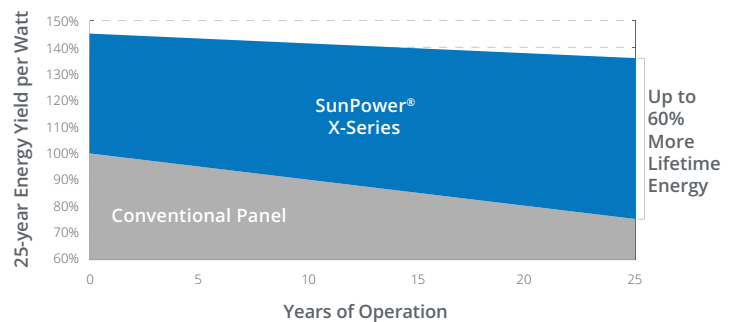
The SunPower Maxeon® Solar Cell

- Enables highest efficiency panels available²
- Delivers leading reliability³
- Patented solid metal foundation prevents breakage and corrosion



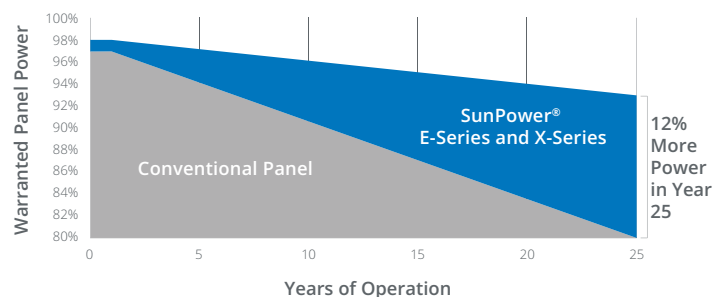
As Sustainable As Its Energy

- Ranked #1 in Silicon Valley Toxics Coalition 2015 Solar Scorecard⁴
- First solar panels to achieve Cradle to Cradle Certified™ Bronze recognition⁵
- Contributes to more LEED categories than conventional panels⁶



Best Reliability, Best Warranty

With more than 25 million panels deployed around the world, SunPower technology is proven to last. That's why we stand behind our panel with the industry's best 25-year Combined Power and Product Warranty, including the highest Power Warranty in solar.

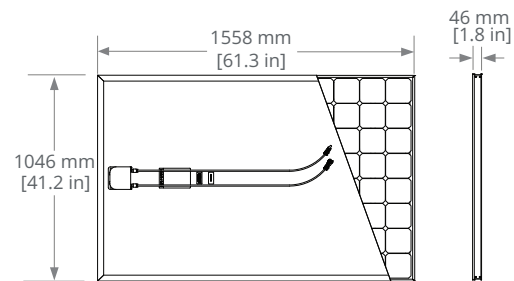


X-Series: X21-350-BLK SunPower® Residential DC Panel

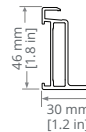
Electrical Data		
	SPR-X21-350-BLK	SPR-X21-335-BLK
Nominal Power (P _{nom}) ⁷	350 W	335 W
Power Tolerance	+5/0%	+5/0%
Panel Efficiency	21.5%	20.6%
Rated Voltage (V _{mpp})	57.3 V	57.3 V
Rated Current (I _{mpp})	6.11 A	5.85 A
Open-Circuit Voltage (V _{oc})	68.2 V	67.9 V
Short-Circuit Current (I _{sc})	6.50 A	6.23 A
Max. System Voltage	1000 V UL & 1000 V IEC	
Maximum Series Fuse	15 A	
Power Temp Coef.	-0.29% / °C	
Voltage Temp Coef.	-167.4 mV / °C	
Current Temp Coef.	2.9 mA / °C	

Tests And Certifications	
Standard Tests ⁸	UL1703 (Type 2 Fire Rating), IEC 61215, IEC 61730
Quality Management Certs	ISO 9001:2015, ISO 14001:2015
EHS Compliance	RoHS, OHSAS 18001:2007, lead free, Recycle Scheme, REACH SVHC-163
Sustainability	Cradle to Cradle Certified™ Bronze. "Declare." listed.
Ammonia Test	IEC 62716
Desert Test	MIL-STD-810G
Salt Spray Test	IEC 61701 (maximum severity)
PID Test	1000 V: IEC 62804, PVEL 600 hr duration
Available Listings	UL, TUV, MCS, FSEC, CEC

Operating Condition And Mechanical Data	
Temperature	-40° F to +185° F (-40° C to +85° C)
Impact Resistance	1 inch (25 mm) diameter hail at 52 mph (23 m/s)
Appearance	Class A+
Solar Cells	96 Monocrystalline Maxeon Gen III
Tempered Glass	High-transmission tempered anti-reflective
Junction Box	IP-65, TE (PV4S)
Weight	41 lbs (18.6 kg)
Max. Test Load ⁹	Wind: 154 psf, 7400 Pa, 754 kg/m ² back Snow: 208 psf, 10000 Pa, 1019 kg/m ² front
Design Load	Wind: 62 psf, 3000 Pa, 305 kg/m ² back Snow: 125 psf, 6000 Pa, 611 kg/m ² front
Frame	Class 1 black anodized (highest AAMA rating)



FRAME PROFILE



(A) Cable Length: 1000 mm +/-10 mm

1 SunPower 360 W compared to a Conventional Panel on same-sized arrays (260 W, 16% efficient, approx. 1.6 m²), 4% more energy per watt (based on PVSyst pan files), 0.75%/yr slower degradation (Campeau, Z. et al. "SunPower Module Degradation Rate," SunPower white paper, 2013).

2 Based on search of datasheet values from websites of top 10 manufacturers per IHS, as of May 2019.

3 Jordan, et. al. Robust PV Degradation Methodology and Application. PVSC 2018.

4 SunPower is rated #1 on Silicon Valley Toxics Coalition's Solar Scorecard.

5 Cradle to Cradle Certified is a multi-attribute certification program that assesses products and materials for safety to human and environmental health, design for future use cycles, and sustainable manufacturing.

6 X-Series and E-Series panels additionally contribute to LEED Materials and Resources credit categories.

7 Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25° C). NREL calibration Standard: SOMS current, LACCS FF and Voltage.

8 Type 2 fire rating per UL1703:2013, Class C fire rating per UL1703:2002.

9 Please read the safety and installation guide for more information regarding load ratings and mounting configurations.

See www.sunpower.com/company for more reference information.

For more details, see extended datasheet: www.sunpower.com/solar-resources. Specifications included in this datasheet are subject to change without notice.

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