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TECHNOLOGIES

Advancements in Glass for Improved Efficiency in Infrastructure Design

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Introduction

- Today, during our session Celebrating the International Year of Glass: The Role of Glass in the Age of Sustainable development, we want to discuss advancements in glass for improved efficiency in infrastructure design

VIG Units

Bird Safe Glazing

Semi-Mirror Coatings

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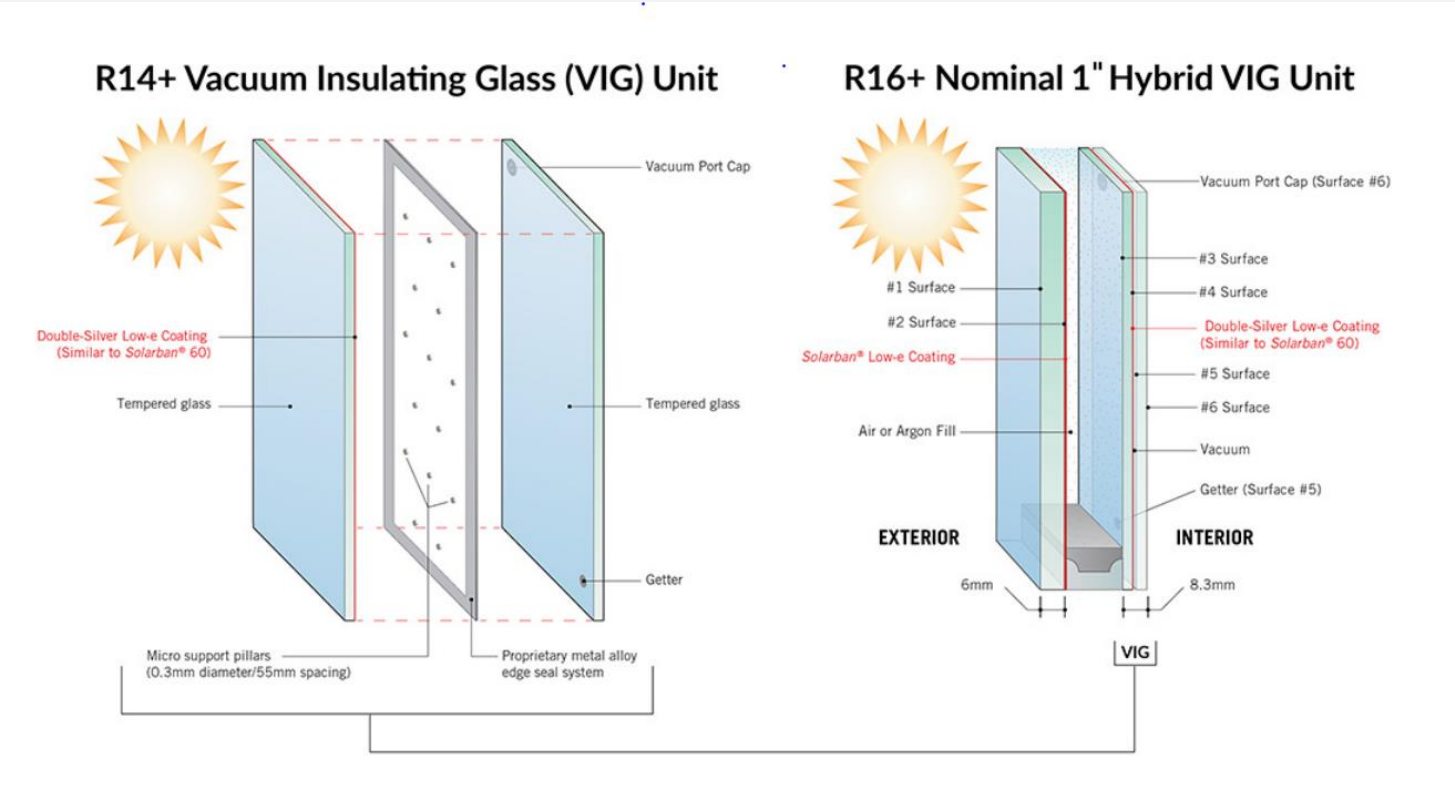
Relationship of Each Topic to Sustainable Development

- VIG Units: The fabrication of VIG units delivers high insulating values to move buildings toward carbon-neutral

- Bird-Safe Glazing: The fabrication of glass with bird-safe patterns protects the bids by ensuring that they can safely see and flare from glass facades

- Semi-Mirror Coatings: Allow glass fabricators to print and fire attractive designs on glass under firing conditions traditionally used in the industry

