



Windows Technology Development and Deployment

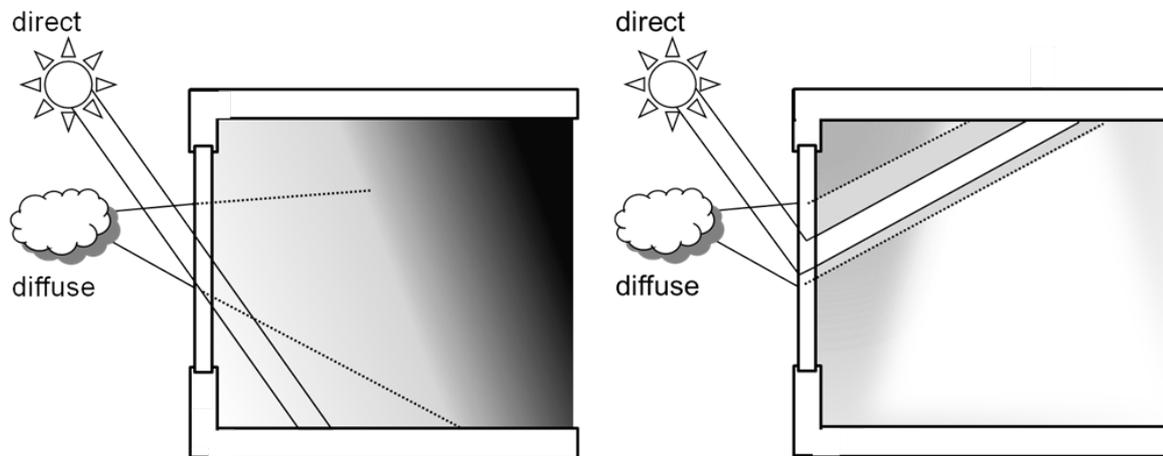
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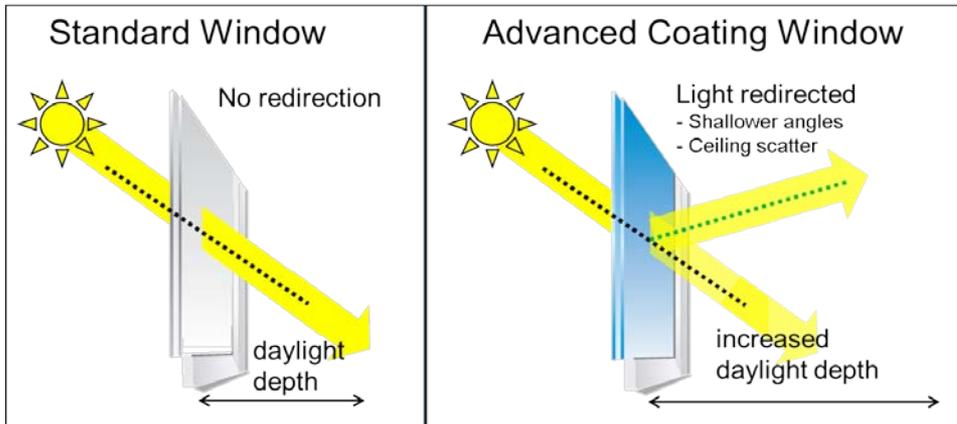
DOE Windows Roadmapping Workshop, Minneapolis, MN

PNNL Windows Activities

- ▶ Technology development
 - Daylighting (BTP/ET and PNNL/LDRD)
 - Vacuum Insulated Glass (Private Industry and Battelle IR&D)
- ▶ Technology Deployment
 - Volume Purchase Program (BTP/ET)



Advanced Window Coatings for Daylighting



Objective

- Develop window coatings that double daylight penetration into buildings to save energy

Scope of Work

- Demonstrate proof-of-concept and optimize performance

Total Cost - \$200K BTP/ET and \$217K PNNL LDRD

- FY11 \$100K BTP/ET Economic Scoping Study
- FY11 \$92K PNNL LDRD Technical work
- FY12 \$100K BTP/ET Single wavelength performance
- FY12 \$125K PNNL LDRD broad spectrum response

