



November 11, 2022

The Honorable Marcia Fudge
Secretary
U.S. Department of Housing and Urban Development
451 7th Street, S.W.
Washington, DC 20410

RE: Notice of Federal Advisory Committee Meetings: Manufactured Housing Consensus Committee (FR-6348-N-01)

Dear Secretary Fudge,

As promised in its previous correspondence, the Manufactured Housing Institute (MHI) committed to providing supporting documentation to its proposal to the Manufactured Housing Consensus Committee (MHCC). As a supplement to its November 9th, 2022 Comment Letter, MHI is pleased to submit the following presentations to the MHCC for consideration ahead of the MHCC's meeting scheduled for November 15-17, 2022. The three presentations, attached as exhibits to this supplemental correspondence, further demonstrate the benefits of adopting MHI's proposal versus a wholesale adoption the DOE's Energy Rule. Such materials also provide supporting analysis behind MHI's proposal. Below, you will find a brief summary of the contents of each presentation:

1. Economic Impact Analysis chart based on the Energy Rule and updated data regarding MHI's proposed thermal requirements (Attached hereto as Exhibit A): The first presentation is the Economic Impact Analysis which is based upon the Energy Rule and supporting data regarding MHI's proposed thermal requirements. This analysis demonstrates the advantages and the cost savings that will benefit the consumer under MHI's proposal as compared to the greater economic impact on the consumer under the Energy Rule. The Economic Impact Analysis, which compares the current HUD standard with the proposals of MHI and DOE, establishes the following:

- DOE's Technical Support Document provided incremental cost increases for step-ups in energy efficiency measures using the HUD Code as a baseline. For example, the incremental cost increase of going from R11 to R13 to R21 insulation in the walls. Using the DOE's own data, this analysis calculates the incremental cost increase for the Energy Rule and MHI's proposal.
- Using validated energy simulation software, this analysis calculates the marginal energy savings achieved from the Energy Rule and MHI's proposal – that is– how much a consumer will save in energy costs on a monthly basis.
- This analysis further demonstrates that for all three Zones with Tier 2 homes, **MHI's proposal results in better 10-year outcomes for all consumers than the Energy Rule.** On average, consumers will experience a net cost that is less under MHI's proposal than under the Energy Rule.

2. Analysis of DOE's Energy Conservation Standards for Manufactured Housing (Attached hereto as Exhibit B): The second presentation demonstrates the DOE's failure to consider key cost inputs which will negatively impact both consumers and suppliers. As provided in greater detail in the attached presentation, this analysis demonstrates the DOE's failure to sufficiently consider the following factors in

formulating its conclusions and the cumulative effect of such factors:

- ***Inflation and Cost Increases:*** DOE failed to consider the impact of considerable cost increases and supply chain constraints because of the pandemic and related economic disruptions.
 - DOE's cost/benefit or life-cycle cost ("LCC") model took cost estimates from 2014 and applied a nominal cost increase of **2.3% annually** from 2014-2023. However, beginning with the Covid-19 pandemic, actual costs for construction materials have grown substantially, and the actual cost increase for construction materials from 2014-2021 is **6.5% annually**. Manufactured housing construction costs may be even higher.
 - DOE assumed a 5% interest rate for land-home deals and a 9% interest rate for home-only deals. The current 30-year fixed mortgage rate is now approximately 7%.
 - Fixing only these two inputs to reflect actual cost inflation and actual interest rates for land/home loans, **based on DOE's own LCC model for Tier 2 homes, approximately 95% of shipments will have a negative 10-year LCC.** In geographic terms, of the 19 "representative" cities chosen by the DOE, 16 of those representative cities will have a negative 10-year LCC for Tier 2 homes. This data accounts for the increased energy savings that result from inflation as well.
 - Assuming Tier 2 homes represent 55% of the industry producing approximately 120,000 homes annually, this means that approximately **63,000 homes would have a negative 10-year LCC based on the Energy Rule.**
- ***Negative Impact:*** DOE failed to consider negative impacts on low-income and minority homebuyers.
 - The Energy Rule will disparately impact minority communities even without accounting for actual cost increases. Black or African American manufactured home purchasers are approximately 22.5% more likely to finance their purchase with a home-only loan as compared with a land-home loan. Likewise, Hispanic manufactured home purchases are 11% more likely to finance their purchase with a home-only loan.
 - At a 9.5% home-only interest rate, 37% of Tier 2 shipments will have a negative 10-year LCC based on DOE's own model. Using a 11% home-only interest rate, 86% of Tier 2 shipments will have a negative 10-year LLC based on DOE's own model.
 - The Biden Administration has prioritized housing affordability and racial equity: *"The Federal Government has a critical role to play in overcoming and redressing... [its role in declining to invest in communities of color and in failing to provide equitable access,] and in protecting against other forms of discrimination by applying and enforcing Federal civil rights and fair housing laws. It can help ensure that fair and equal access to housing opportunity exists for all throughout the United States."*
- ***Additional Costs.*** DOE failed to consider potential costs of testing and compliance, transportation, and supply chain constraints.

