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# Emerging Window Technologies + How to Capitalize on Incentive Programs Offered by Utility Companies

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Alliance to Save Energy



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ALLIANCE TO  
**SAVE ENERGY**  
*Creating an Energy-Efficient World*



# Acknowledgement and Disclaimer

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# What is the Efficient Windows Collaborative (EWC)?

The EWC is a coalition of companies, organizations, and government agencies interested in expanding the market for high-efficiency fenestration products.

**Alliance to Save Energy:** lead communications/ marketing activities

**University of Minnesota:** information products & technical support

**AZS Consulting:** outreach support

**Members:** guide activity focus, support EWC activities

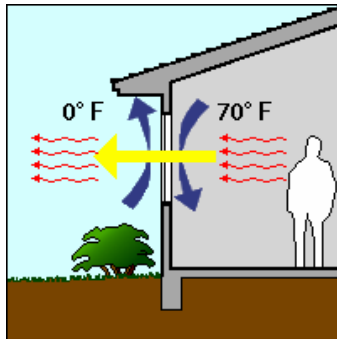
**U.S. Department of Energy:** provides funding



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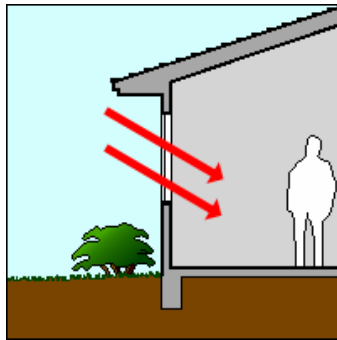
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# Why Window Energy Efficiency Matters



## Heating

U.S. average: About 25% of home heating energy use is due to cold windows.



## Cooling

U.S. average: About 30% of home cooling energy use is due to solar heat gain through windows.

About **2.5 percent of U.S. energy use** is due to residential windows




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# Efficient windows of the German Democratic Republic



# Potential to Reduce the Energy Impact of U.S. Windows

- Reduction of air leakage of existing windows could save hundreds of trillions of Btu
  - Reduction of the energy impact of conduction, convection, radiation if all windows across the U.S. were replaced...
    - With the current market mix → ~40%
    - With ENERGY STAR windows → ~50%
    - With the best available products → ~75% 
    - With possible future technologies → ~100%
- More energy than what flows through the Alaskan pipeline

Estimates based on: Arasteh et al. 2006. *Zero Energy Windows*. Lawrence Berkeley National Laboratory



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# What Utility Programs Can Do

- Weatherization of existing windows
- Replacement of existing windows with energy-efficient windows
- Promotion of energy-efficient windows in new construction
- Support for emerging window technologies



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# Weatherization of Existing Windows

Caulking, weatherstripping, window repair:

- Common low-income weatherization measures
- Common part of whole-house efficiency programs, such as Home Performance With Energy Star



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# Weatherization of Existing Windows

## The Opportunity of Storm Window Programs

- Makes sense where window replacement is unlikely
  - Benefits low-income and older housing in particular
  - Savings easily qualify as additional
- Field evaluation by LBNL and NAHB Research Center:
  - Substantial, cost-effective energy savings from adding low-E storm windows to single-pane windows
- Without NFRC rating, specification is difficult
  - **Made 2006-07 federal tax credit criteria unclear**
- NFRC is currently developing rating procedure



