Rating & Certification for Energy Performance of Windows & Window Attachments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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November 7, 2014

BTO Emerging Technologies: Research Portfolio

Advanced windows

Advanced refrigerator technology

Building energy models/calculators

Low global warming potential refrigerants

Heating, ventilating, air conditioning, water heating, and working fluids

Solid state lighting

Sensors and controls

Advanced heat pump technology:

- Air source heat pumps
- Integrated heat pumps
- Heat exchangers

Building Envelope: Next generation insulation

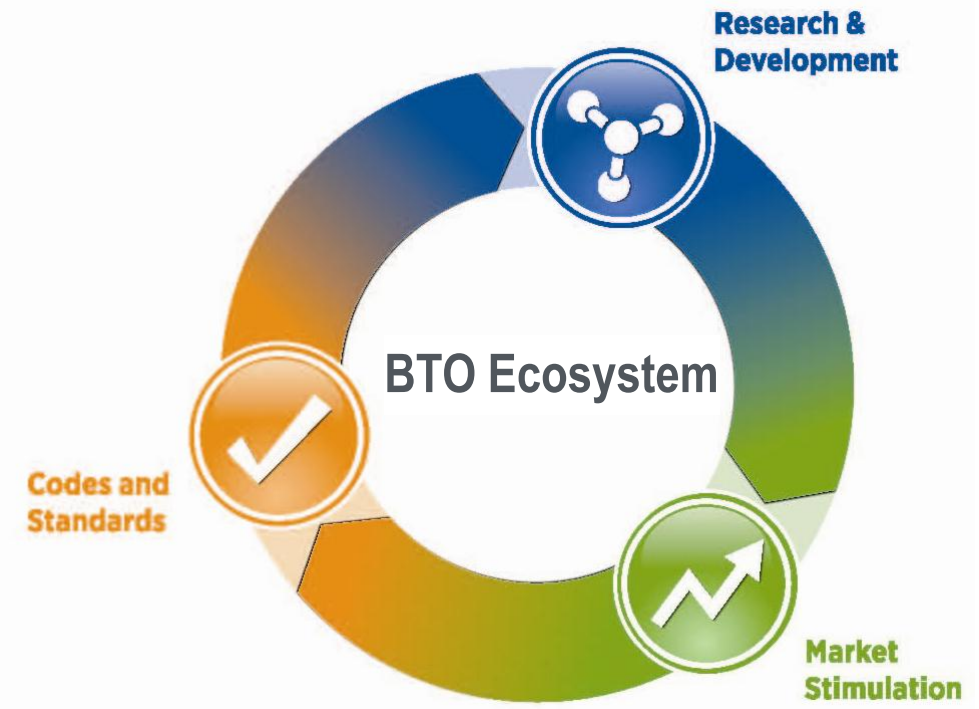
BTO's Integrated Approach

Research & Development

- Develop technology roadmaps
- Prioritize opportunities
- Solicit and select innovative technology solutions
- Collaborate with researchers
- Solve technical barriers and test innovations to prove effectiveness
- Measure and validate energy savings

Market Stimulation

- Identify barriers to speed and scale adoption
- Collaborate with industry partners to improve market adoption
- Increase usage of products & services
- Work through policy, adoption, and financial barriers
- Communicate the importance and value of energy efficiency
- Provide technical assistance and training



Codes and Standards

- Establish minimum energy use in a transparent public process
- Protect consumer interests
- Reduce market confusion
- Enhance industry competitiveness & profitability
- Expand portfolio of EE appliances & equipment
- Raise the efficiency bar

National Fenestration Ratings Council (NFRC)

NFRC develops and administers energy-related and certification programs that serve the public by providing fair, accurate and credible information on fenestration performance.

1988: LBNL releases WINDOWS 3.1 software

1989: NFRC created

"Persistence wore down resistance"
Roland Temple, VELUX-AMERICA

1991:

- **1st edition of Certified Products Directory (CPD) with 200 products. Today it has over 100,000.**
- **NFRC adopts a U-factor procedure**

1993: First NFRC labeled products manufactured

EPAct 1992

- **Recognizes NFRC national rating council**
- **Mandates voluntary national energy rating system for windows and window systems**
- **Called on DOE to support NFRC and monitor its activities**

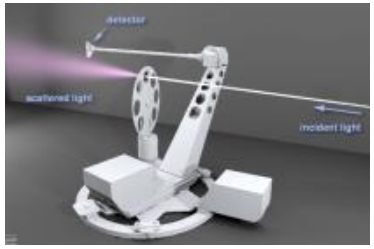
1997: ENERGY STAR Window Program created by DOE. NFRC label required to participate in the program.