Vitro Architectural Glass VacuMax VIG and Hybrid VIG Units



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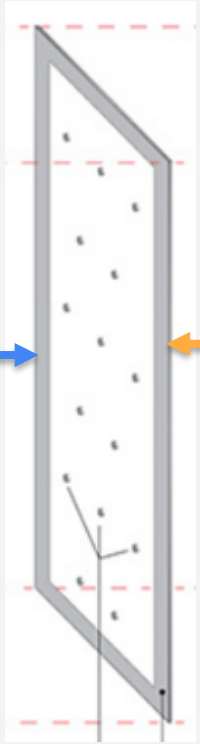
Glass-to-Glass Edge Seals, The Heart of a VIG

<u>Metal Alloy Seals</u>:
--Good hermeticity can be obtained
--Thermal conductivity around the edges of the unit can occur



<u>Ceramic Enamel Seals:</u>
--Good hermeticity
--Lower thermal conductivity
--Special, low-melting glasses are used
--They allow sealing without destroying the temper of the glass sheets
--Sealing by thermal and laser sintering means

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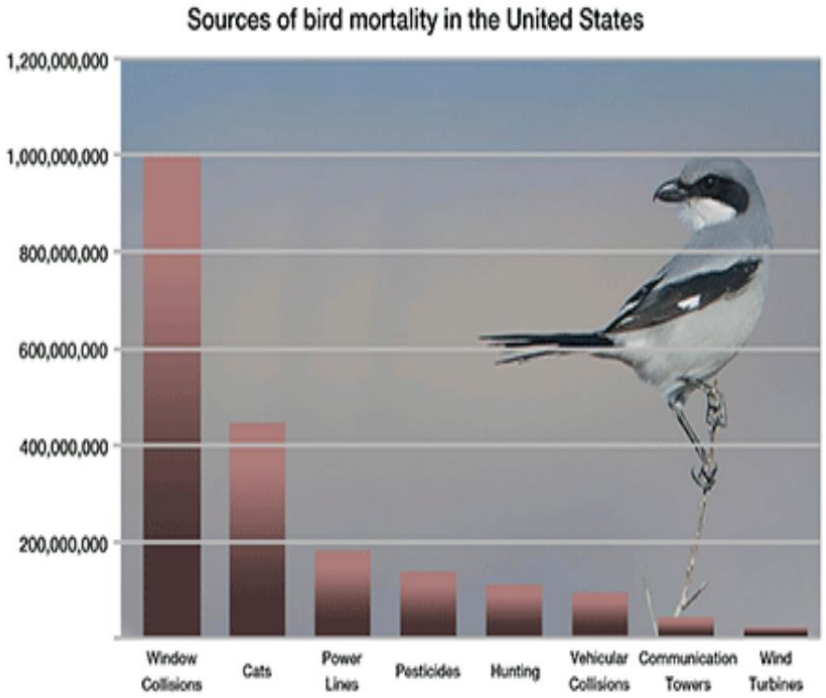
Birds are Dying Due to Collisions with Glass



- Sources: "American Bird Conservancy Guide to Bird-Safe Glazing" and Dr. Christine Sheppard, Collisions Manager of the American Bird Conservancy

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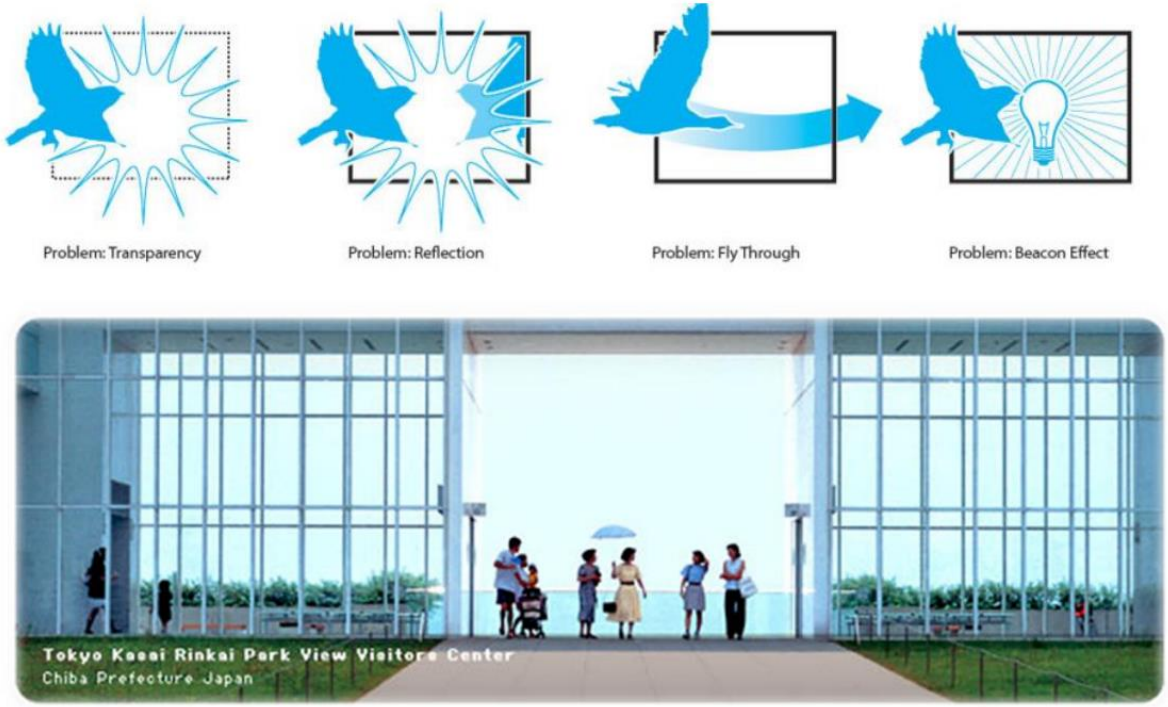
Problems Birds Encounter with Glass-Covered Buildings