# Replacement of Existing Windows

## Utility Incentives for Energy-Efficient Windows

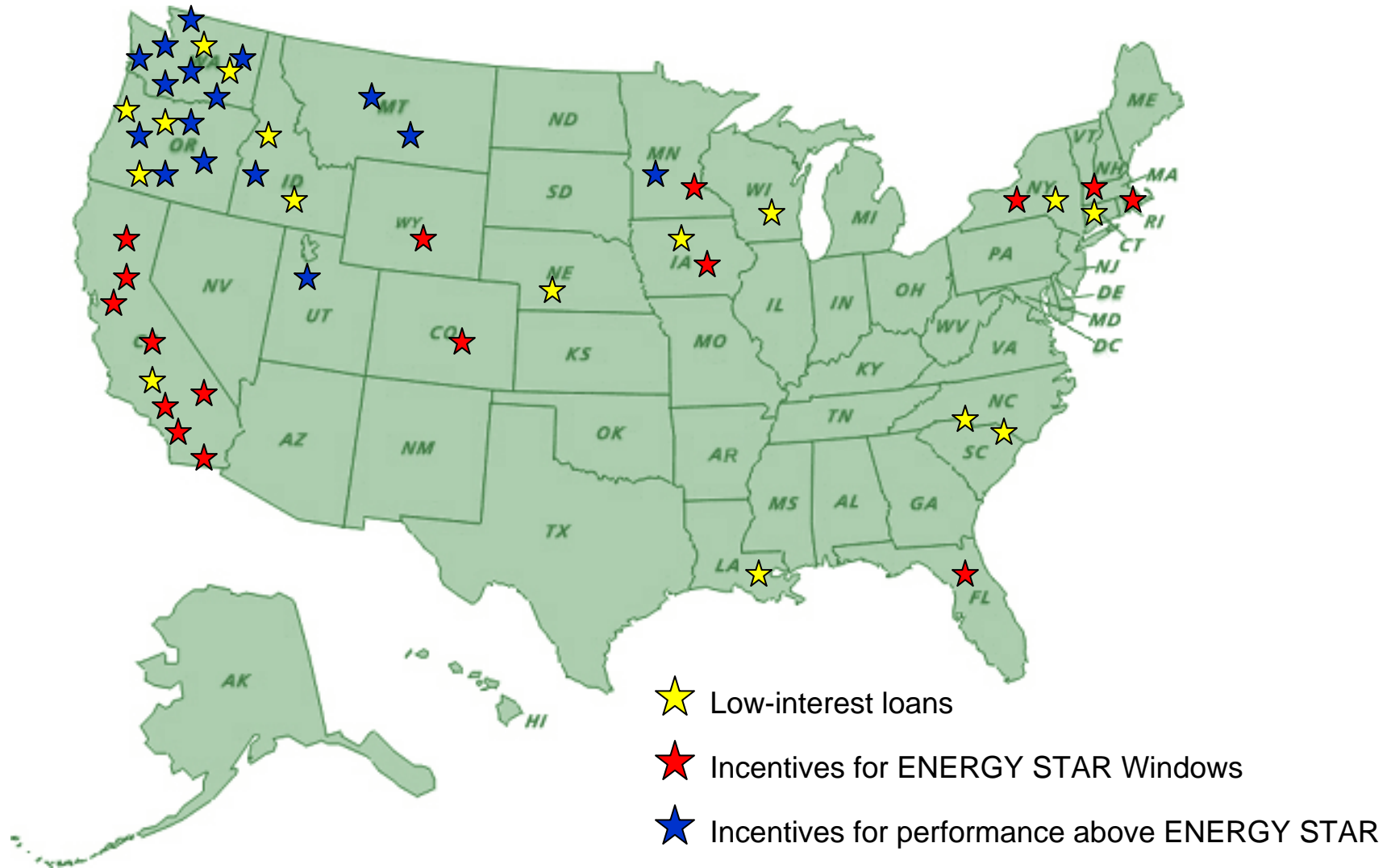
A range of electric and natural gas utilities include incentives for energy efficient replacement windows in their energy conservation programs

- Rebates can vary between \$0.50 and \$8.00 per ft<sup>2</sup>
- Typically capped at \$350-\$500
- Many utilities offer low-interest loans



# Utility Programs for Windows Across the U.S.

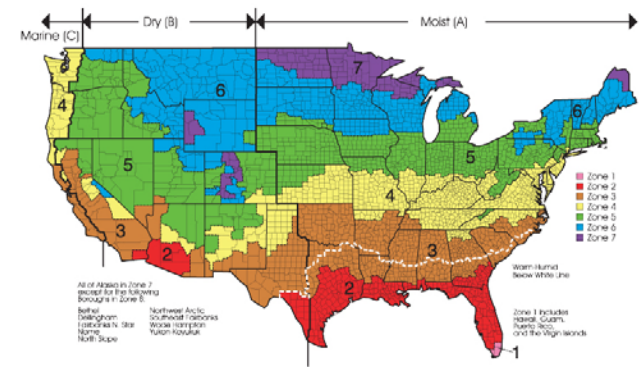
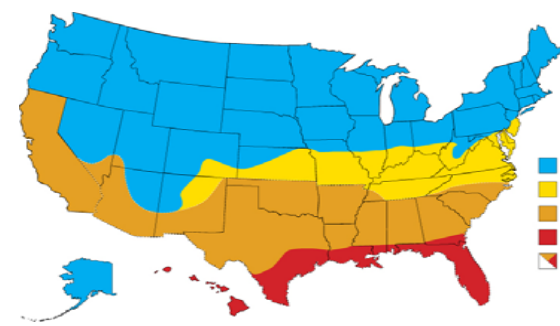
(Not a complete account – for illustrative purposes only)