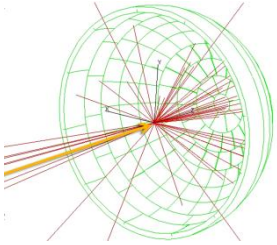
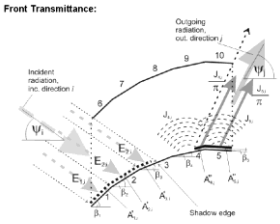
2012: ENERGY STAR Window Program moved to EPA.

Simulation vs. Testing

- Manufacturers: Computer simulations are adequate
- Government: Test everything
- Compromise: NFRC would use simulated ratings that were validated with physical tests

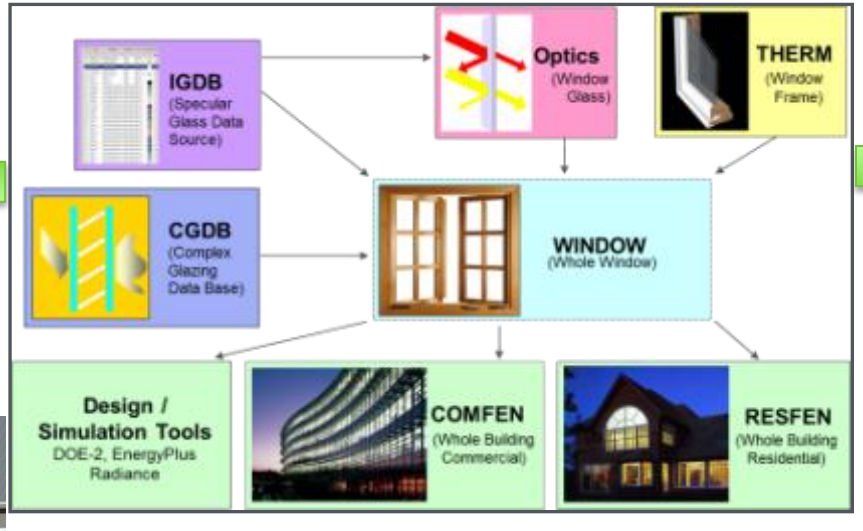




Tools, Standards, Product Data

Product Design



Ratings / Deployment

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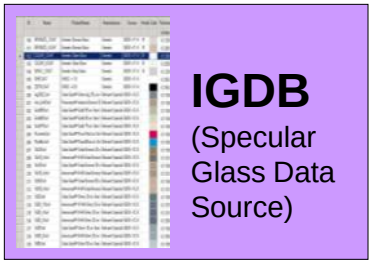
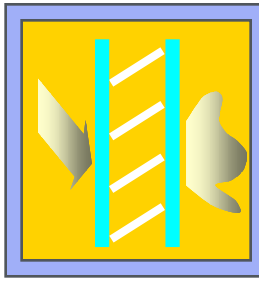
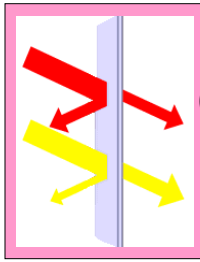
Suite of Software Tools at LBNL



IGDB
(Specular Glass Data Source)

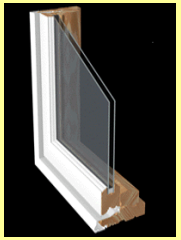


CGDB
(Complex Glazing Data Base)



Optics
(Window Glass)

WINDOW
(Whole Window)



THERM
(Window Frame)

Design / Simulation Tools
DOE-2, EnergyPlus
Radiance

COMFEN
(Single Zone Commercial)

RESFEN
(Whole Building Residential)

