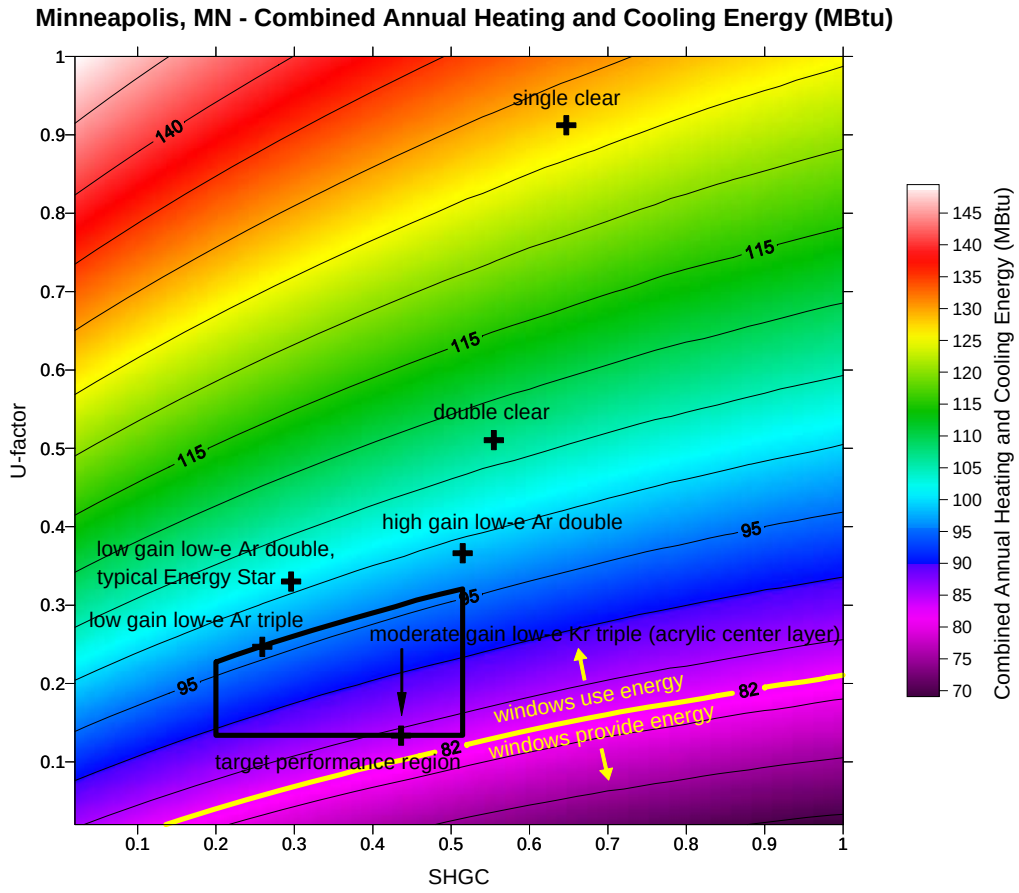
Residential Window Energy Use

- Residential Heating Energy Use of Windows is about 2 Quads / year
- Total energy consumption in US is about 100 Quads / year
- All Energy Star windows, still 1 Quad
- Goal: Zero Energy Windows

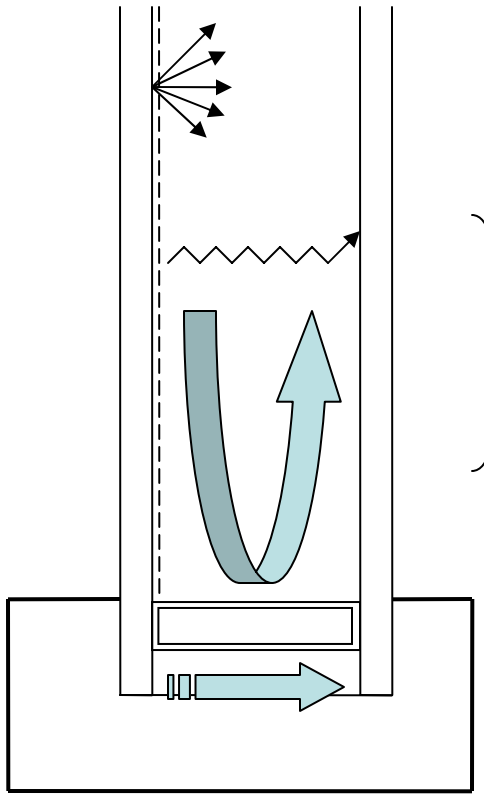
Performance Goals



Heating Climates:

- static high solar, hi-R (U=0.1 Btu/h-ft2-F) can meet ZEH goals
- dynamic solar gain (.6<SHGC<.15) and U<.2 also meet ZEH goals

Heat Transfer in Windows



Radiation

Conduction

Convection

Conduction

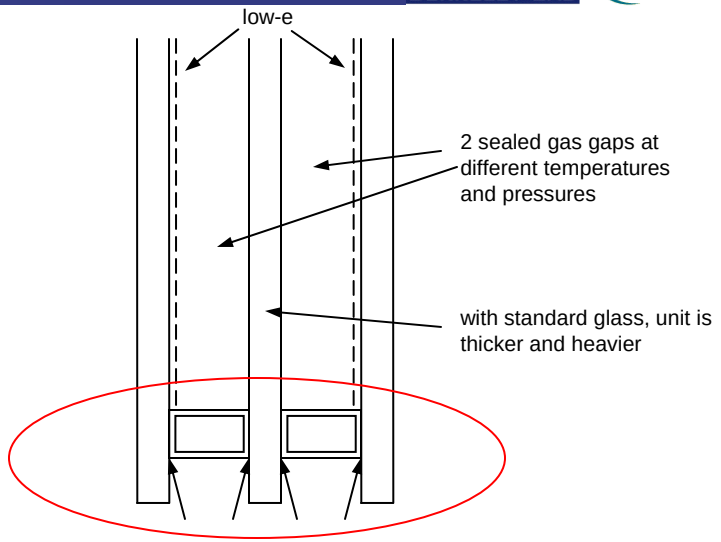
Low-e coatings

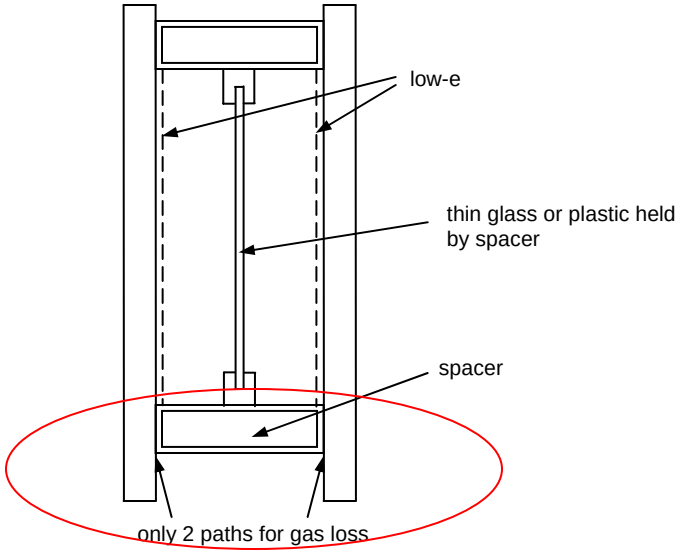
Special gas fills
Multiple cavities

Low conductance spacers
Better frames

Background

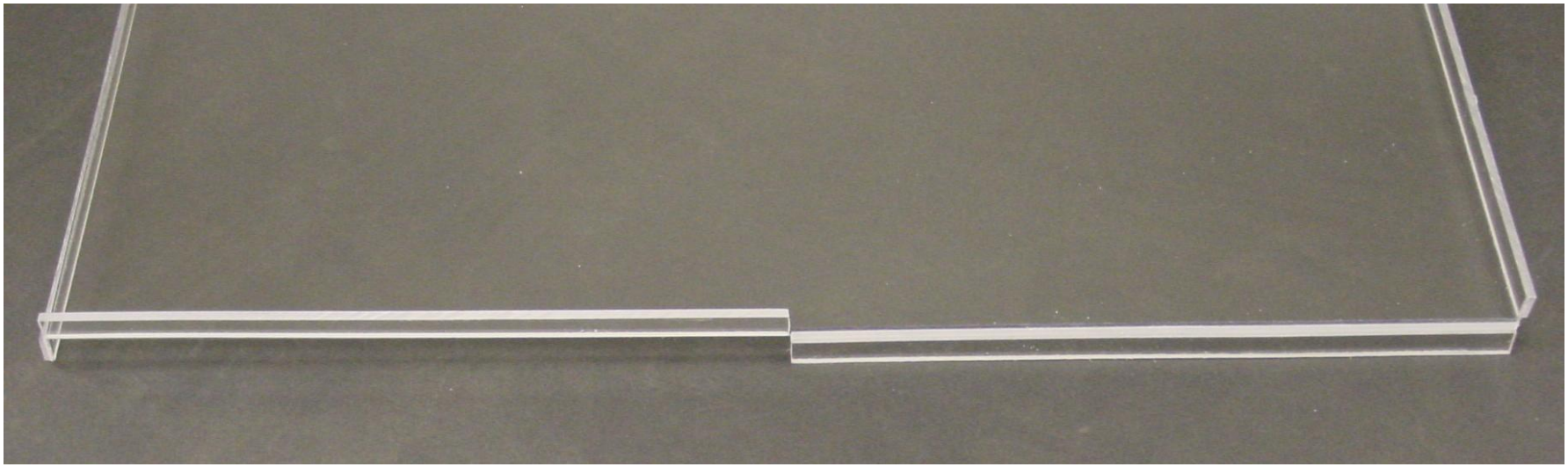
- Vacuum windows, aerogels high-risk strategies
- Current technologies for highly insulating products use multiple layers of low-e and gas fill