# Do ENERGY STAR® Windows Incentives Provide Additional Savings?

- Programs seek savings beyond business as usual
- Most rebate programs tend only incrementally affect window purchase decisions
- Low-interest loan programs may sway customers toward window replacement

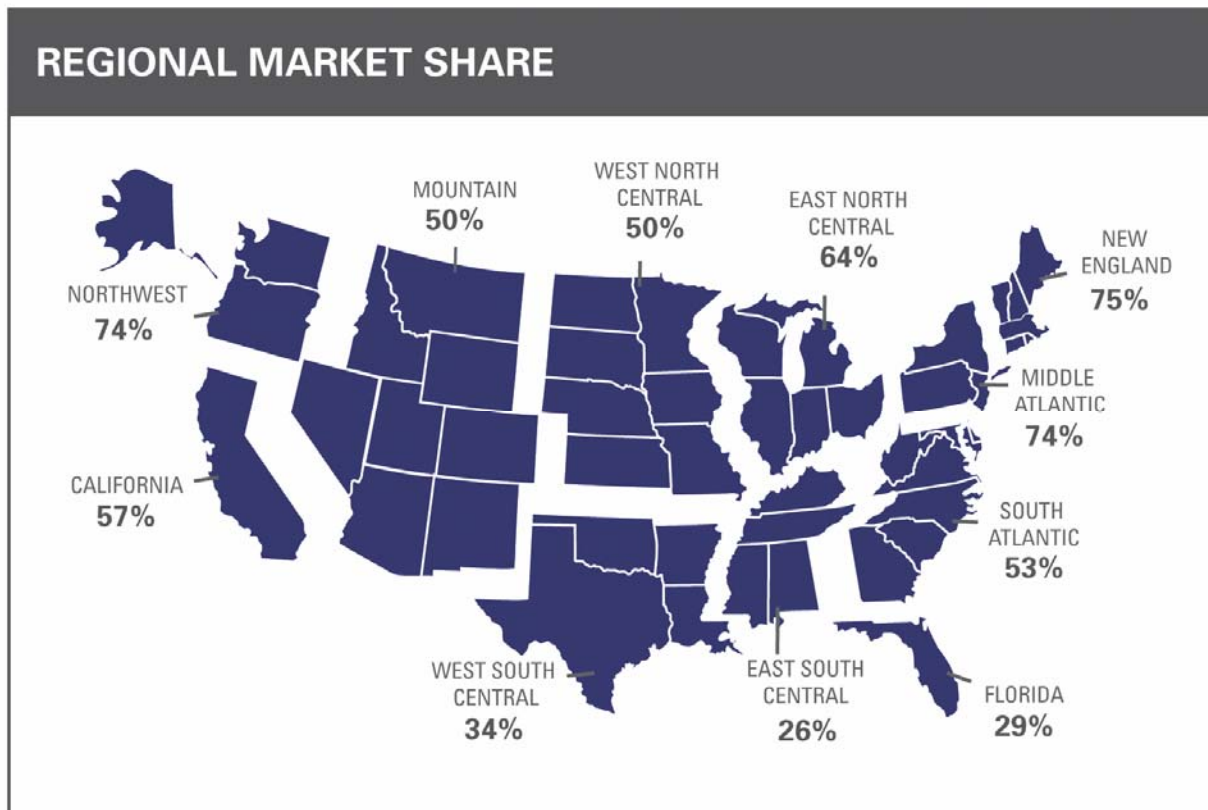
Climate Zone	2006 IECC		ENERGY STAR	
	U-factor	SHGC	U-factor	SHGC
North (5-8)	0.35	N.A.	0.35	N.A.
N. Central (4)	0.40	N.A.	0.40	0.55
S. Central (3)	0.65	0.40	0.40	0.40
South (1-2)	0.75	0.40	0.65	0.40