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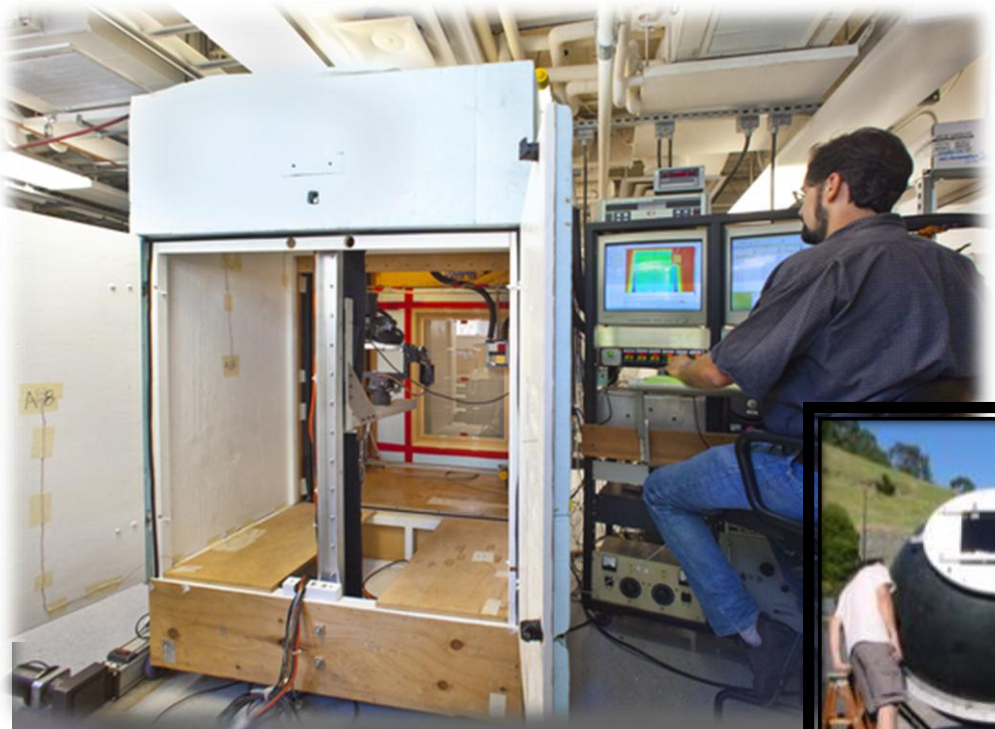
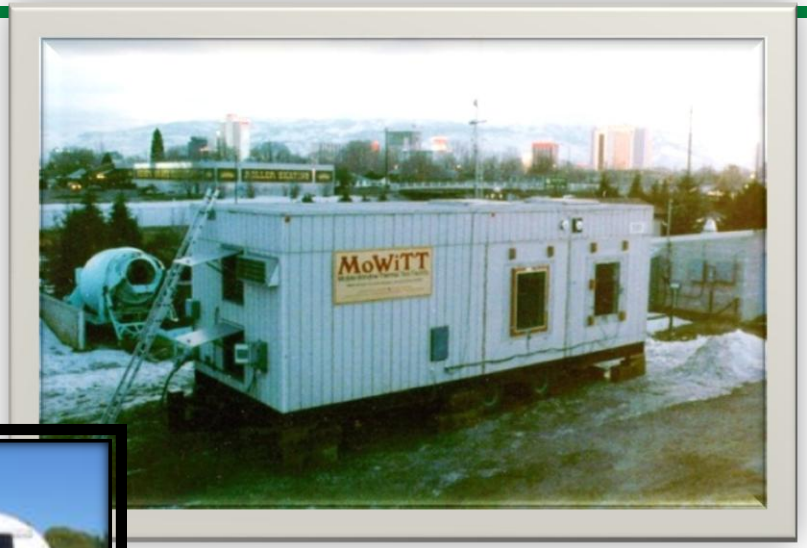
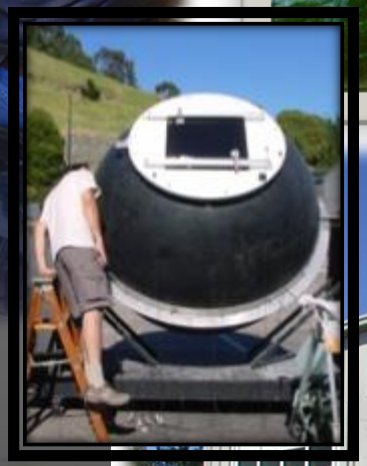
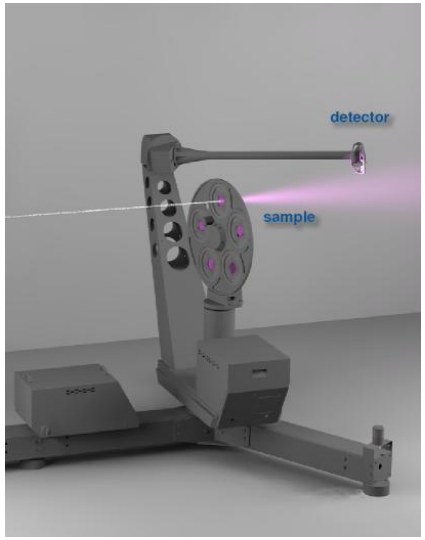
Window Measurement Facilities at LBNL