Progress & Accomplishments

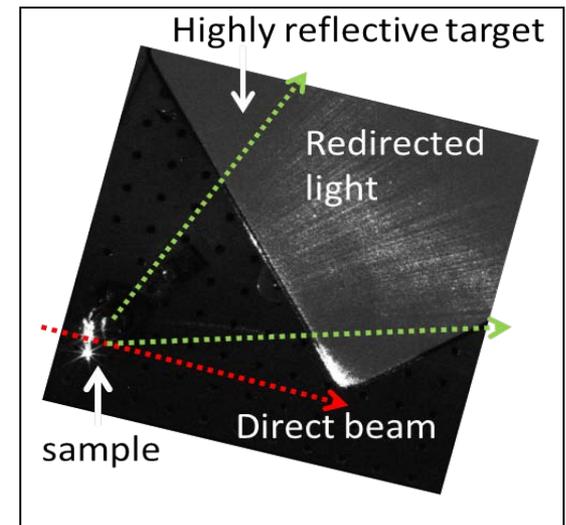
- Demonstrated single wavelength redirection effect
- Demonstrated multi-wavelength response
- Provisional patent in progress

Expected Outcomes

- Demonstration of light redirection
- Broad wavelength response

Next Steps

- Improve performance
- Scale-up



Photograph of daylighting effect

Vacuum Insulated Glazing at PNNL

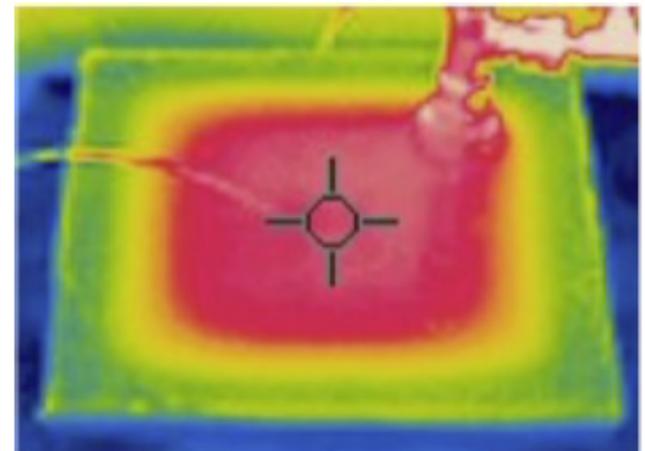
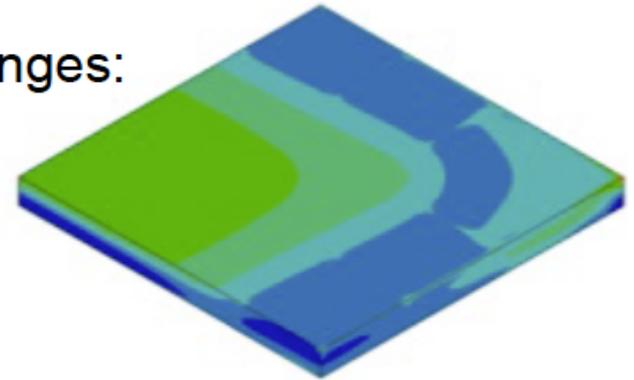
Summary: PNNL researchers are developing materials and techniques to produce low-cost, durable and highly insulating evacuated glazing

Approach: Soft material solutions to VIG challenges:

- Transparency
- Standoffs
- Edge seals
- Assembly
- Evacuation
- Longevity

Achievements:

- Model of thermal & compressive stresses vs. materials used
- Model of vacuum lifetime vs. material permeation & outgassing
- Measured center-of glass insulation (ΔT) vs. pressure for 36in² units
- Produced 3.5'x1.5' VIG prototypes



High Performance Windows Volume Purchase Program (VPP)

- High price premium between double and triple pane windows creates cost barrier for consumers
- 80% of windows sold in US are ENERGY STAR compliant, but no higher tier program exists.
- VPP created to lower costs through two strategies:
 - Raise awareness of high performance windows, thereby increasing demand.
 - Create competition between manufacturers through a public website showing prices.
- Program includes low-E storm windows. Very cost effective upgrade for existing windows.



Phase I – May 2010

- 62 manufacturers responded to original solicitation.
 - 40 passed verification and are entered into the program.
- More than 50 publications and articles appear in two years.
- State of Pennsylvania added low-E storm windows to priority list for all state weatherization programs.
- Energy Trust of Oregon created utility incentive program specific to high performance levels.

Phase II – May 2011

- Slight changes to specifications made. 28 manufacturers are verified and entered into the program.
- Website enhanced to allow searchable criteria to be entered.
- Questar Gas and Pacific Power created incentive programs specific to R5 levels; others also being approached.
- Sales reports total more than 17,000 windows worth ~\$4.5 million through first two phases of the program.
- Phase II extension initiated in May 2012 until end of December 2012.