# ENERGY STAR window market penetration:

US: >50%

Northwest & Northeast: >75%



Source:

[www.energystar.gov](http://www.energystar.gov)



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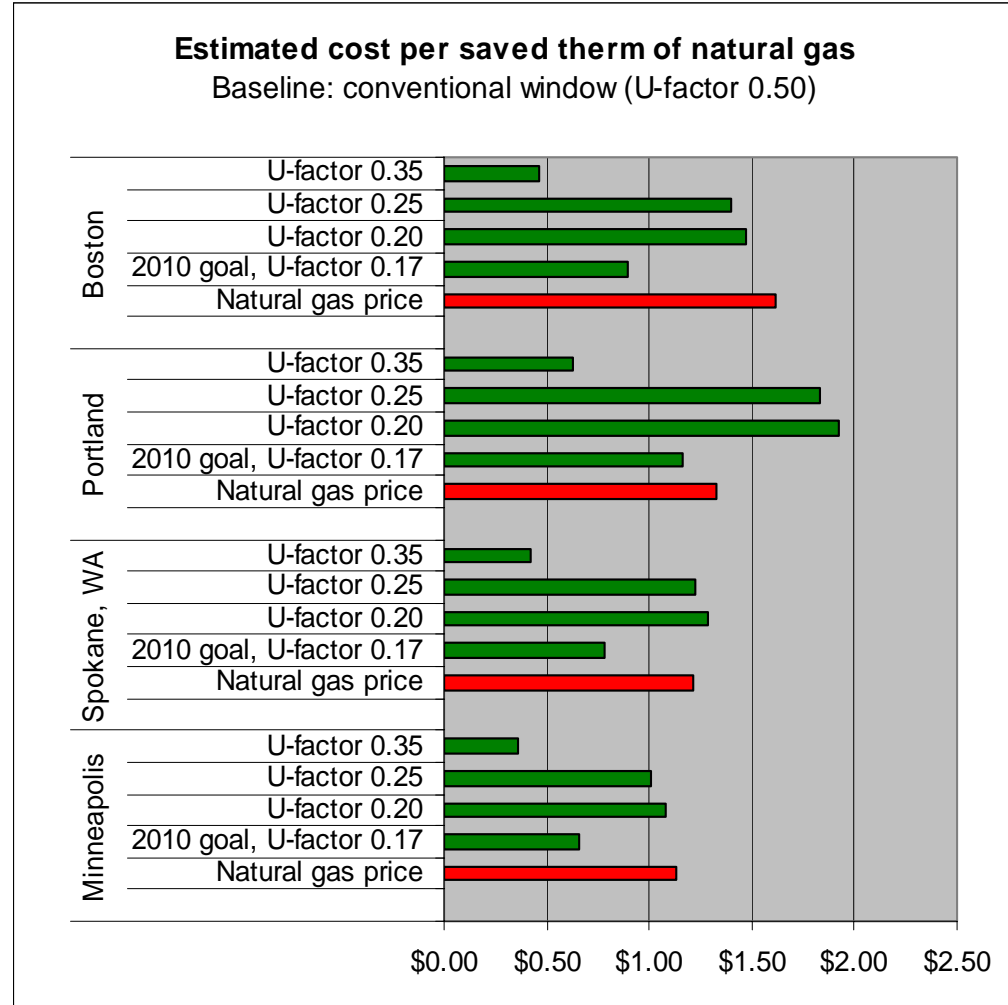
# Advanced Window Options

## A Market Transformation Opportunity

- EWC and LBNL are helping the Consortium for Energy Efficiency (a consortium of utility companies) analyze the economic potential of higher window performance tiers
- Programs to stimulate market for very low U-factors could bring down cost over time



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Efficient Windows Collaborative estimates. Natural gas price shown based on Alliance to Save Energy projections of 2007-08 winter fuel prices

