Solar Design Guidelines:
Recommendations for the City of Detroit

Prepared by the Detroit Collaborative Design Center

OVERVIEW

These Solar Design Guidelines provide a framework for spatial and aesthetic considerations relevant to solar energy installations. In particular, they call attention to design decisions that impact the built environment of Detroit, taking into account different land uses and solar mounting options. The guidelines include recommendations for how to fit in with the surrounding context, how to design the edge of solar installations, how to approach different land uses, how to maximize landscape opportunities and layer solar with other uses, and how to celebrate solar as an educational opportunity. This document also illustrates relevant requirements for historic districts and other policy implications for locating solar.

By design, these guidelines are not prescriptive, but rather descriptive in nature, making recommendations for design decision-making but not dictating the course of action. Recommendations included here are intentionally flexible and anticipate greater specificity as City processes and policy grow to explicitly articulate solar energy options in Detroit.

Furthermore, these design guidelines do not seek to represent or duplicate technical requirements for solar installations, nor make recommendations regarding how to maximize solar efficiency and performance. Solar projects should follow best practices for efficiency and all applicable technical requirements, including but not limited to considerations for solar orientation, structural loads, wiring and equipment specifications, and safety. These guidelines do not focus on solar readiness, though other cities have prepared such guidelines to help residents design for future solar installations.

Solar projects should follow all current zoning and code requirements. Building and fire codes include critical measures to ensure safety, including considerations for security and emergency access. All solar projects should comply with code and safety requirements and follow local approval processes.

Process Notes

These guidelines are informed by a a handful of sources, including:

» Research into similar guidelines from other US cities.
» Engagement and discussions with Detroiters, solar installers, and other stakeholders at four community events.

The project team also provides a depth of knowledge about solar projects in Michigan and beyond. The Detroit Collaborative Design Center has 25 years of experience working with Detroit communities on built environment issues that impact neighborhoods.

PRINCIPLES

The City of Detroit has developed guiding principles for solar initiatives, including:

» Aligns with current City planning efforts.
» Fights blight and transforms liabilities into assets by utilizing otherwise vacant and unproductive land, in particular former brownfields and superfund sites.
» Provides jobs and job training opportunities for Detroit residents, including at-risk youth, in the construction, installation, operations, and maintenance of the project(s).
» Supports local manufacturing. Any partner proposing to use city-owned land should consider use of local manufacturers, suppliers, and labor.
» Supports small business participation. Any partner proposing to use city-owned land should consider including a small business set aside or provision for contracting with small businesses.
» Increases community access to solar, in-particular low- and moderate-income Detroit residents as well as households and businesses that are renters or do not have adequate space to install their own solar systems.
» Integrates with and improves fabric of the surrounding neighborhood through thoughtful landscaping and design.

A few additional related principles provide an overarching vision for the design of solar installations in the City of Detroit, as well as a framework for the guidelines included in this document. These principles include:

Be a good neighbor.
These design guidelines lay a framework for how solar can be a good neighbor throughout the different landscapes in Detroit, including putting forth a welcoming facade that contributes to our neighborhoods.

Respond to Detroit's unique landscape.
Solar power has a unique potential in Detroit due to our abundance of vacant and industrial land. The solar feasibility map resulting from this study will provide greater context for solar siting, but it is important to note that solar should respond and add value to Detroit's existing landscape and distinct neighborhoods.

Leverage solar for Detroiters.
Solar power should benefit Detroiters in a variety of ways, from reduced energy bills and job creation to education and beautification.

Make the invisible visible.
Solar power is an opportunity for education and increased resiliency citywide. Solar performance should be communicated with residents and building occupants and solar should be made visible through design and signage whenever possible.

SITE CONSIDERATIONS

Land uses range from residential to commercial, industrial, and vacant land. Solar arrays can be rooftop or ground mounted. The design guidelines included here respond to these scenarios, all of which call for variations and unique site-specific considerations. When relevant, variations to design guidelines based on land use are noted.