- The Energy Rule failed to account for significant compliance costs. Without limitation, in rural areas, it is estimated that in-field duct testing could cost over \$1,000 per home. Many Tier 2, Zone 2 & Zone 3 homes will need 2x6 walls rather than 2x4 which will increase lumber and transportation costs (due to weight). Exclusive of lumber costs, an additional axle may be needed for weight which is another \$200 to \$250 per floor, \$400 to \$500 per multisection homes. Transportation costs such as fuel have increased dramatically over the past year. And the industry is experiencing significant supply chain difficulties, especially for fiberglass insulation—a commodity for which supply must increase to comply with the DOE's Final Rule.
 - Before supply chains normalize, the cost for fiberglass insulation will increase drastically and home starts may be limited if there is not enough fiberglass insulation or if plants must use alternatives such as blown insulation. Many in the industry do not believe that there will be enough fiberglass insulation to meet the demand. As such, manufacturers will be forced to pivot to spray foam insulation, which is more costly and labor-intensive. Additionally, the process for the installation of spray foam insulation requires a cooling off period, which will increase the amount of time of the home on the line, decreasing the thru-put, and will inevitably cause fewer homes to be built. All of this will inevitably increase the overall cost of the homes to the consumer, none of which has been calculated by DOE.
 - **These unaccounted-for costs will easily subsume the DOE's projected 10-year LCC savings for all manufactured homes.** For Tier 1 homes, DOE projected a national average of \$720 10-year LCC savings and for Tier 2 homes, DOE projected a national average of \$743 10-year LCC savings. If, for example, in-field duct testing is required which costs approximately \$1,000 per home, then all 10-year LCC savings are eliminated.
- ***Affordability and Credit Access.*** DOE underestimated potential impacts on credit access and lost sales.
 - These additional costs will make home ownership unaffordable for thousands of Americans. To estimate the impact on affordability, the DOE relied upon a 2007 economic study. This study predated the Great Recession, predated the Covid-19 pandemic and the following inflation period, predated the current rise in interest rates, and predated the recent increases in retail prices for manufactured homes which may make potential customers even more price sensitive.
 - **DOE's Final Rule conceded with its sensitivity analysis that over 5,000 families annually will not be able to afford a manufactured home,** and this number is almost certainly understated for the reasons described above. Based on industry information, it is likely that the realistic impact of the implementation of the Energy Rule could actually affect twice as many families.

3. Architectural and Design Analysis of how the Energy Rule will generally impact the design of manufactured homes as opposed to the design elements of manufactured homes based on current standards (Attached hereto as Exhibit C): DOE's standards will negatively impact the aesthetic appearance and the design of manufactured homes. As demonstrated in the attached presentation, significant architectural modifications will be required for manufacturers to stay in compliance with the Energy Rule which will result in less aesthetically pleasing homes. Most notably, multisection homes will face substantial architectural

modifications. To meet the DOE standards, the industry will have to consider a variety of tradeoffs, including, a reduction of windows and/or significant changes in home architecture to accommodate additional insulation. Consequently, such modifications will be either be more difficult to implement and less appealing, or even prohibitive.

