



A Building America partner in research, innovation, and real home solutions.

# Performance Driven: Perspectives on the DOE Zero Energy Ready Home

EEBA – Excellence in Building Conference  
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University of Minnesota



Energy Efficiency &  
Renewable Energy

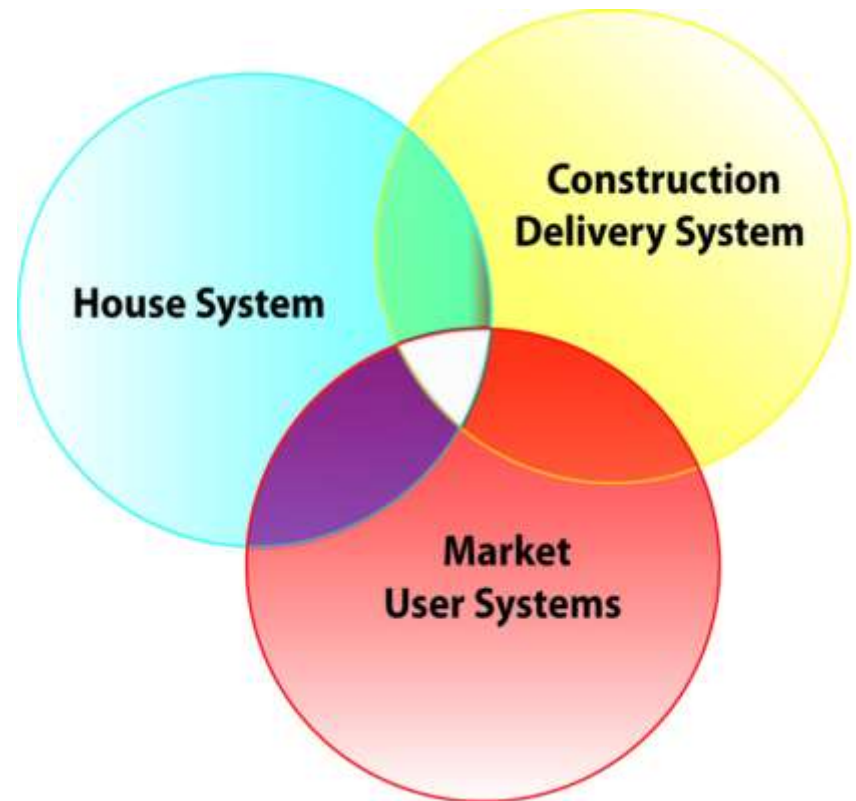


NorthernSTAR

UNIVERSITY OF MINNESOTA  
Driven to Discover™

# NorthernSTAR – Guiding Principles

- **Exploring the next generation of high performance homes for cold climates, using**
  - building science as our compass
  - research as our guide.
- **Using a total systems approach**
  - House (physical) system
  - Construction delivery system
  - Market (consumer-user) system



# DOE Zero Energy Ready Homes

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- **Why build to DOE ZERH?**
  - Consumer motivations
  - Builder motivations
- **What does DOE ZERH require?**
  - Overall a performance-based approach
  - With some prescriptive components
- **How do you get there?**
  - Strategic partners and resources

# Why DOE ZERH?

## Consumer Value Proposition

Lives Better	Works Better	Lasts Better
Engineered Comfort	Ultra-Low Utility Bills	Quality Construction
Healthier Living	Advanced Technology	More Durability
Solar Ready	Water Efficient	Disaster Resistant
Long-Term Warranty	Black-Out Power	Lower Cost Insur./Mort.

# Why DOE ZERH?

## Builder Business Case

- **Business Metrics**
  - Competitive advantage
  - Reduced callbacks & warranty
  - Improved sales and referrals
- **Harvesting the Value Innovation Premium**
  - If you can successfully communicate,
  - the innovation and the value,
  - the market leader can command better margins.

# What is DOE ZERH?

- **In my view, this program is ...**
  - Built on a technically superior platform
  - Focused on the right things (not just energy)
  - In the right way (performance-based)
  - At the right level (strategic differentiation)
  - With a delivery process that is credible, but not onerous.