Different land uses also relate to spatial considerations included in the zoning code. See the policy memo for an overview of how zoning and other code issues impact solar in Detroit. The physical implications of these policies are illustrated toward the end of these guidelines.

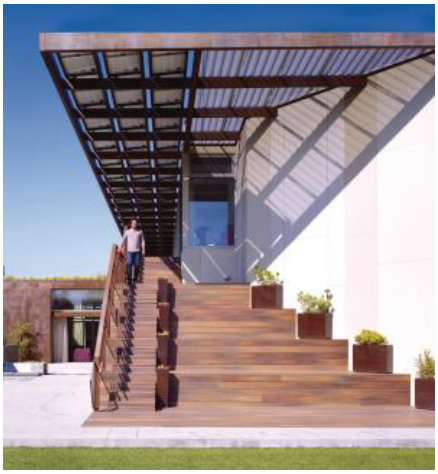
It is important to note that state-level policy and the political climate currently limit many types of solar installations that have the potential to benefit Detroit neighborhoods, with implications for community solar as well as individual property owners. These design guidelines are relevant to Michigan's current solar framework as well as a future in which policy champions solar projects that contribute to Detroit communities.

GUIDELINES

Complement & Blend with Context

Solar arrays should blend in with their surrounding context, which applies to both rooftop and ground mount systems. In most cases, solar installations should aim for the "least visible high performance location," particularly in residential neighborhoods. This is a consistent design recommendation in other cities and also noted by Detroit residents. When appropriate, the design of solar installations may also complement or intentionally contrast with surrounding materials and colors as a design element.

Rectilinear rooftop array on Gesu Catholic School [1]



Integrated solar awning on the Yin-Yang House in Venice, California [2]

Plan for performance.

Performance and maximized solar gain should drive design decisions. This includes decisions about whether rooftop panels are flush or angle mounted. Glare is not an inherent concern as solar panels are designed for light absorption and are covered with anti-reflective coatings.*

Keep it simple.

The layout of both ground mount and rooftop solar arrays should be as geometrically simple as possible, contributing to productivity by maximizing space as well as aesthetic considerations.

Match shapes, layout, and colors whenever possible...

The composition of rooftop arrays should follow the general shape of the roof, embracing simplicity and symmetry. For ground mounted arrays, panels can be installed in square or row arrangements. Consider solar arrays framed by vegetation (see Edge Conditions). Finish colors of frames should either match or complement the surroundings.

OR intentionally complement context by design.

The Interior Secretary's Standards for Rehabilitation state that "new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features."** This suggests that new additions should complement rather than mimic existing structures in a compatible manner. In some cases, solar arrays can be intentionally celebrated and integrated into the building design.

Larger Context

See Historic District considerations toward the end of this report for related historic standards. Zoning regulations also impact the layout of solar, as illustrated in the "Policy Implications" section of this document.

* https://www.energy.gov/eere/solar/downloads/solar-pv-and-glare-factsheet
** https://www.nps.gov/tps/standards/rehabilitation.htm

1. Source: https://www.detroitgreenmap.com/project/gesu-school/
2. Source: http://www.aiatopten.org/node/29

Consider Edge Conditions

The public-facing edges of solar arrays are important to consider. Solar arrays should be good neighbors, contribute to neighborhood beautification, and provide security while also creating an attractive border condition that adds visual appeal. Residents indicated an interest in ensuring secure installations that deter vandalism and benefit Detroit neighborhoods. Locally appropriate character and aesthetics are key.

In community conversations, we heard that Detroiters prioritize edge conditions that ensure safety and deter vandalism, while beautifying neighborhoods.

Prioritize a welcoming public-facing edge that contributes to the surrounding context.