# Whole-House Approach

## Example: New York Energy Smart™

- Assisted Home Performance with ENERGY STAR®
  - Covers up to 50% of energy-efficiency improvement cost
  - max. \$5,000 per household or \$10,000 for a 2 - 4 family building
  - Eligibility depends on income
- Low-interest loan options
  - ENERGY STAR Financing: easy application process, unsecured loan, low interest
  - Energy Smart Loans: up to 4% interest rate reduction on loans from New York lenders
- ENERGY STAR windows are among eligible improvements
  - May not offer fast payback, but substantial **comfort improvement!**



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# New Construction Programs

- ENERGY STAR Homes
- LEED for Homes
- National Green Building Standard



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# ENERGY STAR Homes

- Prescriptive path requires use of ENERGY STAR qualified windows
- Many ENERGY STAR partners encourage the construction, marketing, and purchase of ENERGY STAR Homes
  - In Massachusetts alone, 19 ENERGY STAR partners offer special financing (e.g. Bank of America), consumer education and marketing support (e.g. National Grid), and/or home rating assistance (e.g. Northeast Utilities)

[www.energystar.gov](http://www.energystar.gov)



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# LEED® for Homes

Public review version of June 2007:

Credits	Metric	Climate Zone			
		Northern	N. Central	S. Central	Southern
Prerequisite	U-factor	0.35	0.40	0.40	0.55
	SHGC	Any	0.45	0.40	0.35
2 Points	U-factor	0.31	0.35	0.35	0.55
	SHGC	Any	0.40	0.35	0.33
3 Points	U-factor	0.28	0.32	0.32	0.55
	SHGC	Any	0.40	0.30	0.30

45 points from all categories are needed for LEED certification



# National Green Building Standard™

## December 2007 Draft Version

Credits	Metric	Climate Zone		
		1-2	3	4-8
Mandatory	U-factor	0.35	0.40	0.65
	SHGC	Any	0.40	0.40
5-8 points (depending on climate zone)	U-factor	0.30	0.35	0.45
	SHGC	Any	0.25	0.30
10-12 points (depending on climate zone)	U-factor	0.25	0.35	0.45
	SHGC	Any	0.25	0.25

30 points in the energy-efficiency category are needed for Bronze qualification



# Support for Emerging Window Technologies

## U.S. DOE Emerging Technology Windows Program

- Research and develop leapfrog technologies
- Provide guidance and tools to manufacturers and consumers

State or regional actors - e.g. **Bonneville Power Administration, California Energy Commission, NYSERDA...**