- To meet the U-value performance requirements for Tier 2, Zone 3 homes, assuming the home has additional insulation added without altering the framing, the windows had to be eliminated completely. As a result of the reduced windows, the requirements for egress, light and ventilation are no longer met. **Therefore, it would not be possible to manufacture this home to be in compliance with code regulations and the Energy Rule.**
 - Additionally, even if this home could be constructed in a manner to comply with code regulations and the Energy Rule, there are not enough windows in the market today to meet the demand if a lower U-value is required.
- If a manufacturer were to construct a home that met the required Tier 2, Zone 3 U-value with an insulation package that met the value under the prescriptive section of the code, which would require substantial framing changes, it would still be very difficult to construct this home using materials currently available on the market. Specifically:
 - Most manufacturers do not currently use the floor insulation technique that would be required to construct this home to meet DOE requirements.
 - There is not enough supply of R-21 insulation in the market to meet the amount necessary to comply with DOE requirements to keep up with the current demand.
 - It will be problematic to get the required insulation (R-38) in the roof cavity due to the required thickness and available attic space.
 - **To have almost the same amount of windows in the home as is allowed under current regulations, manufacturers would have to install windows that have a U-value equal to 0.30, which are not currently available on the market.**
- To construct a multi-section home in Zone 3, the shipping height will be increased due to the 5.5” heel height and the increased floor joist depth. **Because of the required insulation thickness under the Energy Rule, optional vaulted ceilings will no longer be available to the consumers.**

MHI supports energy conservation efforts, and our manufacturer members are committed to continue leading the way in energy efficient manufacturing. The analysis and presentations provided herein further demonstrate this commitment while providing a clear and conscientious basis for MHI’s proposed changes to the Energy Rule. MHI remains committed to working with the MHCC, HUD and DOE to realistically improve energy efficiency that not only encourages innovation and conservation but also eliminates regulatory barriers that impede consumer access to safe, affordable manufactured housing.

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Submission by the Manufactured Housing Institute
November 11, 2022

Sincerely,

A handwritten signature in black ink that reads "Lesli Gooch". The signature is written in a cursive, flowing style with a prominent initial "L" and a long, sweeping underline.

Lesli Gooch, Ph.D.
Chief Executive Officer

Enclosures

Exhibit A

Economic Impact Analysis

Table 1. Net Benefit (Cost)of DOE Proposal for Multi-section Homes based on DOE Costs and SBRA Energy Savings Estimates

Multi-section Home													
HUD Standards Climate Zone	Locations (heating equipment type)	Efficiency level	Level of efficiency (Uo-value)	Base average home cost (DOE TSD p. 6-2)	Marginal increase in home cost (DOE TSD)	Percent increase in cost	Marginal increase in down payment	Marginal increase in mortgage	Marginal increase in monthly mort. pay.	Marginal energy savings (\$/mth)	Net Mthly. Savings (Cost)	Principal repayment	Net benefit (cost)
1	Miami (Electric)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$10	(\$15)	\$1,967	(\$4,045)
		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$19	(\$14)	\$2,568	(\$4,644)
	Houston (Natural gas)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$12	(\$13)	\$1,967	(\$3,845)
		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$18	(\$14)	\$2,568	(\$4,664)
	Atlanta (Electric)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$34	\$9	\$1,967	(\$1,135)
		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$39	\$7	\$2,568	(\$2,184)
	Charleston (Electric)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$26	\$1	\$1,967	(\$2,115)
		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$31	(\$1)	\$2,568	(\$3,114)
	Jackson (Electric)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$31	\$6	\$1,967	(\$1,505)
		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$38	\$5	\$2,568	(\$2,344)
	Birmingham (Electric)	HUD standard	0.116	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.090	\$108,500	\$3,077	2.8%	\$308	\$2,770	\$25	\$32	\$7	\$1,967	(\$1,395)