Edge conditions along the property line should contribute to and not detract from Detroit neighborhoods. Fences and landscaped edges should be well-maintained and support neighborhood character. Incorporate landscape buffers outside the fence line and/or within the fence line for ground mounted installations to beautify the solar array. Planting below and between rows of panels can also help enliven the installations. Screen solar infrastructure such as wiring and inverters; however, visible solar panels offer educational opportunities.

This array designed for Freshkills Park in New York City incorporates a friendly fence and native landscaping. [3]

Create buffers for security as well as beauty.

A fence and/or landscape barrier should surround the solar array to encourage safe interactions, ensure security, and create an aesthetically pleasing boundary that complements the neighborhood character and contributes to the community.

Fences should not be excessive and chain link should be avoided. Vacant industrial properties may need more robust fencing due to their lack of “eyes on the street.” Friendly edges still need to be prioritized in order to build a more welcoming urban condition.

3. Source: https://www1.nyc.gov/office-of-the-mayor/news/381-13/mayor-bloomberg-city-s-largest-solar-energy-installation-be-built-freshkills-park

Accommodate setbacks and shadows.

Fences should be set back from the property line to allow for a landscape buffer. Solar arrays should be set back from fences to accommodate the shadow cast from the fence or landscaped edge. The setback should be landscaped, per these guidelines.

When possible, eliminate barriers.

In public spaces and areas with frequent oversight, remove fences and barriers. Integrate the solar array into the surrounding landscape and public realm.

Eden Park demonstration project in Cincinnati, OH with no barriers [4]

Solar Access

Projects should also consider the current and future impact of neighboring properties on solar access. Currently, Michigan and Detroit do not recognize any common law right to sunlight and have not enacted any solar access laws; however, solar access can be established through a privately negotiated agreement with neighboring property owners. See the policy memo for legal considerations regarding solar access and opportunities for related local legislation that protects solar access, including solar fences and solar access permits.

Larger Context

Landscaping costs can be prohibitive for small solar installations. Consider a city subsidy for improved fences and landscape treatment and/or reducing costs in the permit process, if streamlined to promote solar installations.

4 Source: http://www.nebraskansforsolar.org/tag/solar-development-by-rural-electric-cooperatives-municipalities/

Design for Different Land Uses

Sites vary in terms of their fitness for solar, as do existing land uses and neighboring uses. Respond to the proximity of other nearby land uses and their compatibility with solar. Use the solar map produced by this feasibility study as an initial guide.

In community conversations, we heard that Detroiters are not interested in large solar arrays in residential areas unless there is a tangible benefit to the surrounding neighborhood.

Plan solar in response to different land use types.

Residential: Solar arrays on residential rooftops should match the shape of the roof and be flush mounted or integrated whenever possible. See the "Policy Implications" section of this document for rooftop clearances and spatial requirements for ground mounted arrays.

Commercial, institutional and multi-family housing: Commercial rooftops allow greater flexibility for solar, as angle mounted arrays are rarely seen by passersby. Installations should favor simple rectilinear geometry to ensure efficiency. Clearances for larger rooftop arrays are also included in the "Policy Implications" section.

Vacant lots: Large vacant lots are well-suited for ground mounted solar arrays that benefit neighborhoods in terms of beautification, jobs, reduced energy bills, or otherwise. With policy change, large vacant lots offer opportunities for community solar. Vacant single residential lots may not provide adequate space for solar arrays. Be sure to consider the shadows cast by neighboring houses and trees. See additional "Consider Edge Conditions" guidelines.

Industrial land: Vacant industrial land, excess land on industrial properties, and brownfield sites are well-suited for solar arrays. Couple solar with parking canopies or other uses, as described in the "Locate Stretegically & Layer Uses" guidelines.