# What is DOE ZERH?

## Solid Program Platform

- High-performance homes so energy efficient, most or all annual energy consumption can be offset by renewable energy.



# What is DOE ZERH?

## Systems-Based Program Requirements

Exhibit 1: DOE Challenge Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. ENERGY STAR for Homes Baseline	<input type="checkbox"/> Certified under ENERGY STAR Qualified Homes Version 3 <sup>5</sup>
2. Envelope <sup>6</sup>	<input type="checkbox"/> Fenestration shall meet or exceed latest ENERGY STAR requirements <sup>7, 8</sup> <input type="checkbox"/> Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 IECC levels <sup>9</sup>
3. Duct System	<input type="checkbox"/> Ducts located within the home's thermal and air barrier boundary <sup>10</sup>
4. Water Efficiency	<input type="checkbox"/> Hot water delivery systems shall meet efficient design requirements <sup>11</sup>
5. Lighting & Appliances <sup>12</sup>	<input type="checkbox"/> All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. <input type="checkbox"/> 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	<input type="checkbox"/> EPA Indoor airPLUS Verification Checklist and Construction Specifications <sup>13</sup>
7. Renewable Ready <sup>14</sup>	<input type="checkbox"/> EPA Renewable Energy Ready Home Solar Electric Checklist and Specifications <sup>15</sup> <input type="checkbox"/> EPA Renewable Energy Ready Home Solar Thermal Checklist and Specifications <sup>16</sup>

### Encouraged:

- EPA's WaterSense and Indoor airPLUS (full compliance)
- Quality Management and Disaster Resistance (IBHS Fortified Home)

# What is DOE ZERH?

## Performance-Based Approach

Exhibit 2: DOE Challenge Home Target Home <sup>3, 17</sup>

HVAC Equipment			
	Hot Climates (2012 IECC Zones 1,2) <sup>18</sup>	Mixed Climates (2012 IECC Zones 3,4)	Cold Climates (2012 IECC Zones 5,6,7,8)
AFUE	80%	90%	94%
SEER	18	15	13
HSPF	8.2	9	10 <sup>19</sup>
Geothermal Heat Pump	ENERGY STAR EER and COP Criteria		
ASHRAE 62.2 Whole-House MV System Performance	1.4 cfm/W; no heat exchange	1.4 cfm/W; no heat exchange	1.2 cfm/W; heat exchange with 60% SRE
Insulation and Infiltration			
Insulation levels shall meet the 2012 IECC and achieve Grade 1 Installation, per RESNET standards.			
<ul style="list-style-type: none"> <li>Infiltration<sup>20</sup> (ACH50): 3 in CZ's 1-2   2.5 in CZ's 3-4   2 in CZ's 5-7   1.5 in CZ 8</li> </ul>			
Windows <sup>21, 22, 23</sup>			
	Hot Climates (2012 IECC Zones 1,2,)	Mixed Climates (2012 IECC Zones 3,4)	Cold Climates (2012 IECC Zones 5, 6,7,8)
SHGC	0.25	0.27	any
U-Value	0.4	0.3	0.27
Homes qualifying through the Prescriptive Path with a total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs. <sup>24</sup>			
Water Heater			
ENERGY STAR minimum			
Thermostat <sup>25</sup> & Ductwork			
<ul style="list-style-type: none"> <li>Programmable thermostat (except for zones with radiant heat)</li> </ul>			

Higher Eff.  
HVAC Equip.

2012 vs. 2009  
IECC Insul.

More Eff.  
Windows

Half ACH50

ENERGY STAR  
Water Htg.

# What is DOE ZERH?

## Other Program Requirements

### Lighting & Appliances

- For purposes of calculating the DOE Challenge Home Target Home HERS Index, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator, ENERGY STAR ceiling fans, and ENERGY STAR lamps (bulbs) in 80% of sockets or 80% of lighting fixtures are ENERGY STAR Qualified.