2		DOE proposal	0.082	\$108,500	\$4,018	3.7%	\$402	\$3,616	\$33	\$37	\$5	\$1,967	(\$1,783)
	Phoenix (Natural gas)	HUD standard	0.096	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.076	\$108,500	\$2,404	2.2%	\$240	\$2,163	\$19	\$15	(\$4)	\$1,537	(\$2,303)
		DOE proposal	0.066	\$108,500	\$4,317	4.0%	\$432	\$3,885	\$35	\$22	(\$13)	\$2,759	(\$4,796)
	Memphis (Electric)	HUD standard	0.096	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.076	\$108,500	\$2,404	2.2%	\$240	\$2,163	\$19	\$23	\$3	\$1,537	(\$1,413)
		DOE proposal	0.066	\$108,500	\$4,317	4.0%	\$432	\$3,885	\$35	\$32	(\$3)	\$2,759	(\$3,536)
	El Paso (Natural Gas)	HUD standard	0.096	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.076	\$108,500	\$2,404	2.2%	\$240	\$2,163	\$19	\$10	(\$9)	\$1,537	(\$2,903)
		DOE proposal	0.066	\$108,500	\$4,317	4.0%	\$432	\$3,885	\$35	\$14	(\$21)	\$2,759	(\$5,656)
	San Francisco (Natural Gas)	HUD standard	0.096	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.076	\$108,500	\$2,404	2.2%	\$240	\$2,163	\$19	\$4	(\$15)	\$1,537	(\$3,583)
		DOE proposal	0.066	\$108,500	\$4,317	4.0%	\$432	\$3,885	\$35	\$7	(\$28)	\$2,759	(\$6,606)
	Albuquerque (Electric)	HUD standard	0.096	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.076	\$108,500	\$2,404	2.2%	\$240	\$2,163	\$19	\$21	\$2	\$1,537	(\$1,593)
		DOE proposal	0.066	\$108,500	\$4,317	4.0%	\$432	\$3,885	\$35	\$31	(\$4)	\$2,759	(\$3,656)
	Baltimore (Natural Gas)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$13	(\$7)	\$1,635	(\$2,765)
		DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$16	(\$16)	\$2,555	(\$4,899)
	Salem (Electric)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
		MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$51	\$30	\$1,635	\$1,765

3

	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$59	\$27	\$2,555	\$231
Chicago (Natural Gas)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$19	(\$2)	\$1,635	(\$2,105)
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$22	(\$10)	\$2,555	(\$4,149)
Boise (Electric)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$38	\$17	\$1,635	\$135
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$44	\$12	\$2,555	(\$1,549)
Burlington (Natural gas)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$21	\$1	\$1,635	(\$1,815)
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$25	(\$7)	\$2,555	(\$3,849)
Helena (Electric)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$53	\$32	\$1,635	\$1,945
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$62	\$29	\$2,555	\$551
Duluth (Natural Gas)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$29	\$9	\$1,635	(\$865)
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$34	\$1	\$2,555	(\$2,789)
Fairbanks (Natural Gas)	HUD standard	0.079	\$108,500	\$0	0.0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	MHI proposal	0.061	\$108,500	\$2,557	2.4%	\$256	\$2,302	\$21	\$39	\$19	\$1,635	\$335
	DOE proposal	0.055	\$108,500	\$3,997	3.7%	\$400	\$3,598	\$32	\$46	\$14	\$2,555	(\$1,279)

Assumptions	
Down payment	10%
Principal	90%
Mort. interest rate	9%
Loan term (yrs)	20
Occupancy term (yrs)	10
Principal recapture rate	0%

Average Benefit (Cost)		MHI	DOE
Zone	1	(\$2,340.08)	(\$3,122.03)
	2	(\$2,358.84)	(\$4,849.82)
	3	(\$421.72)	(\$2,216.82)

Ref.: TECHNICAL SUPPORT DOCUMENT: SUPPLEMENTAL NOTICE OF PROPOSED RULEMAKING PROPOSING ENERGY CONSERVATION STANDARDS FOR MANUFACTURED HOUSING
Estimates of energy savings provided by Ekotrope software.