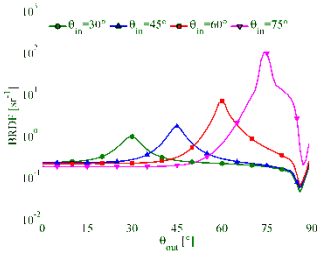


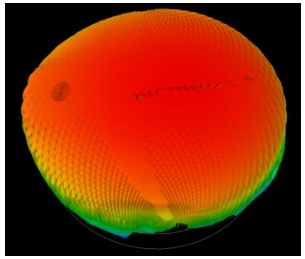


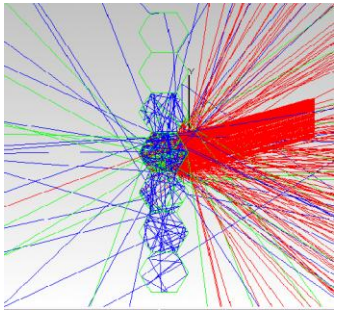


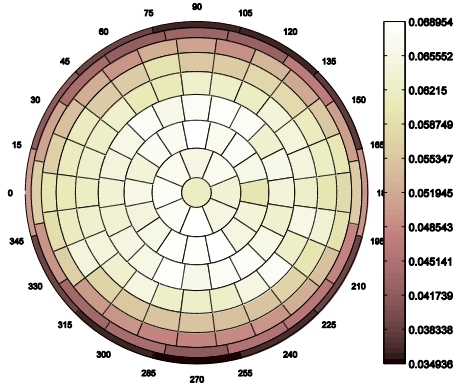
Basic Property Measurements are Inputs to Computer Models