Lake Region Electric Cooperative solar array in Pelican Rapids, MN [5]

Solar array on GM Plant property in Warren, MI [6]

5 Source: https://www.dl-online.com/news/3784336-buying-solar-energy
6 Source: https://www.crainsdetroit.com/article/20170207/NEWS/170209847/solar-energy-workforce-in-michigan-grows-by-48-in-2016

Produce Pilot Projects

The City of Detroit should implement and/or support pilot projects in the near term to showcase solar arrays designed for different land uses. Aim for one pilot in each City Council District. City-owned properties are well-suited for solar pilot projects. Consider establishing solar districts to promote a range of solar projects in communities already committed to sustainable practices.

In Minnesota, the Xcel Energy Renewable Energy Development Fund (REDF) Minneapolis Parks and Recreation Board (MPRB) Solar Demonstration Project installed 200 kW of PV in the Minneapolis parks system to model the incorporation of renewable energy into public amenities. The project's installations demonstrate a variety of solar designs and are located in diverse, high-traffic public areas to showcase solar to a large number of visitors and stakeholders.

Solar pavilion in a Minneapolis park[7]

Larger Context

Zoning regulations for accessory uses currently apply to solar arrays. See the "Policy Implications" section of these guidelines and the policy memo for additional land use and zoning considerations.

7 Source: http://imgurl.info/explore/minneapolis-lake-nokomis-beach/

Locate Strategically & Layer Uses

Solar arrays have the potential to maximize impact when coupled with other compatible uses. Projects that are well-suited to accommodate solar panels can create a market for solar and reduce citywide energy use. In particular, public projects such as streetscape improvements and public buildings should lead the market for solar energy, providing opportunities for related jobs and education as pilot projects.

Michigan State University solar parking canopy [8]

Brooklyn Solar Work's canopy installation on the Crown Heights co-op [9]

Layer uses and double up on planned projects, especially civic infrastructure.

Layer solar panels with other projects suitable for solar installations, both public and private. Opportunities include streetscape improvements, carports, parking canopies, awnings, bus stops, multi-family housing developments, and publicly-funded buildings. Ensure that projects planned by the city incorporate solar if feasible.

Site for educational and placemaking opportunities.

Identify and maximize opportunities for public education about solar, particularly visible solar projects in the public realm. Use solar as a means for activating public spaces. Couple installations with signage. See the "making the invisible visible" guidelines.

Maximize opportunities for building upgrades.

A common concern about solar in Detroit relates to the condition of aging roofs. Solar installations can couple with building upgrades such as overdue roof improvements, contributing to solar readiness and common home repairs.

Project Ideas

A sampling of potential public project types that layer uses include:

» Greenways should incorporate solar powered amenities and utilize adjacent open space for solar arrays.
» Publicly owned properties should be early adopters of solar retrofits.
» DDOT bus shelters should incorporate solar panels.
» Recreation centers and parks offer educational opportunities.

Larger Context

Create a Solar Design Recognition Program to celebrate solar projects on civic buildings. Require solar on parking structures and canopies. Require solar on new publicly-funded infrastructure and buildings, as well as private developments, such as multifamily housing.

8 Source: https://statenews.com/article/2017/09/new-solar-panel-carports-could-save-msu-10-million-in-electricity-costs
9 Source: https://www.brooklynsolarworks.com/gallery

Maximize Co-Benefits

Solar power can be coupled with other uses to create multiple benefits that support a range of objectives, including environmental and community goals. Solar installations should be designed to maximize co-benefits and seek out opportunities to enhance other goals.

Seek opportunities for landscape performance.

Ground mounted solar creates additional opportunities for productive landscapes. Seek to couple solar with other environmental benefits such as green stormwater infrastructure and native habitats. Design solar as a "cue to care,"* contributing to the upkeep and beautification of Detroit neighborhoods.

Native plant habitat, Westmill Solar Park [10]

Marry solar with other infrastructure.

Connect solar with other infrastructural benefits. For example, install solar as a productive use for brownfield sites, coupled with capping or bioremediation, install solar on freeway buffers, or integrate solar with parking lot canopies or parking structures.