Exhibit B

Analysis of DOE's Energy Conservation Standards

Analysis of DOE's Energy Conservation Standards for Manufactured Housing

Identification of Potential Issues and Sensitivity Analyses

November 11, 2022

Executive Summary

■ Assignment

- DOE relied upon a cost-benefit analysis for consumers of manufactured homes
- Analysis Group assessed this cost-benefit analysis with particular focus on **important inputs that have changed** since DOE's original analysis

■ Summary of Preliminary Conclusions

1. Adjusting DOE's assumptions for recent inflation and interest rate increases invalidates DOE's conclusion that its proposed rule is cost-effective for consumers
2. DOE's rule will have particularly negative impacts on minority and low-income homebuyers, who tend to face higher borrowing costs
3. DOE has underestimated the number of households that will no longer be able to afford a manufactured home as a result of the rule
4. DOE has failed to consider additional costs of compliance, such as duct testing and transportation costs, which could further negate any anticipated savings for consumers

Qualifications

Pavel Darling, Vice President *(MBA, MIT Sloan School of Management; B.A. in Economics, Middlebury College)*

Mr. Darling is an expert on energy matters, and often consults to utilities, state and regional organizations, and global companies in his work. He focuses on projects related to cost/benefit analyses of new construction and resource retirements; environmental effects of emissions and pollution controls; economic impacts of energy projects, mergers and policies; and natural gas, biomass, and other market studies. Mr. Darling also has extensive experience working on various climate change projects, including assessments of decarbonization policy proposals and quantification of greenhouse gas emissions impacts.

He has also submitted and supported expert testimony across different venues, including state utility commissions, siting boards, the Federal Energy Regulatory Commission and the Environmental Protection Agency. Mr. Darling's prior experience working at a utility involved preparing annual filings and working with stakeholders to assess bill impacts of proposed energy efficiency changes. He has also coauthored a number of published reports and journal articles.

About Analysis Group

Analysis Group is one of the largest international economics consulting firms, with more than 1,000 professionals across 14 offices in North America, Europe, and Asia. Since 1981, we have provided expertise in economics, finance, health care analytics, and strategy to top law firms, Fortune Global 500 companies, and government agencies worldwide. Our internal experts, together with our network of affiliated experts from academia, industry, and government, offer our clients exceptional breadth and depth of expertise.

Analysis Group's Energy & Environment practice is distinguished by our deep expertise in economics, finance, regulatory issues, and public policy, as well as significant experience in environmental economics and energy infrastructure development. We have worked on energy issues for a wide variety of clients, including energy producers, energy customers, regulatory commissions and government agencies, system operators, foundations, and nongovernmental institutions.

Background on DOE's Energy Efficiency Standards for Manufactured Housing

- Key Dates:

- Aug. 26, 2021 DOE issued Supplemental Notice of Proposed Rulemaking (SNOPR)
- May 31, 2022 Final rule and cost-benefit analyses released, relying on data from 2021 and earlier
- May 31, 2023 Expected compliance date

- By statute, DOE must consider cost effectiveness (42 U.S.C 17071(b)(1))

- “The energy conservation standards established under this section shall be based on the most recent version of the International Energy Conservation Code (including supplements), **except in cases in which the Secretary finds that the code is not cost-effective**, or a more stringent standard would be more cost-effective, based on the impact of the code on the purchase price of manufactured housing and on total life-cycle construction and operating costs.”