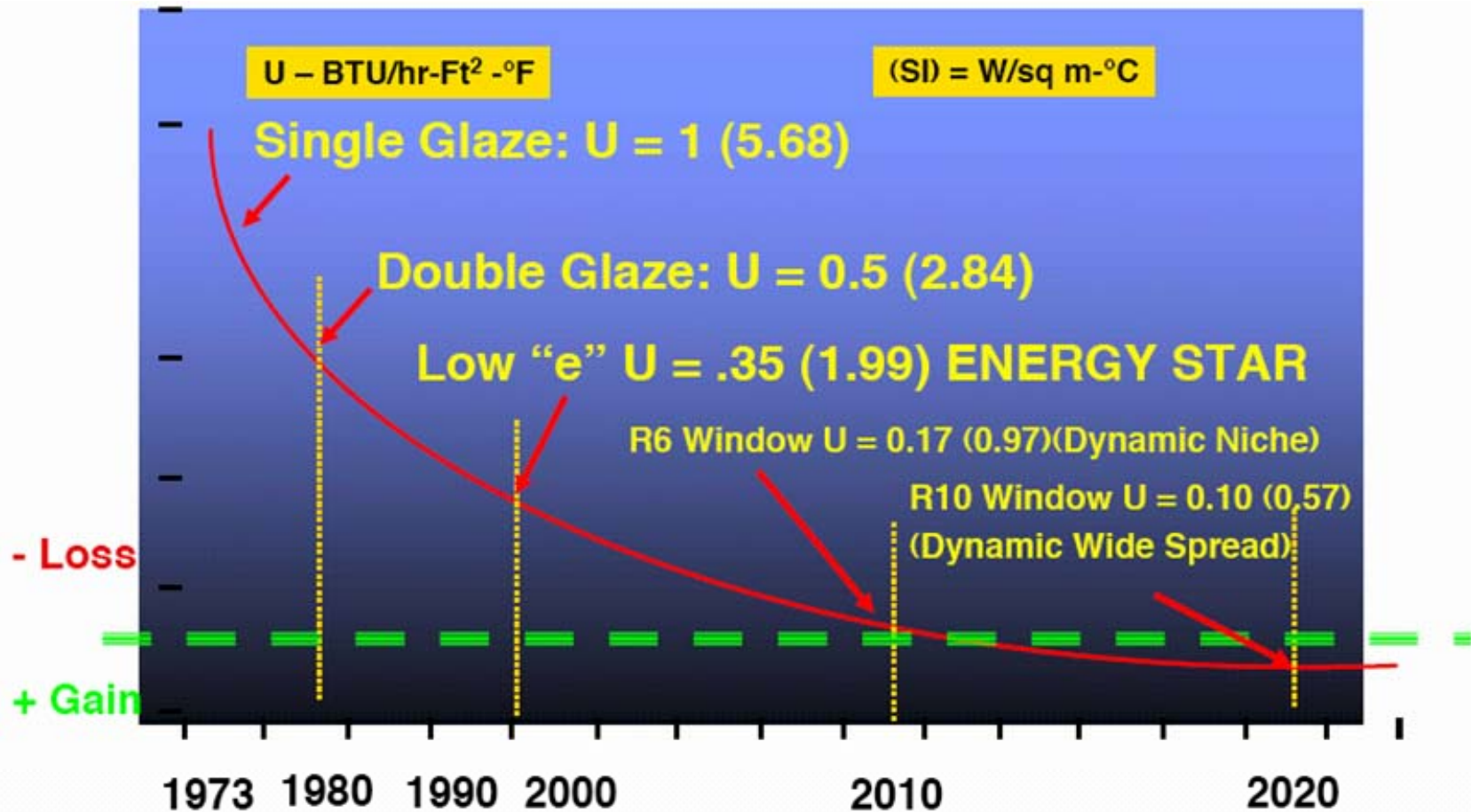
*“Among the statutory purposes of NYSERDA are developing and implementing new energy technologies with economic, social, and environmental objectives...”*



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# Toward Zero-Energy Windows



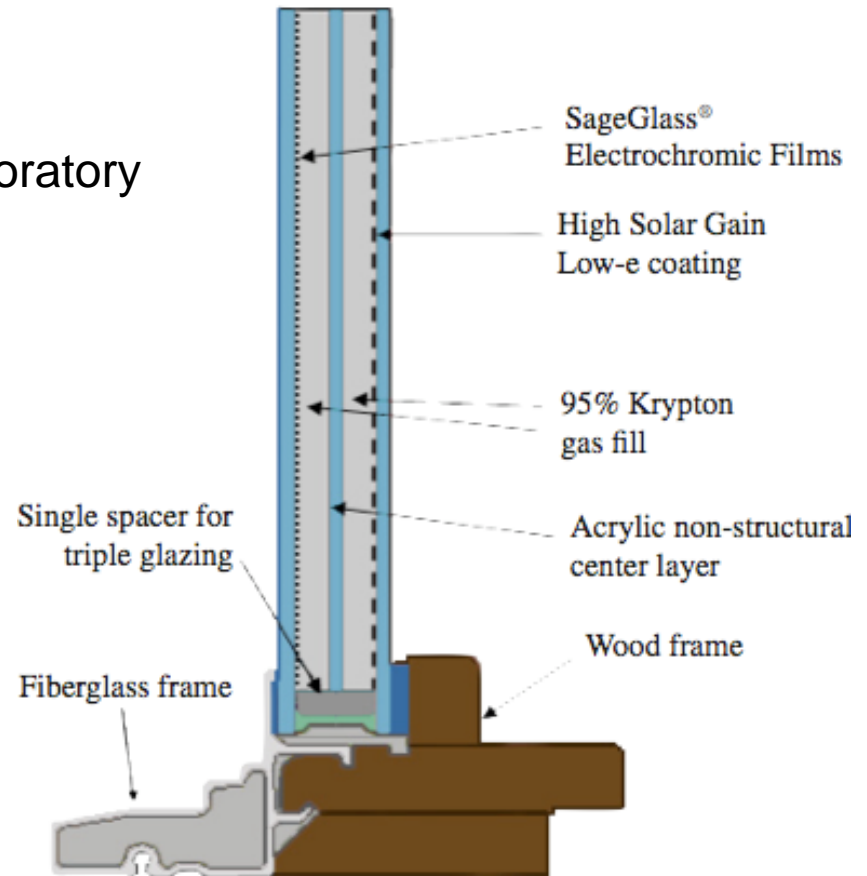
# DOE Zero-Energy Window Prototype (2006)