  - All glass is heavy
  - Thin film products expensive
  - Multiple spacers can lead to gas leakage
  - Market share is low (<1%)
- This research aims to develop lower-cost, non-structural center layers
  - Utilize available low-e and gas-fill technologies
  - Research novel center layer designs and materials





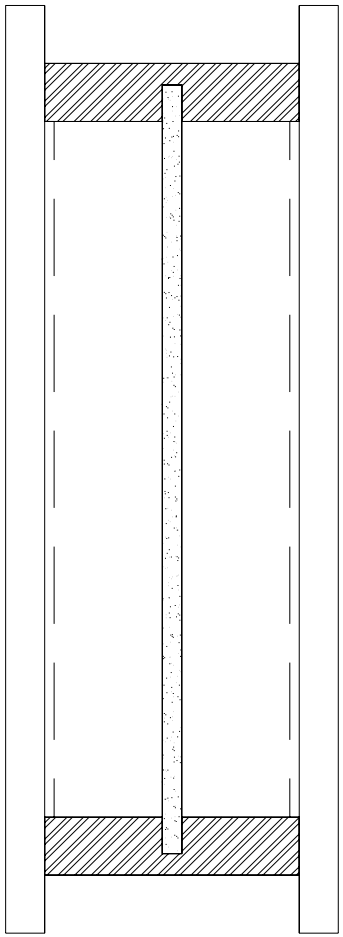
Prototypes

- Utilize available low-e and gas-fill technologies
- Research novel center layer designs and materials
- Develop interests from industry partners who would supply new components