Summary of Preliminary Conclusions

DOE's conclusions on cost effectiveness disregard or do not sufficiently consider variation in key cost inputs over time and across groups for buyers and suppliers

1 Inflation and Cost Increases

DOE has failed to consider the impacts of considerable cost increases and supply chain constraints. Taking these into account, DOE's conclusion is invalid and the rule has a net cost to consumers rather than a benefit.

2 Negative and Inequitable Impacts

DOE has failed to consider negative impacts on low-income and minority homebuyers.

3 Affordability and Credit Access

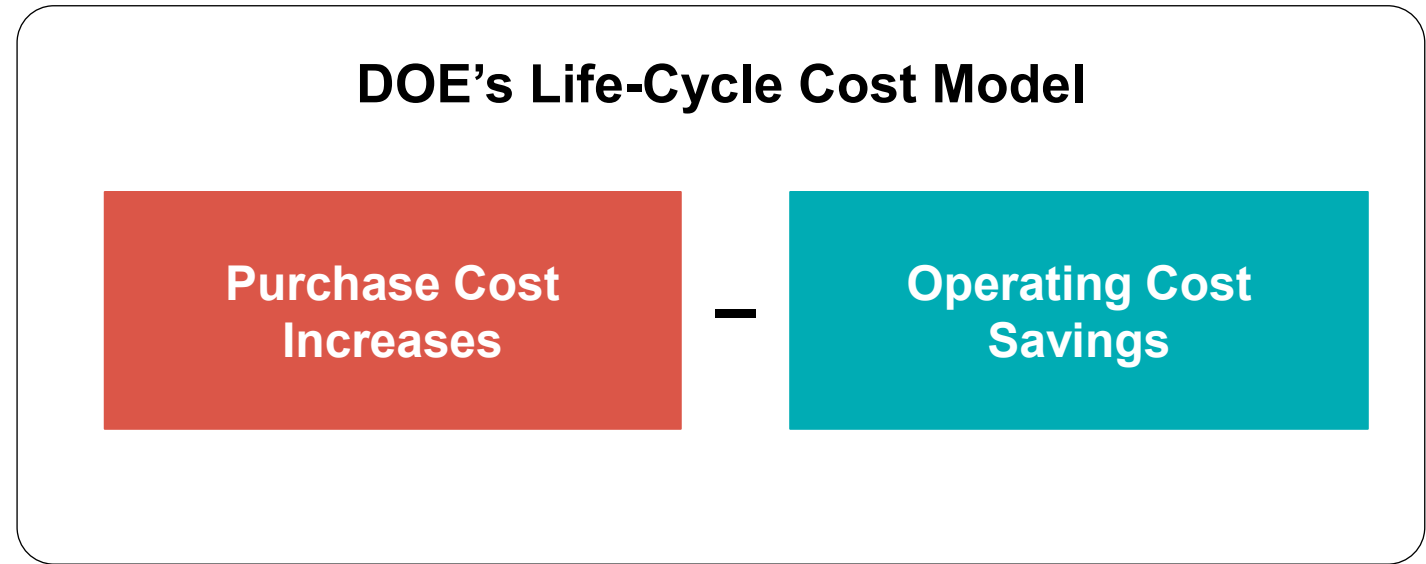
DOE has underestimated potential impacts on credit access and lost sales.