Potential Co-Benefits

» Native habitats and pollinator gardens
» Green stormwater infrastructure
» Neighborhood beautification
» Water catchment systems

Larger Context

Incentives such as grant funding and expedited permitting can play a major role in encouraging solar projects to incorporate additional landscape benefits. Update zoning and other policy to enable solar coupled with urban agriculture and other productive land uses.

* "Cues to care" is a term coined by University of Michigan Professor Joan Nassauer used to describe an indication of human intention that suggests that a landscape is cared for and meets cultural norms for maintenance.

10 Source: https://www.audubon.org/news/can-solar-plants-make-good-bird-habitat

Solar Strand at the University of Buffalo [11]

Solar bus shelter in Los Angeles, CA [12]

Make the Invisible Visible

Solar should blend in with and complement the surrounding context. However, solar projects should also offer opportunities for education and data sharing whenever possible. This means sharing what solar power is, what it does, where it is located, and what it means in terms of energy and money savings.

Create opportunities for education.

Include signage that highlights and explains solar installations whenever possible. Do not assume people know what solar is or what it does and create opportunities to teach people about solar technology. Signage can make the invisible visible when solar arrays are hidden from sight. Less traditional uses of solar make more sense to be visible to passersby. Examples include solar water pumps, solar bus stops, and more. Consider making solar visible for the sake of education.

Install solar in the public realm.

Seek opportunities to install solar in public spaces, including open space and streetscapes. There are many examples of creative solar installations that use artistic means to celebrate solar power. Encourage creative solar solutions that invite discussion and excitement.

Make data accessible.

Data sharing is key to strengthening support for solar. Prioritize signage and more interactive dashboards to share energy and savings with building users and passersby whenever possible.

Larger Context

Offer incentives for installing educational signage to accompany solar projects such as mini-grants or expedited permitting. Require solar to be integrated in public infrastructure such as bus stops and lighting.

11 Source: https://www.domusweb.it/en/interviews/2013/09/02/forms_of_energy_.html
12 Source: http://www.solaripedia.com/13/199/1997/solar_bus_shelter_la.html

LARGER CONTEXT

Historic Districts

See the policy memo for a more thorough presentation of Detroit historic districts and the processes tied to solar systems in historic districts. This section considers the spatial and aesthetic character of solar projects in historic districts.

Policy Summary

Currently, solar energy systems in Detroit historic districts must be installed in areas with limited-to-no visibility from the public right-of-way. Ground mounted panels must be located in a rear yard. Rooftop panels shall be flat mounted and located on a rear roof elevation and/or garage with a matte dark finish consistent with the color of the existing roofing material. Wall mounted panels must not cover existing architectural features. Solar installations shall comply with the National Park Service document "Incorporating Solar Panels in a Rehabilitation Project."

Additional Considerations

Carports: Engagement for this project has indicated that Detroiters have utilized carports to meet the requirements of solar in historic districts. Carports are hidden from public right-of-way and, if newly constructed, can be designed to maximize solar gain.

Complementing historic features: As previously indicated in these guidelines, the Interior Secretary's Standards for Rehabilitation state that "new work shall be differentiated from the old." This should allow for solar and other installations in historic districts that complement rather than mimic historic conditions.

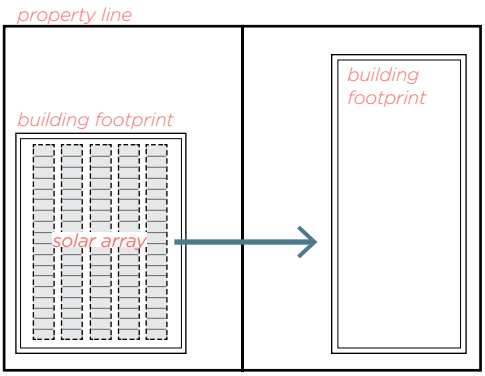
Historic industrial: Although not always included in Detroit's Historic Districts, separate consideration should be given to historic industrial properties, which are common throughout the city. Historic industrial properties should not be required to meet all current historic district solar requirements. For instance, historic industrial properties should be allowed angle-mount solar arrays on their often-flat roofs.

