Building Energy Asset Score: Building Upgrade Guide[1]

ENVELOPE

Windows

Asset Score Report Recommendations:

- **Upgrade Windows (Cost: $$ - $$$, based on glass and frame type)**
- **Upgrade Skylights (Cost: $$)**
- **Add Retrofit Film (Cost: $)**

Window upgrades can include a variety of measures such as replacing single pane windows with double pane windows as well as replacing existing windows double pane windows with those with higher thermal performance, or adding shading, storm windows, or additional film to the glass to reduce heat gain due to solar radiation. Compared to regular double pane windows, high-performance double pane windows can incorporate combinations of low- emissivity film, higher performance frames, and gas fill.

For north- and south-facing windows, consider windows with low solar heat gain coefficient (SHGC) and an appropriate visible transmittance (VT). Certain window coatings, called selective low-e, transmit the visible portions of the solar spectrum selectively, rejecting the nonvisible infrared sections. These glass and coating selections can provide a balance between VT and solar heat gain. Higher SHGCs are allowed in colder regions, but installing continuous horizontal overhangs is still advantageous in that it blocks the high summer sun angles. Table 1 provides general guidelines for upgrading windows in different climate zones. Note that Table 1 only shows examples of combinations of glass, frame, and fill characteristics; other options are available and should be evaluated when considering a window upgrade.

For buildings with operable windows, the mechanical systems should use interlocks to ensure that the HVAC system shuts down in the affected zone while the windows are open. A high level of integration between envelope and HVAC system design helps to maximize energy efficiency.

[1] The complete Asset Score Building Upgrade Guide is available at: https://buildingenergyscore.energy.gov/assets/energy_asset_score_recommendations_guide.pdf

Table 1: Examples of High Performance Windows by Most Applicable Climate Zone

Climate Zone	U-Factor	SHGC	VT	Glass and Coating	Gas-Fill	Spacer	Frame
1-3	0.46	0.23	0.51	Double clear, highly selective low-e coating	Air	Standard	Thermally broken aluminum
1-3	0.47	0.24	0.32	Double clear, low-e reflective coating	Air	Standard	Thermally broken aluminum
1-3	0.32	0.20	0.29	Double clear, low-e reflective coating	Air	Standard	Foam-filled vinyl or pultruded fiberglass
4-5	0.34	0.25	0.51	Double clear, highly selective low-e coating	Argon	Insulated	Thermally broken aluminum
4-5	0.35	0.22	0.32	Double clear, low-e reflective coating	Argon	Insulated	Thermally broken aluminum
4-5	0.32	0.20	0.29	Double clear, low-e reflective coating	Air	Standard	Foam-filled vinyl or pultruded fiberglass
6-7	0.31	0.39	0.50	Triple clear, low-e coating for outer light only	Argon	Insulated	Thermally broken aluminum
6-7	0.26	0.31	0.54	Double clear, low-e reflective coating	Argon	Insulated	Foam-filled vinyl or pultruded fiberglass
8	0.25	0.39	0.53	Triple clear, low-e coating for outer	Argon	Insulated	Aluminum thermally isolated frame
8	0.22	0.36	0.53	Triple clear, low-e coating for outer	Argon	Insulated	Foam-filled vinyl or pultruded fiberglass

Source: ASHRAE (2011), Advanced Energy Design Guide for Small to Medium Office Buildings, Page 121. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. https://www.ashrae.org/technical-resources/aedgs.