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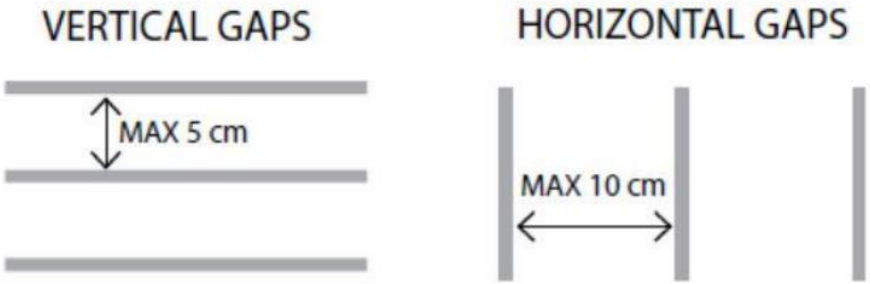
Birds Need Help to Perceive and Avoid Glass

- When designing bird-friendly glazing, the 2” x 4” Rule (5 x 10 cm) should be observed

  *For hummingbirds, the features should spaced 2” (5 cm) apart in both directions



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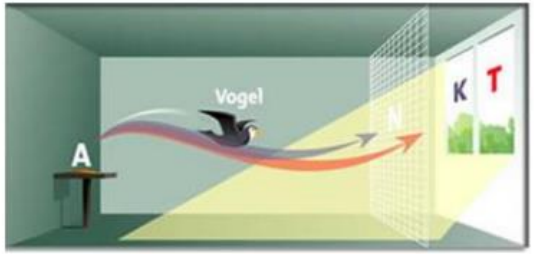
Flight Tunnel Testing to Determine Effectiveness

- **Achieve a score of 70% in flight tunnel tests**
- A score near **50 indicates random behavior**
- A score of **80% is given the rank of "Most Preferred"** by the American Bird Conservancy
- **A** score of 70% is "bird-safe" for the LEED credit and is given a rank of "Preferred"

* It is recommended to install bird-safe glazing from 0 to 40 feet (0-13 meters) above grade



T – Transparent glass
K – Coated trial

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Examples of Suitable Screen-Print Coatings

Etch Stripe Pattern

Etch Dot Pattern

Avoidance Scores: 76% 80%

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Examples of Suitable Digitally Printed Patterns

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Utility of the Single-Layer, Semi-Mirror Coating

Exterior View on a Building

View from Inside a Building

--The thickened solution of metal oxide precursors can be printed over large areas
--The dried paste combusts during firing to result in a metal oxide coating fired to the glass
--Nanometer-scan thicknesses are achieved after firing over these large areas
--It is an alternative to CVD processes—no vacuum conditions are needed
--A one-way mirror effect can be achieved on dark glasses such as in this example
--Multi-Layer coatings are possible with successive print/dry/fire cycles to keep the coating layers discreet

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Resources of Information on These Topics

- VIG Unit Theory:
  - Dr. Cenk Kocer, University of Sydney, Australia

- Ornithology (Bird Vision/Behavior):
  - Dr. Daniel Klem, Muhlenberg College, Allentown, PA
- Bird Flight Tunnel Testing:
  - Dr. Christine Shepperd, Collisions Manager of The American Bird Conservancy

- Semi-Mirror Coatings:
  - Vibrantz Technologies