Policy Implications

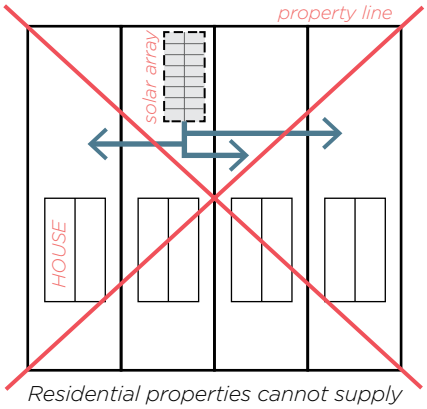
Key current local policies with physical implications are included here.

Statewide Policy

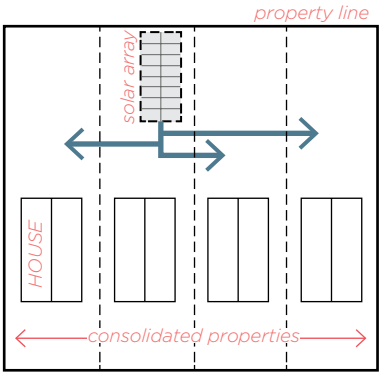
Statewide policy with spatial implications largely pertains to the ability of property owners to share solar energy across property lines. Policy allows that “self-service power suppliers” can only supply power to additional sites if you are an industrial site, in which case you can supply power to a contiguous site. Single residences and commercial establishments cannot supply power across property lines.



Industrial properties can provide power to contiguous sites.



Residential properties cannot supply power across property lines.



Combining properties may allow solar power to be shared between residences.

City of Detroit Policy

There are several policy measures with physical implications at the local level, particularly tied to zoning and building codes. For the purpose of this summary, ground mounted solar arrays are considered an accessory use.

Accessory uses are typically only allowed in the rear and must comply with setback requirements. In R1 and R2 zones, accessory uses cannot occupy more than 50% of the rear yard nor be closer than 10 feet to the house. The combined area of all structures cannot exceed 35% of the site. Roof mounted solar energy systems must comply with height limits. In R1 zones, the height limit is 35 feet. Rooftop structures used for mechanical purposes that do not occupy more than 30% of the roof area may be exempt.

Typical lot: 30x100ft = 3000sf

Example house: 22x30ft = 660sf

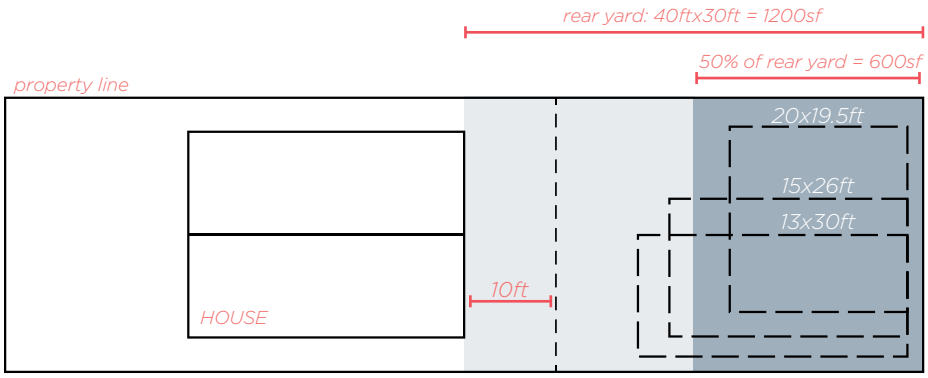
Combined area of all structures cannot exceed 35% of site = 1050sf