- Sage Electrochromic glazing
  - Center layer design:  
Lawrence Berkeley National Laboratory

$$U = 0.18$$

$$\text{SHGC} = 0.04 - 0.34$$

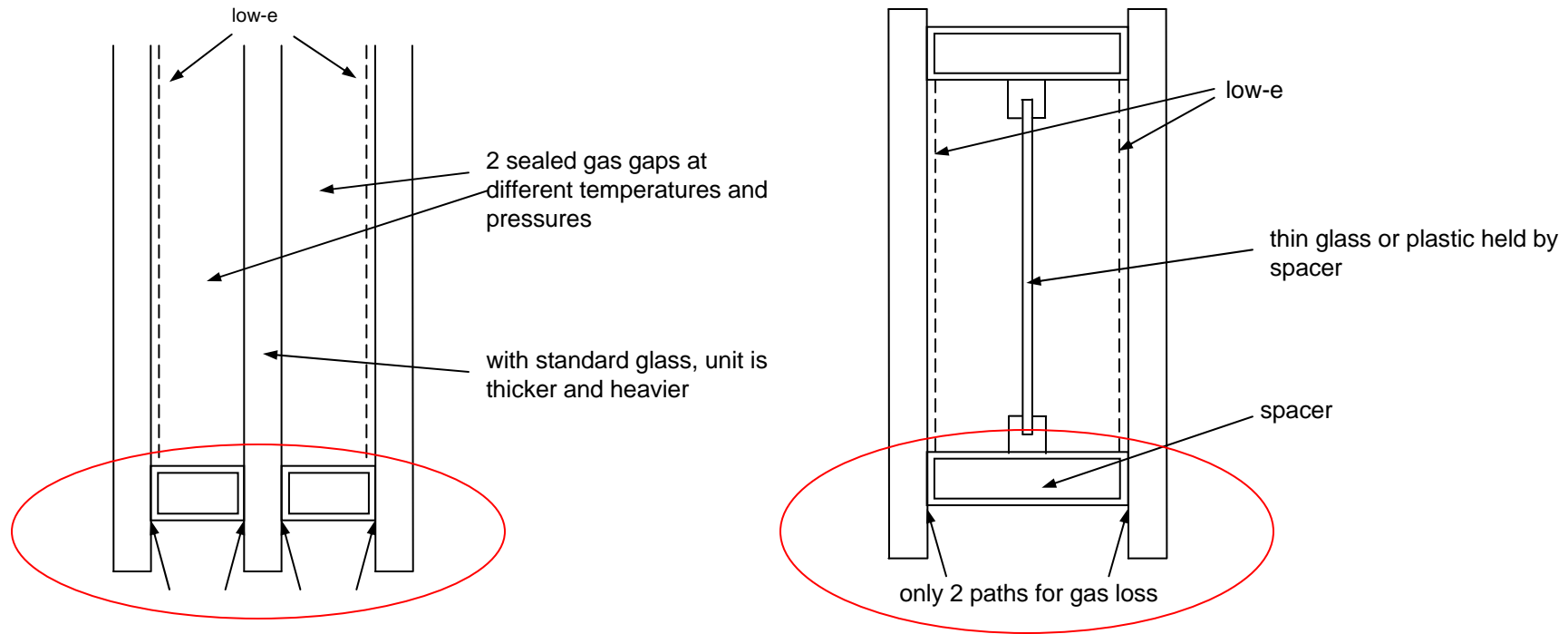
$$\text{VT} = 0.01 - 0.49$$



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# LBNL Research on Non-Structural Center Layers



- Utilize available low-e and gas-fill technologies
- Research novel center layer designs and materials