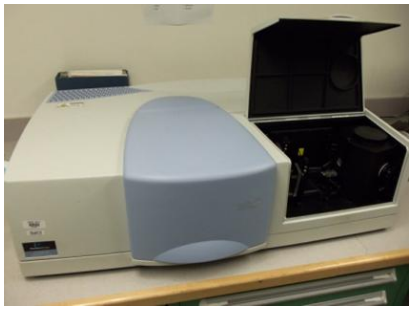


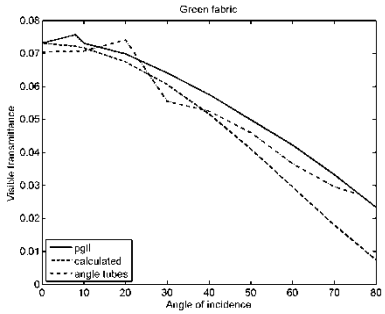




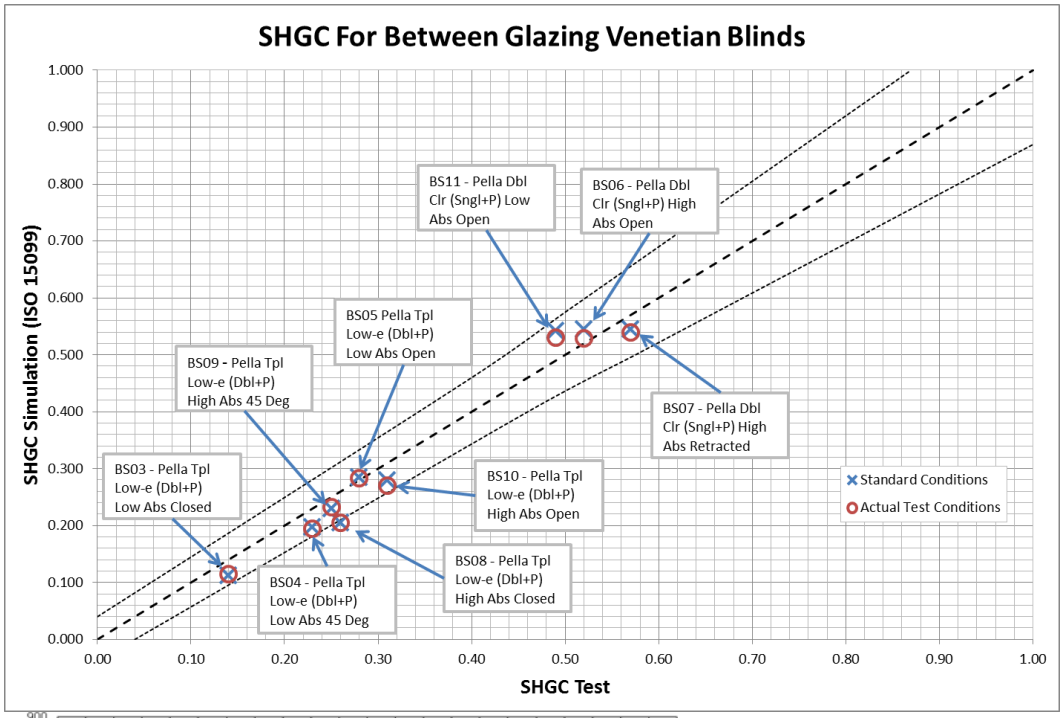


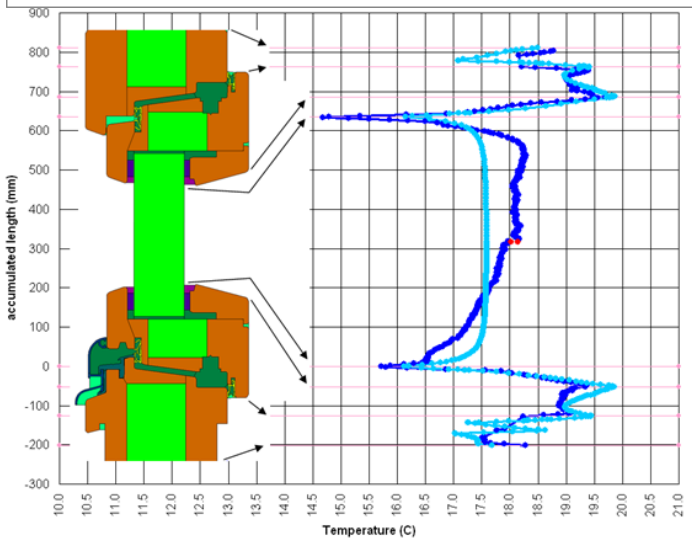


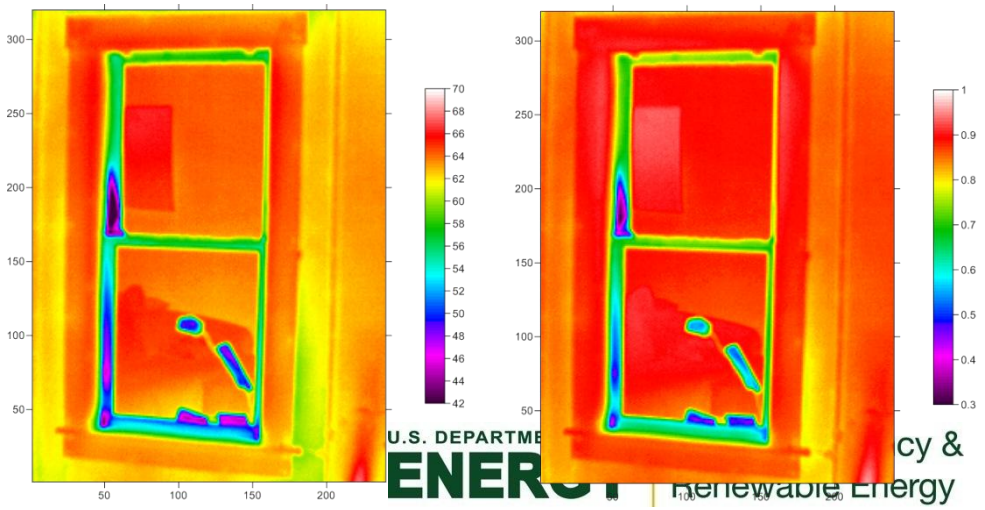




Software Tool Experimental Validation

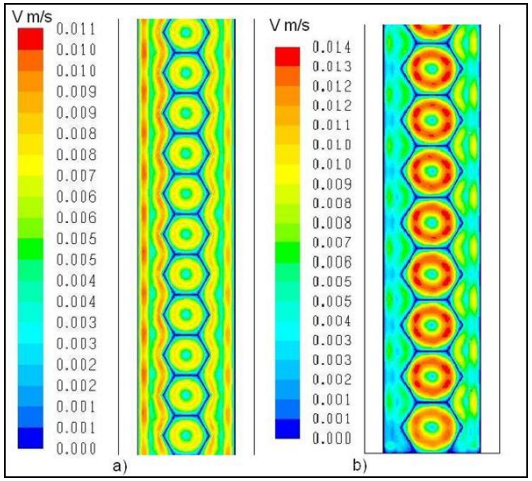


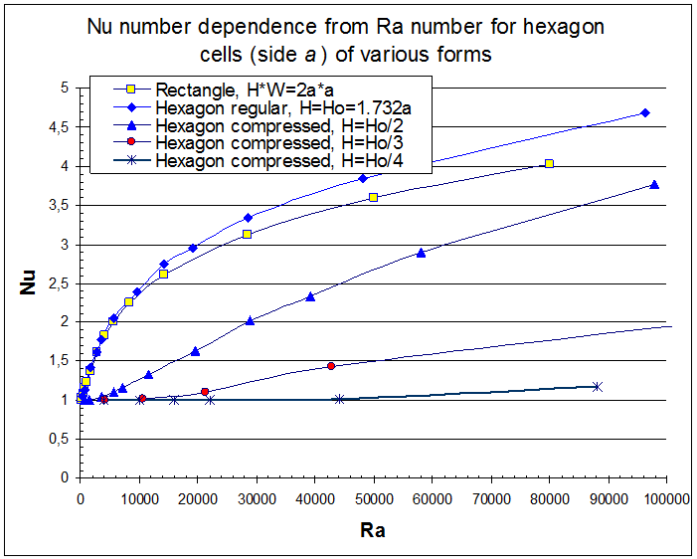




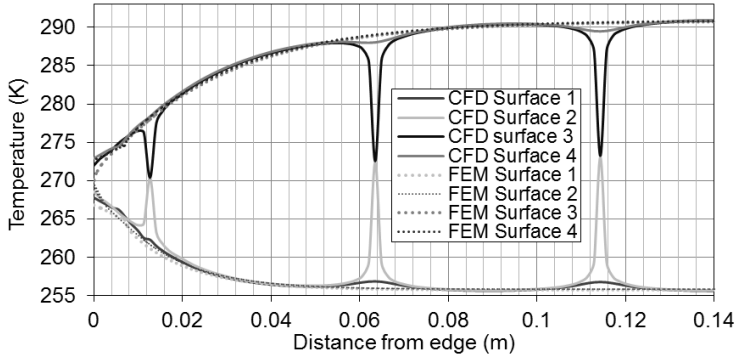
Detailed Numerical Modeling to Develop Models & Better Understand Experiments

Cellular shade thermal model:





Vacuum glazing thermal model:



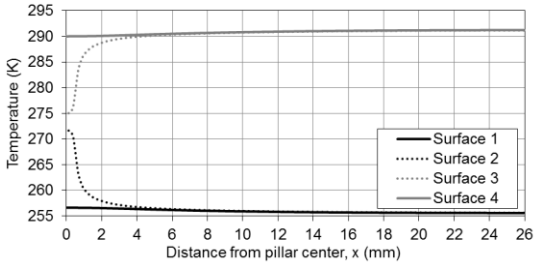


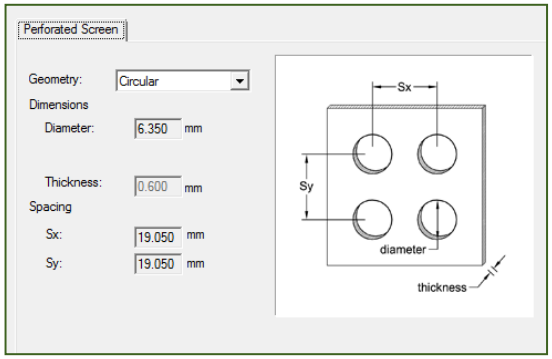
TABLE 7. COG thermal transmittance (U-Factor) using three solution methods

	Surface 2 emissivity: 0.02		Surface 2 emissivity: 0.84	
Model	**U-Factor ($W/(m^2 K)$)**	**% Diff.**	**U-Factor ($W/(m^2 K)$)**	**% Diff.**
Analytical	0.444	5.7%	2.271	0.5%
Analytical[1]	0.487	-3.5%	2.307	-1.0%
2D FEM	0.444	5.7%	2.271	0.5%
2D FEM[1]	0.486	-3.3%	2.289	-0.2%
3D FVM Solid	0.471	-	2.284	-
3D FVM Radiation	0.470	0.2%	2.225	2.6%