4 Additional Costs

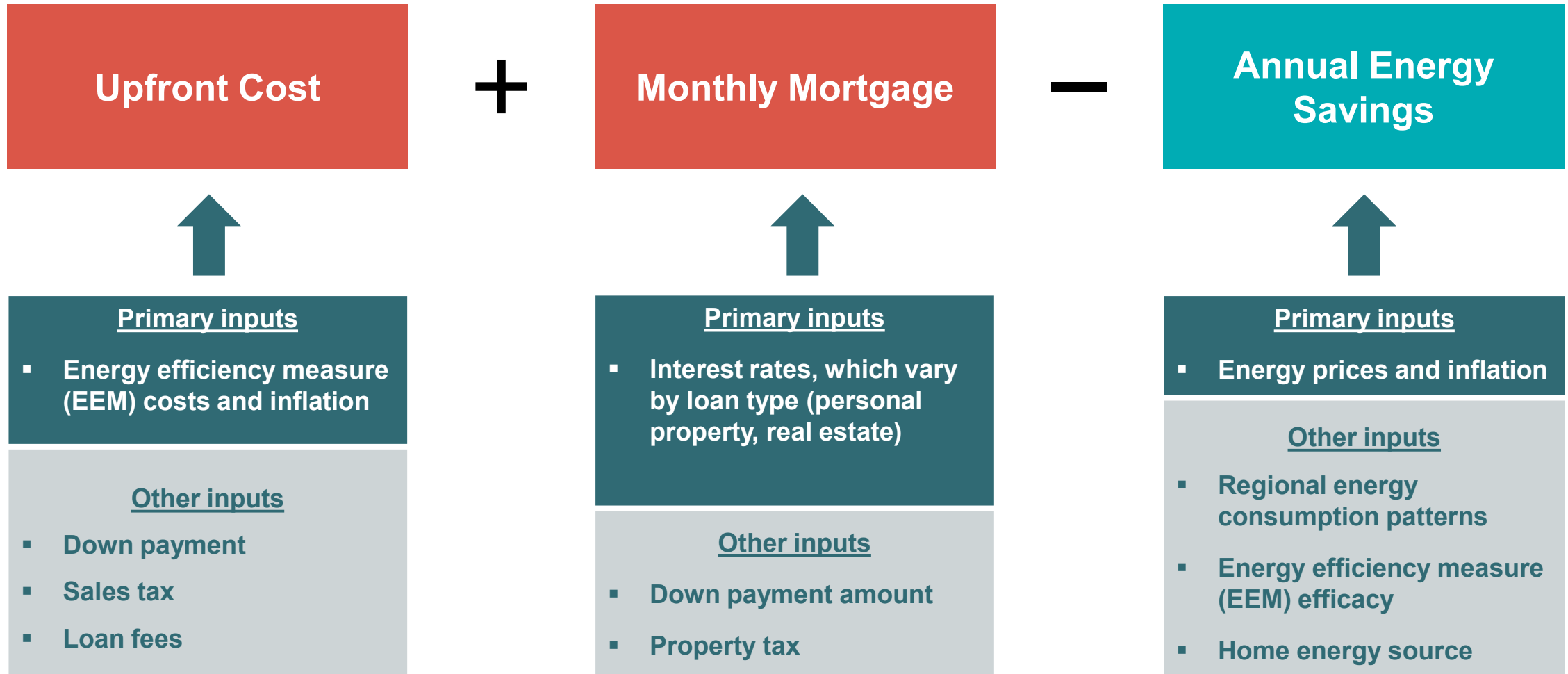
DOE has failed to consider potential costs of testing and compliance, transportation, and supply chain constraints.

Background: DOE's Life-Cycle Cost (LCC) Model

- DOE estimated the **total customer cost** over the life of the manufactured home via the Life-Cycle Cost model, including:
 - **Purchase costs** (e.g., the price of additional energy efficiency measures), and
 - **Operating costs** (e.g., energy bill savings)
- Future costs and savings are discounted to their value in the present year
- Analysis occurs over both 10- and 30-year periods
- DOE also calculates a payback period, equal to the increase in upfront cost divided by the energy savings in first year



Our Focus: Evaluating DOE's Cost-Benefit Analysis by Updating Key Inputs



Summary of Preliminary Conclusions

DOE's conclusions on cost effectiveness disregard or do not sufficiently consider variation in key cost inputs over time and across groups for buyers and suppliers

1 Inflation and Cost Increases

DOE has failed to consider the impacts of considerable cost increases and supply chain constraints. Taking these into account, DOE's conclusion is invalid and the rule has a net cost to consumers rather than a benefit.