Exhibit 3: Benchmark Home Size<sup>28</sup>

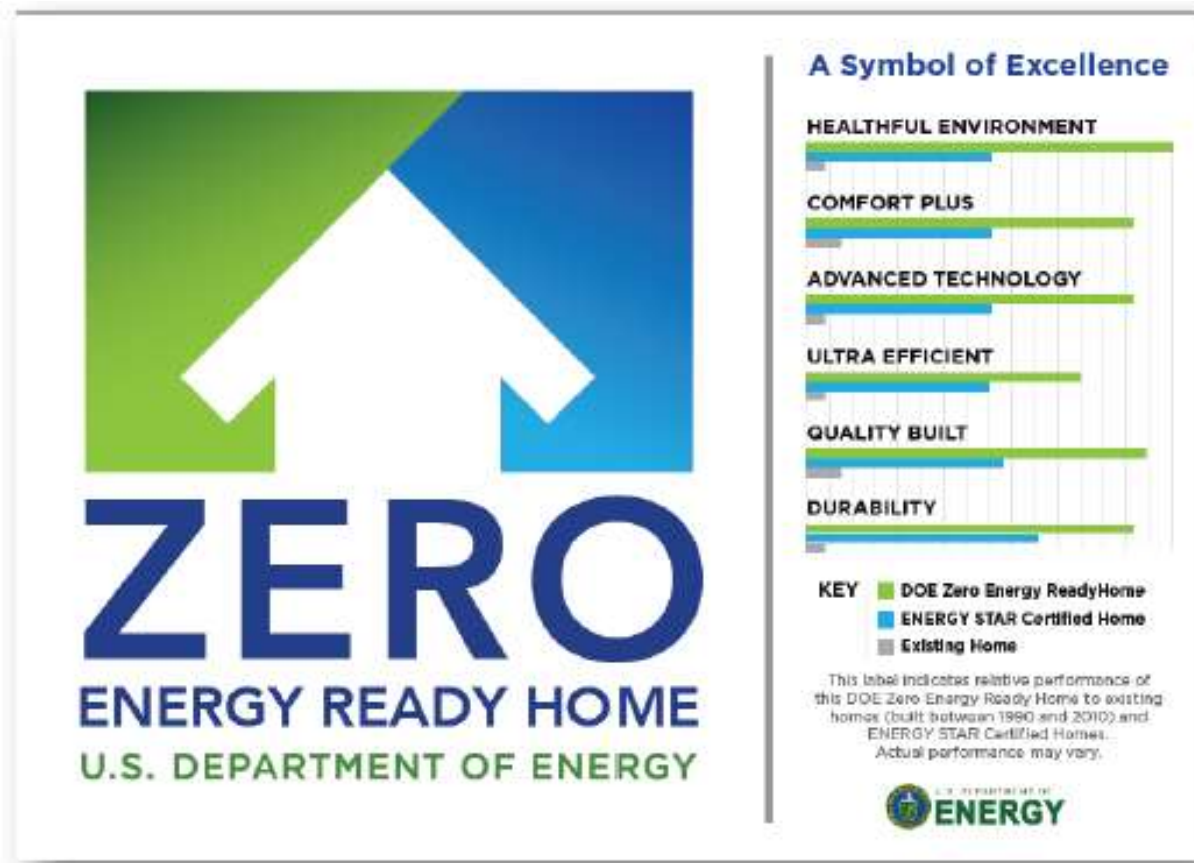
Size  
Adjustment  
Factor

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area <small>Benchmark Home</small>	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

**Note:** Renewable energy systems may not be used to qualify for the Zero Energy Ready Home HERS Index Target Score, but may be used for the incremental HERS Index points needed for the Size Adjustment Factor.

# What is DOE ZERH?

## Third Party Certification



# How to do DOE ZERH?

## Rally Your Partners

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- **Energy Raters**
- **Home Performance Consultants**
- **Renew/Review/Revisit your Trade Allies**
  - Design
  - Subs
  - Supply chain
- **Other Resources**
  - Link up with a Building America Team

# How to do DOE ZERH?

## Gather Your Resources

- **Start by “Mining” the Building America Resources**
  - General Energy Information (EERE Buildings)
    - <http://energy.gov/eere/buildings/residential-buildings-integration>
  - DOE Zero Energy Ready Home
    - <http://energy.gov/eere/buildings/zero-energy-ready-home>
  - Top Innovations “Hall of Fame”
    - <http://energy.gov/eere/buildings/building-america-top-innovations>
  - Building America Solutions Center
    - <http://energy.gov/eere/buildings/building-america-solution-center>