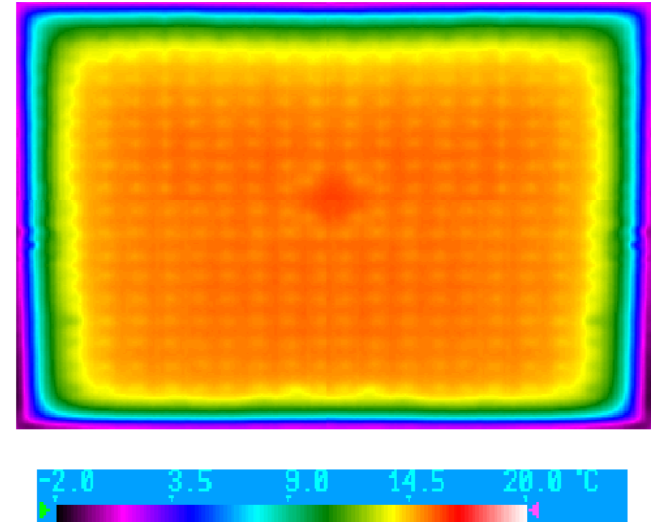


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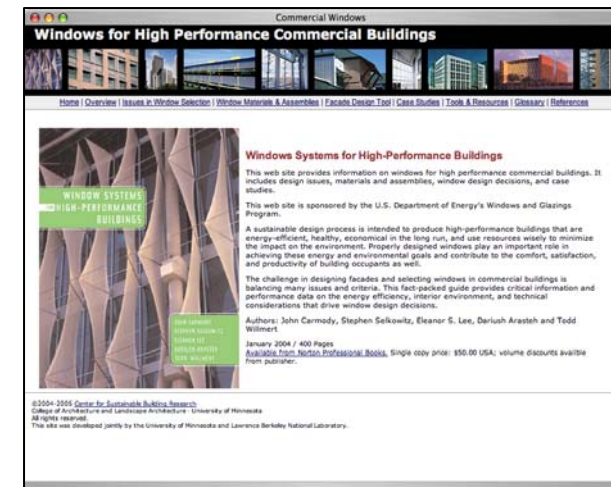
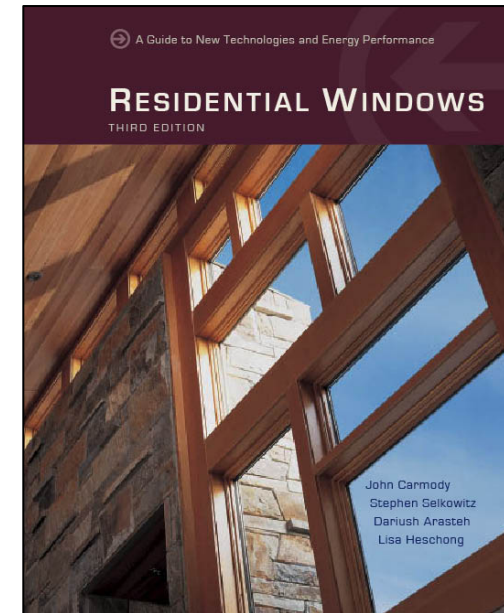
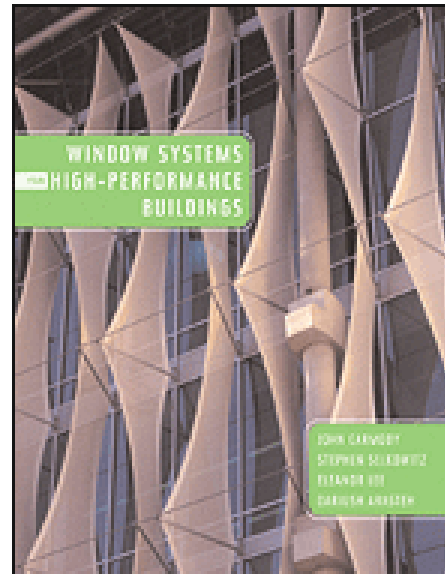
# DOE Research on Long-Term Technologies

- Vacuum Windows
  - Gap between glass layers is evacuated to eliminate conduction/convection
  - Pillars and edge must be strong enough to prevent implosion; these are thermal short circuits
- Aerogel
  - R&D continues on improving visual properties; current products are translucent



# Find out More

[www.efficientwindows.org](http://www.efficientwindows.org)



[www.commercialwindows.umn.edu](http://www.commercialwindows.umn.edu)



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# Thank You!

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