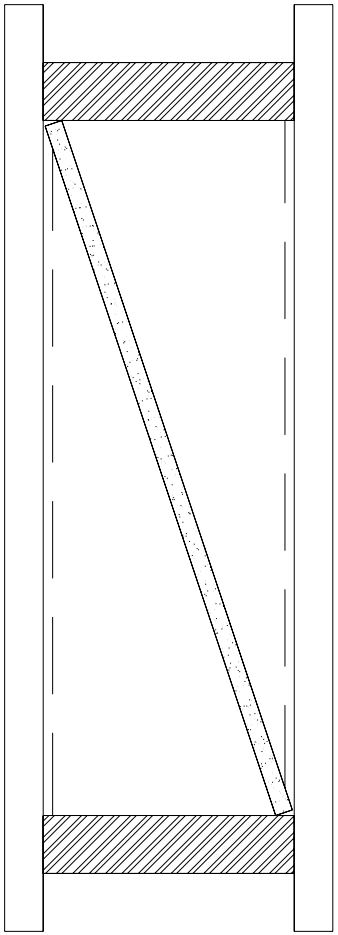


Bent edge insert prototype

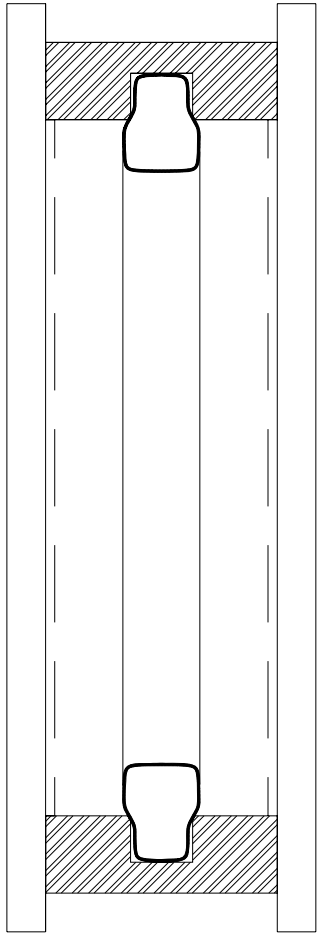
Alternative Designs



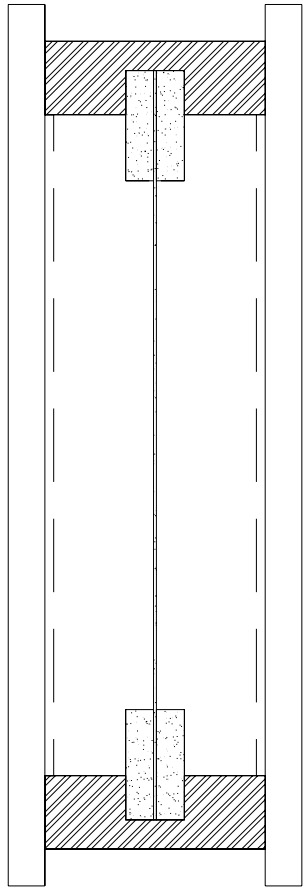
Acrylic in Groove
Spec 6



Angled Acrylic
Spec 7

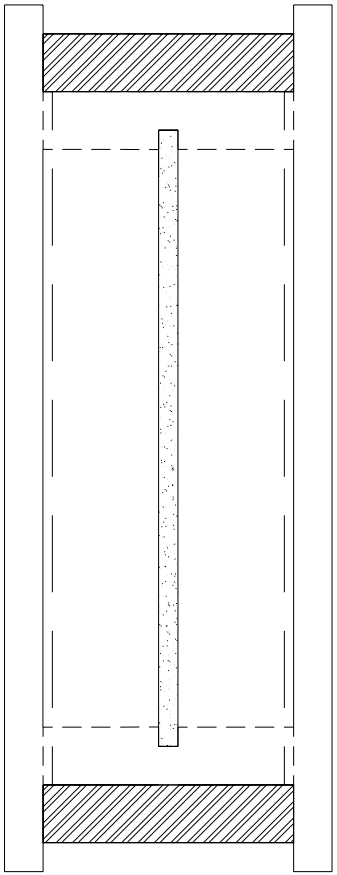


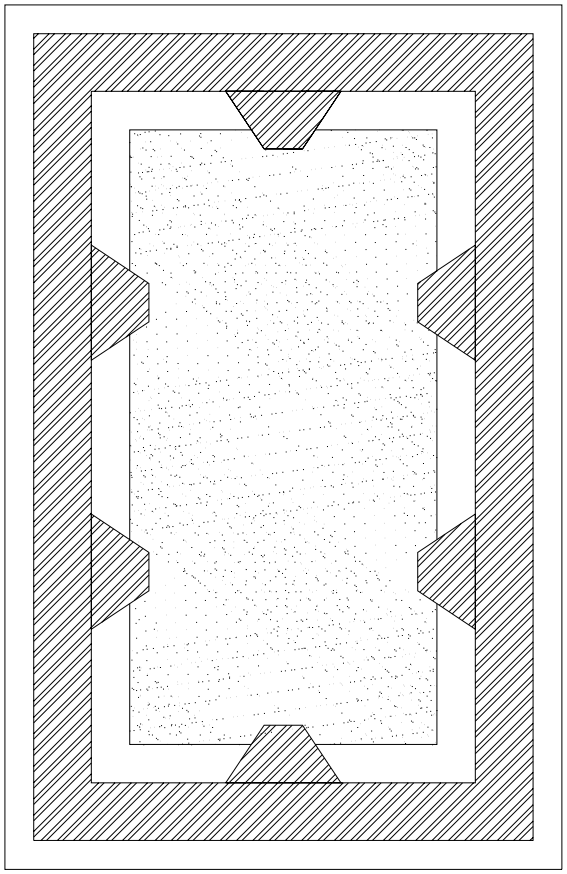
Two Layer Teflon
Spec 8



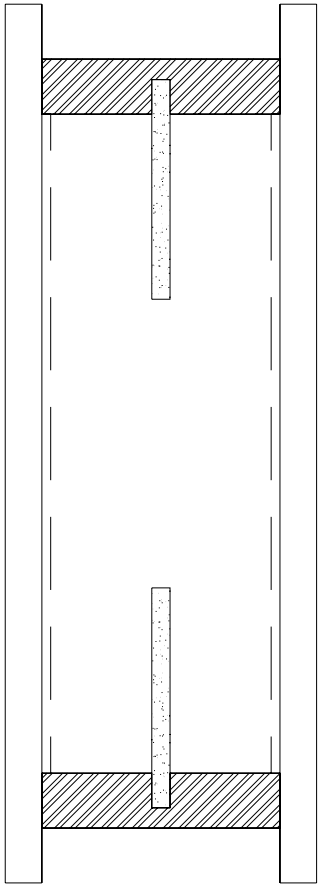