# Minnesota's 1<sup>st</sup> DOE Challenge Home

- **Amaris Custom Homes**
  - Ray Pruban
- **Debuted in 2013 BATC Fall Parade of Homes**
  - Rambler with full walkout basement
  - 3,542 sq. ft. conditioned
  - 5 bedrooms, 4 baths
  - St. Paul, MN (CZ=6)



- **HERS = 41 w/o PV**
- **HERS = 4 w/ 10 KW PV**

# Amaris Custom Homes

- BASELINE certified ENERGY STAR for Homes v3.0
- ENVELOPE meets or exceeds 2012 IECC levels
- DUCT SYSTEM within home's thermal boundary
- WATER EFFICIENCY (WaterSense Section 3.3 specs)
- LIGHTING & APPLIANCES ENERGY STAR qualified
- INDOOR AIR QUALITY (EPA IndoorairPLUS Checklist)
- RENEWABLE READY chaseway built-in for PV array

# Amaris Custom Homes

- ICF foundation
- 2x6 w/ ccSPU + 1" XPS
- Raised heel truss w/ 2" ccSPU + R-48 fiberglass
- Windows:  $U = 0.25$
- Airtightness = 465@50PA
- 95% AFUE furnace & boiler
- 16 SEER AC
- ERV & source exhausts
- ENERGY STAR Appliances
- 90% LED; 10% CFL



- Good shape & orientation
- Passive solar design
- In-floor heating w/ tile
- No/Low VOC materials

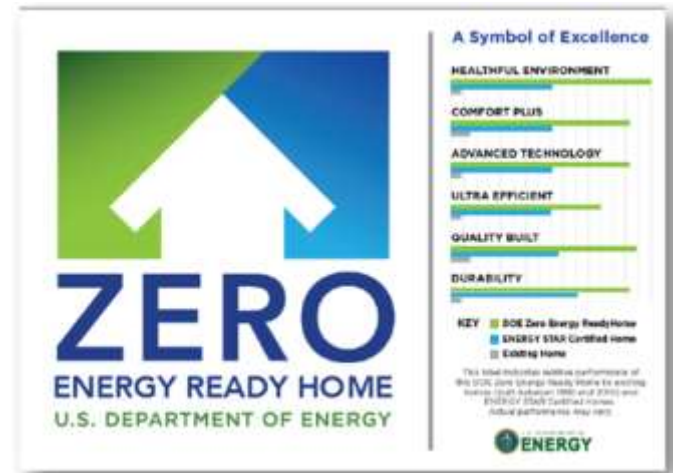
# Amaris Custom Homes

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- **Specific Home Certifications**
  - DOE Challenge Home (now ZERH)
  - ENERGY STAR Version 3
  - MN GreenPath - Emerald
  - LEED for Homes v4 Beta – Silver
- **Builders Association of the Twin Cities Reggie<sup>SM</sup> Award of Excellence**

# Amaris Custom Homes

- **Challenges**
  - Exterior foam
  - Mechanical systems
  - Water distribution
- **Key Lessons**
  - “Green” is challenging to sell because it is poorly defined
  - “Healthier living is built-in” resonated very well with his market segment
  - DOE Challenge Home label was his “best bang for the buck”
  - Has committed to 100% ZERH



# A Builder's Perspective

- It is my pleasure to introduce another of our DOE Zero Energy Ready Home Builder Partners
- **2014 “Housing Innovation Award” winner**
  - Melissa Wahl
  - Cobblestone Homes
  - Saginaw, Michigan