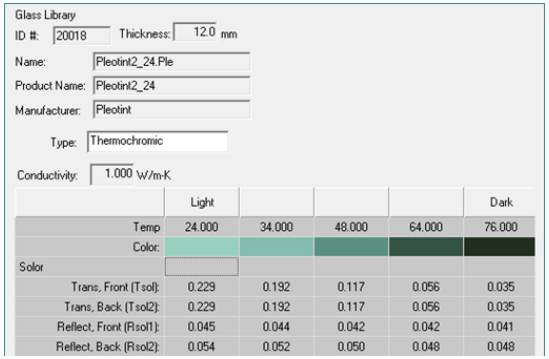
[1]Solved using analytical equation that accounts for pillar conductivity (Curcija and Hart 2012)

Recent Advances

Perforated screens:

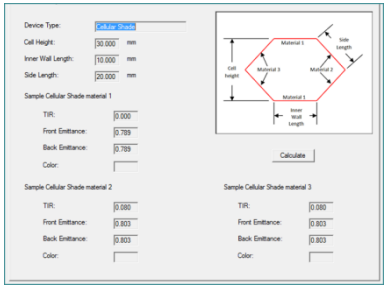


Chromogenic glazing:

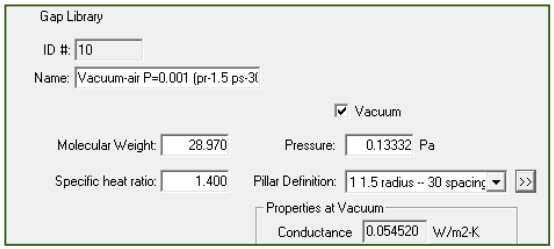


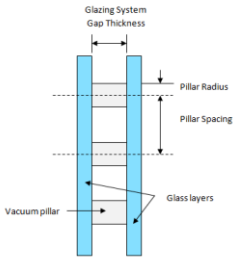
	Light				Dark
Temp	24.000	34.000	48.000	64.000	76.000
Color:					
Solor					
Trans, Front (Tsol):	0.229	0.192	0.117	0.056	0.035
Trans, Back (Tsol2):	0.229	0.192	0.117	0.056	0.035
Reflect, Front (Rsol1):	0.045	0.044	0.042	0.042	0.041
Reflect, Back (Rsol2):	0.054	0.052	0.050	0.048	0.048

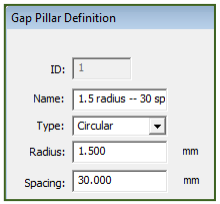
Cellular shades:



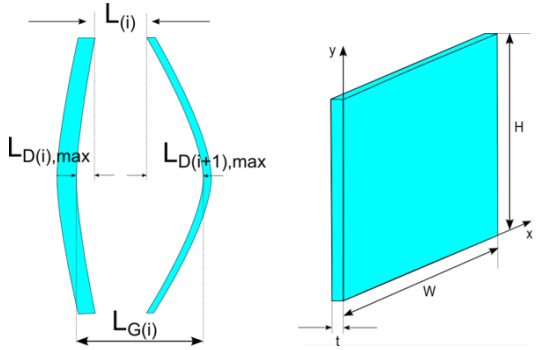
Vacuum glazing





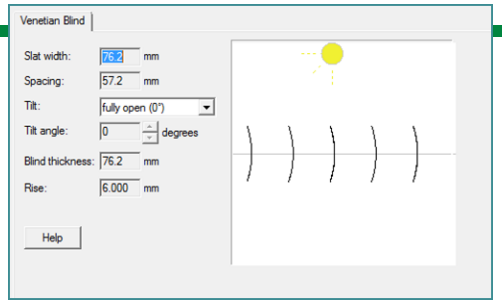


Glazing deflection:

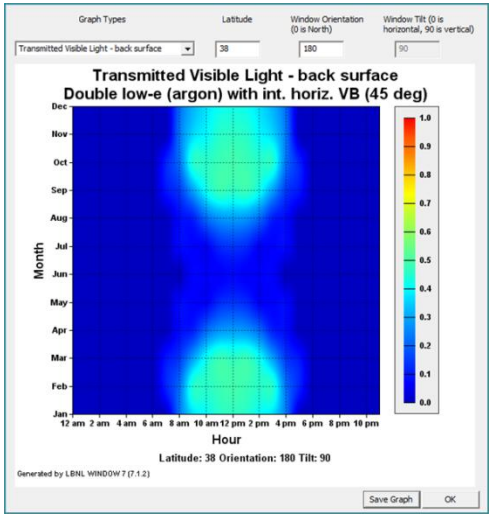


Ufactor	SC	SHGC	Rel. Ht. Gain	Tvis	Keff	Gap 1 Keff
W/m2-K			W/m2		W/m-K	W/m-K
1.667	0.422	0.367	278	0.691	0.0304	0.0304
1.870	0.425	0.369	282	0.691	0.0359	0.0304

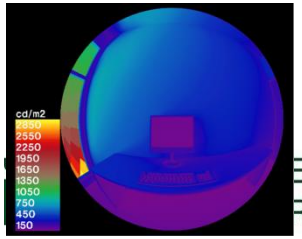
Vertical Louvers:



Angular data:



Radiance renderings:



What EXACTLY is a window system?