One Layer Teflon
Spec 13, 16

Alternative Designs

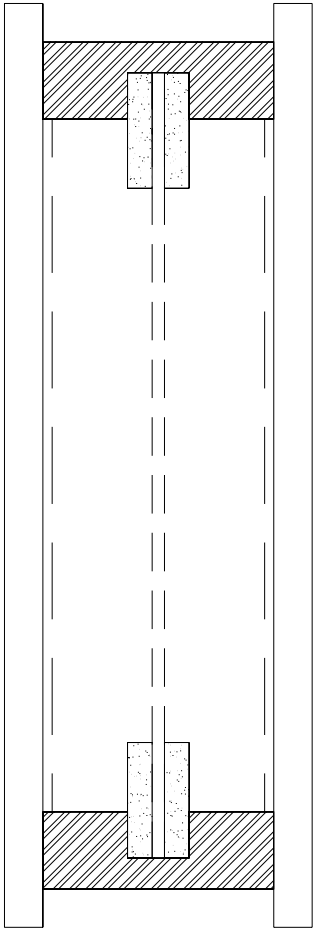




Acrylic Insert on standoffs
Spec 10, 17

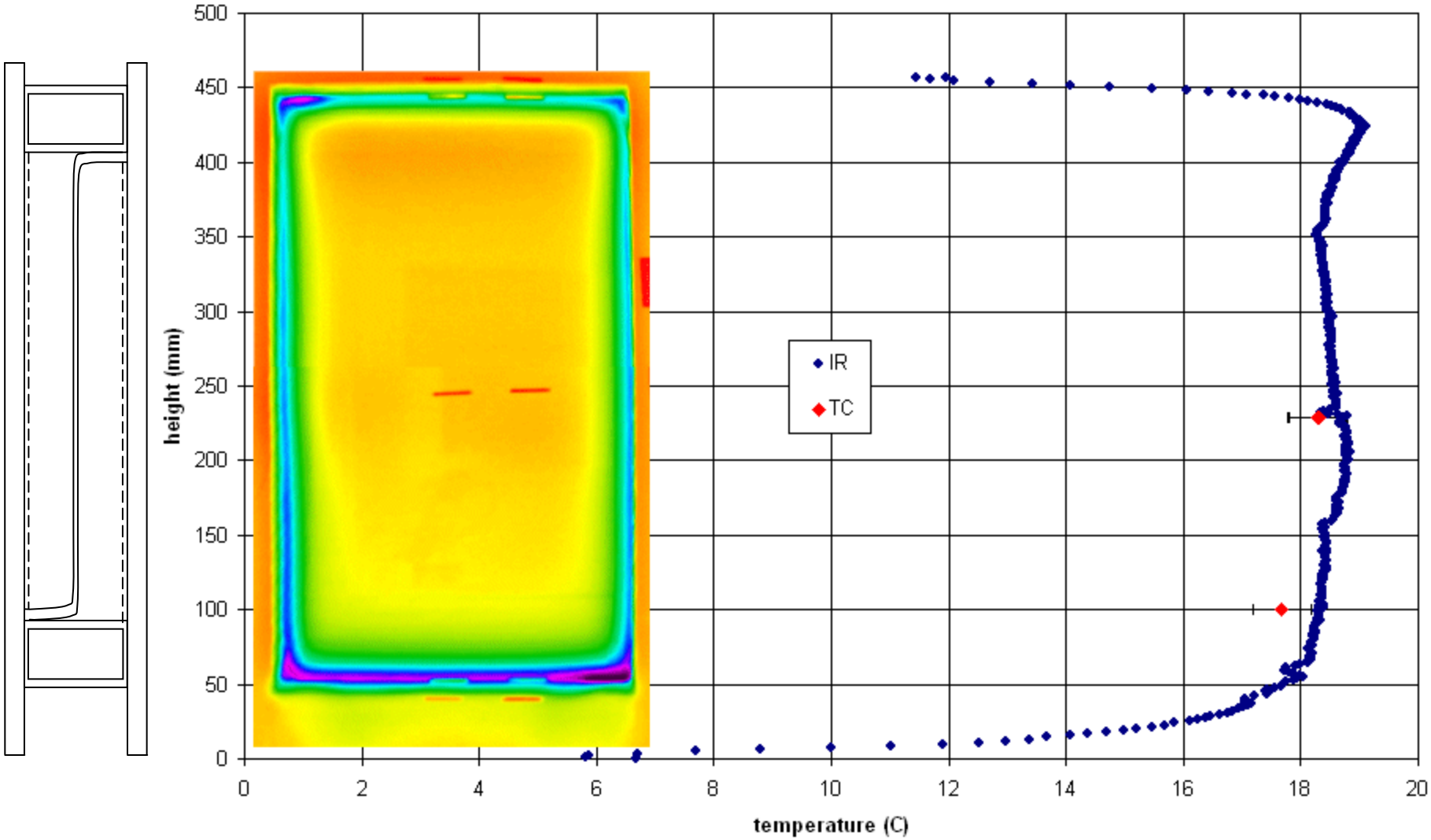


Partial Triple
Spec 11



Screen Insert
Spec 9,15

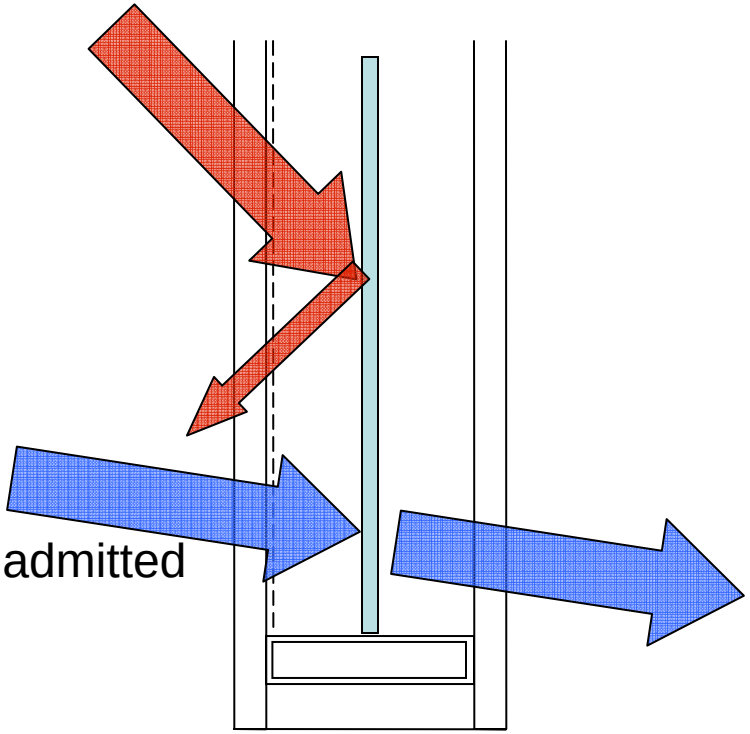
Results



Simple insert performs as well as fixed layer

Angular Selective Center Layers

High Angle summer sun blocked



Low Angle winter sun admitted

Conclusions to Date

- Possible to get very close to “net zero energy windows”
  - Climate based
  - No single, ideal, cost-effective window
- Performance potentials of various insert materials studied
- High-performance frames still necessary

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