# COBBLESTONE

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*Homes*

Melissa Wahl  
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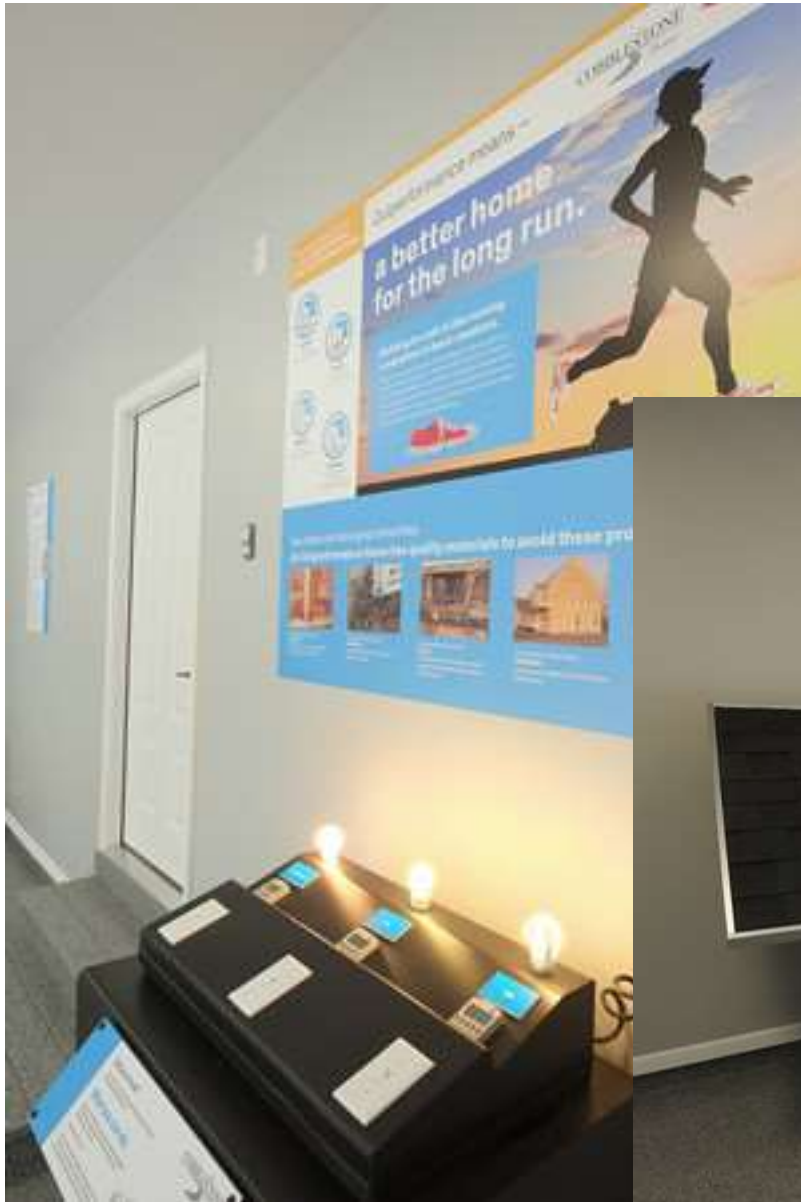






Candy AND Soda  
Flavor extra butter  
POPCORN  
15¢





# Challenges

## Forms needed and pre-planning

Met with Energy Rater and ran through the home's specifications right on REMRATE

Figuring what is best so that we could replicate and do over and over cost effectively.

## Water Delivery

Webinars, conference calls with Building Knowledge and University of Minnesota, and conferences with our plumbers.

# COBBLESTONE

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## *Homes*



Melissa Wahl

Cobblestone Homes

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# In Summary

- **How does this support Zero Energy Ready Homes?**
  - The BA team support can help identify and resolve key technical issues related to the delivery of ZERHs.
  - These BA demonstration projects and educational efforts blaze a pathway for leading-edge builders.
  - ZERH requires a push-pull strategy.
    - Transaction success improves when a knowledgeable buyer intersects with a capable builder.

# Consumer-Oriented Resources



**A Symbol of Excellence**  
Every Zero Energy Ready Home offers a cost-effective, high performance package of energy savings, comfort, health, and durability unparalleled in today's marketplace.



### Lives Better

**HEALTHFUL ENVIRONMENT**

Every DOE Zero Energy Ready Home has a comprehensive package of measures to minimize dangerous pollutants, provide continuous fresh air, and effectively filter the air you breathe.