1050sf - 660sf = 390sf for solar

Solar array options: 13x30ft, 15x26ft or 20x19.5ft

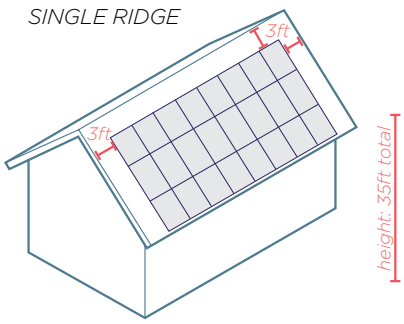
Rear yard area: 40x30ft = 1200sf

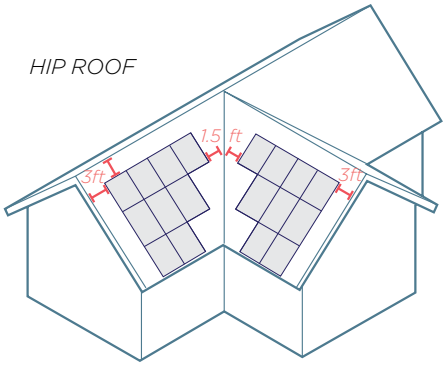
50% of rear yard: 1200sf/2 = 600sf (any of the above options allowed)



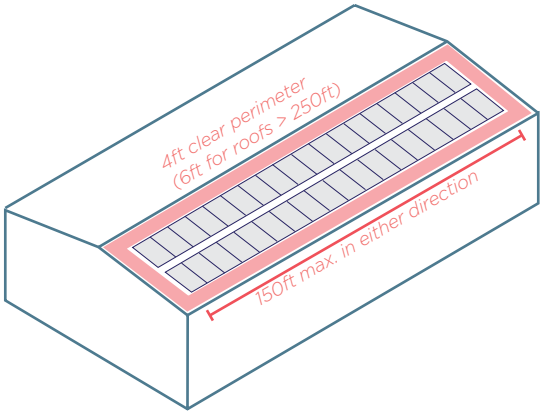
Accessory use zoning calculations for ground mount solar arrays on residential properties.

Fire code has spatial implications for rooftop solar energy systems to allow for emergency access and ventilation. Hip roofs must provide a single 3' wide clear pathway from eave to ridge and single ridge roofs must provide two 3' wide clear pathways from eave to ridge where modules are located. Panels must be located 3' below the ridge of the roof on single-family, two-family and townhomes. If panels are on both sides of a hip or valley, they cannot be closer than 1.5' to the hip or valley.





Clearance requirements for residential rooftop solar arrays.



Requirements for non-residential rooftop solar on buildings with a length or width less than 250'.

For other uses, solar systems must provide a 4' wide clear perimeter around the edges of the roof for buildings with a length or width of 250' or less, and a minimum of 6' wide for larger buildings. Furthermore, arrays should not be larger than 150' by 150' in distance in either axis.

See the policy memos for recommendations and proposed amendments relating to local zoning and permitting processes.

DESIGN GUIDELINES CHECKLIST

Complement & Blend with Context

	Plan for performance.
	Keep it simple.
	Match shapes, colors, and layout whenever possible.
	OR intentionally complement context by design.

Consider Edge Conditions

	Prioritize a welcoming public-facing edge that contributes to the surrounding context.
	Create buffers for security as well as beauty.
	Accommodate setbacks and shadows.
	When possible, eliminate barriers.

Design for Different Land Uses

	Plan solar in response to different land use types.
	Produce pilot projects.

Locate Strategically & Layer Uses

	Layer uses and double up on planned projects, especially civic infrastructure.
	Site for educational and placemaking opportunities.
	Maximize opportunities for building upgrades.

Maximize Co-Benefits

	Seek opportunities for landscape performance.
	Marry solar with other infrastructure.

Make the Invisible Visible

	Create opportunities for education.
	Install solar in the public realm.
	Make data accessible.