Energy Policy Act of 1992; Subtitle C; Section 121

The Secretary [of the Department of Energy] shall, after consulting with the NFRC, industry representatives and other appropriate organizations provide financial assistance to support a voluntary national window rating program that will develop energy ratings and labels for ***windows and window systems***

WCMA
Window Covering Manufacturers Association

Window attachments industry approached DOE and EPA in 2010 and expressed interest in creating an ENERGY STAR program for window attachments.

- Currently **no consistency in performance rating** protocols and thus no way to identify efficient products
- The proven strategy to grow market share of EE consumer products—ENERGY STAR or a similar program—**requires an established independent rating and certification product for energy performance**

NFRC
National Fenestration Rating Council

Is this a job for NFRC?

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CRAFT FOA – Released Nov 2013

Summary

- Up to $1.6 million, 1 award; 4 year funding period
- Cooperative Agreement with substantial involvement between EERE and Recipient;
- 35% cost share
- Financial self-sufficiency at the end of four year funding period

Main Objectives

- Develop energy performance-based rating and certification standards and program procedures
- Oversee the implementation of procedures
- Develop and maintain a database of fenestration attachment product performance

Product Types

- Blinds
- Shades
- Drapes
- Shutters
- Storm Windows
- Interior Storm Panels
- Solar Screens
- Awnings
- Window Quilts
- Window Film

NFRC can choose to rate any of these products, but they are not *mandated to do so.*

National Fenestration Rating Council

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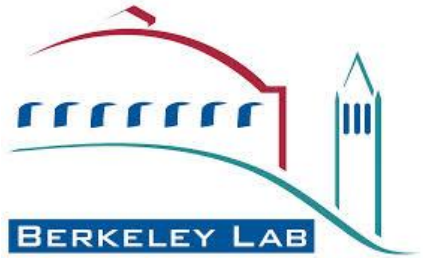
CRAFT FOA Performance Targets

- Developing cost-effective performance indices

Performance Indices – Residential and Commercial	
Thermal Transmittance (U-Factor)	Energy Performance (EP)
Solar Heat Gain Coefficient (SHGC)	Daylighting Potential (DP)*
Visible Transmittance (VT)	Condensation Resistance (CR)
Air Leakage (AL)	

- CRAFT establishment and management
- Rating program development
- Attachment labeling guidelines and enforcement
- IT systems management
- Long-term financial self-sufficiency



D&R INTERNATIONAL

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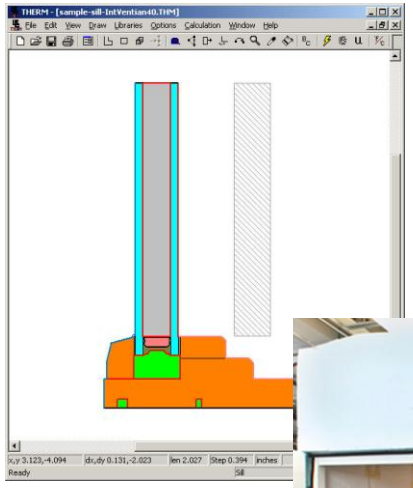
Things to consider as you innovate

- You are going to be selling your product based on energy savings and thermal comfort. **The label matters.**
- Watch the ratings programs as they evolve. Get involved early.



NFRC National Fenestration Rating Council® CERTIFIED	**World's Best Window Co.** Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: **Vertical Slider**
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) **0.30**	Solar Heat Gain Coefficient **0.30**
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance **0.51**	Air Leakage (U.S./I-P) **0.2**

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.
www.nfrc.org

- You won't get a label without testing procedures and modeling tools that work for your product.
- Will today's test labs and simulation method work for your technology?
- LBNL is your friend. They understand the technical and non-technical challenges.

How To Get Involved with BTO

- **Get on our email list http://www1.eere.energy.gov/buildings/newsletter.html, and click on "Sign up to receive news and events from BTO")**
- **Volunteer to be a reviewer**
- **Participate in workshops, RFIs (Requests for Information), and the annual program peer review**
- **Apply to a FOA: 2015 BENEFIT and BUILD**

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