**COMFORT PLUS**

Superior insulation, windows, air sealing and space conditioning systems included in every DOE Zero Energy Ready Home surround you with even temperatures, low humidity, and quiet in every room on every floor.

**KEY**

- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home



### Works Better

**ADVANCED TECHNOLOGY**

Every DOE Zero Energy Ready Home begins with solid building science specified by ENERGY STAR for Homes, and then adds advanced technologies and practices from DOE's world-class research program, Building America.

**ULTRA EFFICIENT**

Compared to a typical home, an ultra-efficient Zero Energy Ready Home is inexpensive to own. In fact, every DOE Zero Energy Ready Home is so energy efficient, a small solar electric system can easily offset most, or all, of your annual energy consumption. We call this Zero Net-Energy Ready.



### Lasts Better

**QUALITY BUILT**

Advanced construction practices and technologies are specified for every DOE Zero Energy Ready Home. These are enforced by independent verifiers with detailed checklists and prescribed diagnostics.

**DURABILITY**

The advanced levels of energy savings, comfort, health, durability, quality and future performance in every DOE Zero Energy Ready Home provide value that will stand the test of time, and will meet and exceed forthcoming code requirements.

**The Future of Housing—Today**

Only a select group of the top builders in the country meet the extraordinary levels of excellence and quality specified by U.S. Department of Energy guidelines.




LEARN MORE AT:  
[buildings.energy.gov/zero](http://buildings.energy.gov/zero)

**NEW TOWN ENERGY**

Call us at:  
303-393-4687

[NewTown@net.com](mailto:NewTown@net.com)



**A Symbol of Excellence**

**HEALTHFUL ENVIRONMENT**

**COMFORT PLUS**

**ADVANCED TECHNOLOGY**

**ULTRA EFFICIENT**

**QUALITY BUILT**

**DURABILITY**

**KEY**

- DOE Zero Energy Ready Home
- ENERGY STAR Certified Home
- Existing Home

This chart indicates relative performance of the DOE Zero Energy Ready Home to existing homes. Chart indicates zero and energy cost ENERGY STAR Certified Homes. Actual performance may vary.



LEARN MORE AT: [buildings.energy.gov/zero](http://buildings.energy.gov/zero)

# Building Consumer Interest

- **All housing market transformation requires a push-pull strategy.**
  - A knowledgeable buyer must intersect with a capable builder.
  - In new construction, the builder may have a better position in the transaction.
    - However, it still takes an interested buyer who is receptive to learning.
  - So I believe we must also “soften the ground” for the builders through public awareness and education.

# Building Consumer Interest

- **Generating Consumer Interest and Demand**
  - We developed an anchor exhibit focused on high-performance homes for the Minnesota State Fair.
  - Funded by the MN DER (State Energy Office)
  - Located in MPCAs Eco Experience Building
    - 2<sup>nd</sup> largest educational draw at the Fair
    - The focus is engagement and education
    - 265,000 visitors went through this building in 12 days
      - Approximately 100,000 visited our exhibit
      - We estimate 1 in 10 stopped to explore at some depth
    - The reviews and feedback have been very encouraging

# Building Consumer Interest



# Building Consumer Interest



# Building Consumer Interest



# Building Consumer Interest



# Building Consumer Interest



# Building Consumer Interest



# A Crazy Year in the Life of ...

- Developing students with building science knowledge and skills for the market.
  - Started last Fall with the DOE “Race to Zero” Student Design Competition.
  - University of Minnesota’s “Team Opti-MN” won 4 awards
    - receive multiple requests to present their project to the academic, building, and affordable housing communities.
  - Then shifted their focus to the MN State Fair to be fully engaged in design, development oversight, and staffing.
  - All of the graduating students (undergrad & grad) landed high-quality, well-paying jobs.

# In Closing

- **What's in a Name?**
  - DOE Challenge Home
    - => DOE Zero Energy Ready Home
  - DOE “Goldilock’s Program” for High Performance Homes
    - It’s not too hard;
    - It’s not too soft;
    - It’s just right!

- **Thank you for your attention!**
- **Questions will be at the end of the session.**
- **Contact information:**
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