2 Negative and Inequitable Impacts

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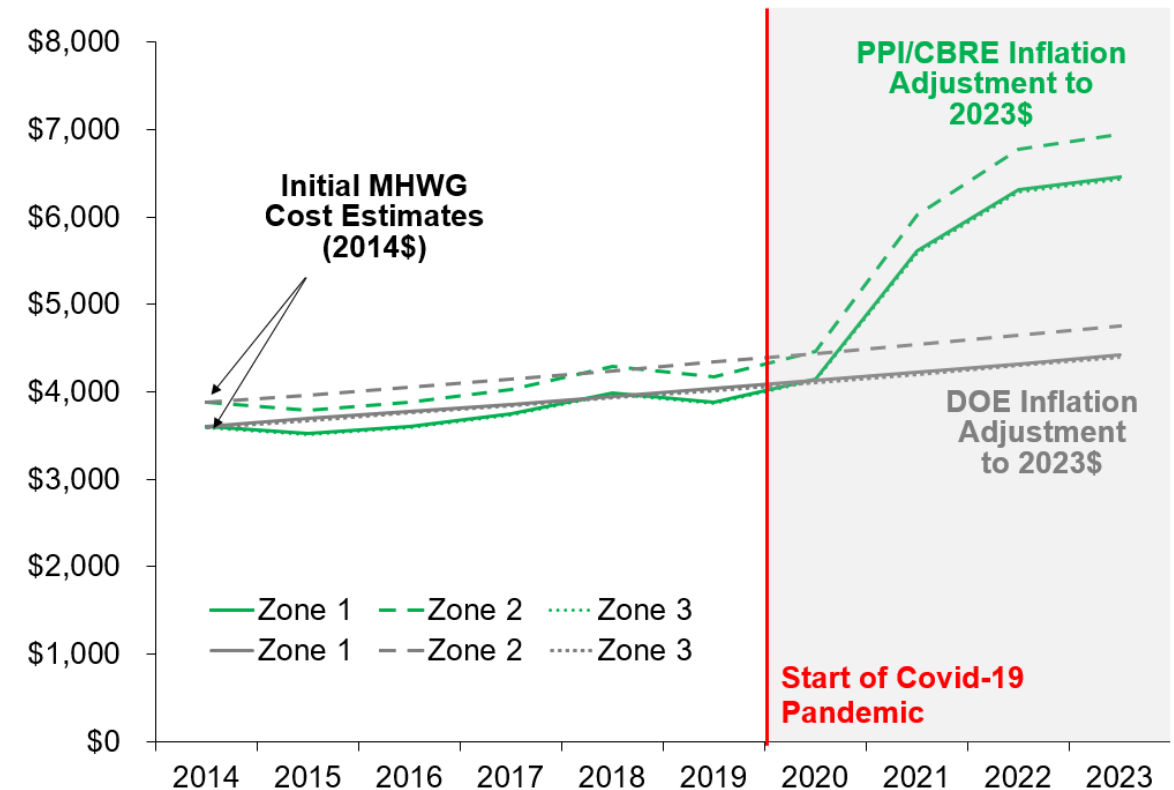
4 Additional Costs

DOE has failed to consider potential costs of testing and compliance, transportation, and supply chain constraints.

DOE Has Inadequately Adjusted EEM Cost Estimates for Inflation

- DOE calculated the costs of energy efficiency measures using cost estimates provided by the Manufactured Housing Working Group in **2014**
- To adjust for inflation, DOE assumes an annual nominal cost increase of **2.3 percent** between 2014-2023 (See gray lines)
- However, costs have increased substantially since the start of the Covid-19 pandemic. According to the BLS Producer Price Index for construction costs, materials costs have grown at an average annual rate of **6.5 percent** between 2014-2021, driven mostly by cost increases of **35.1 percent** from 2020-2021 (See green lines)
- Industry interviews suggest even higher recent increases beyond PPI, with costs at a new floor and unlikely to regress

Estimated Costs of Energy Efficiency Measures, by Inflation Adjustment Approach and Climate Zone



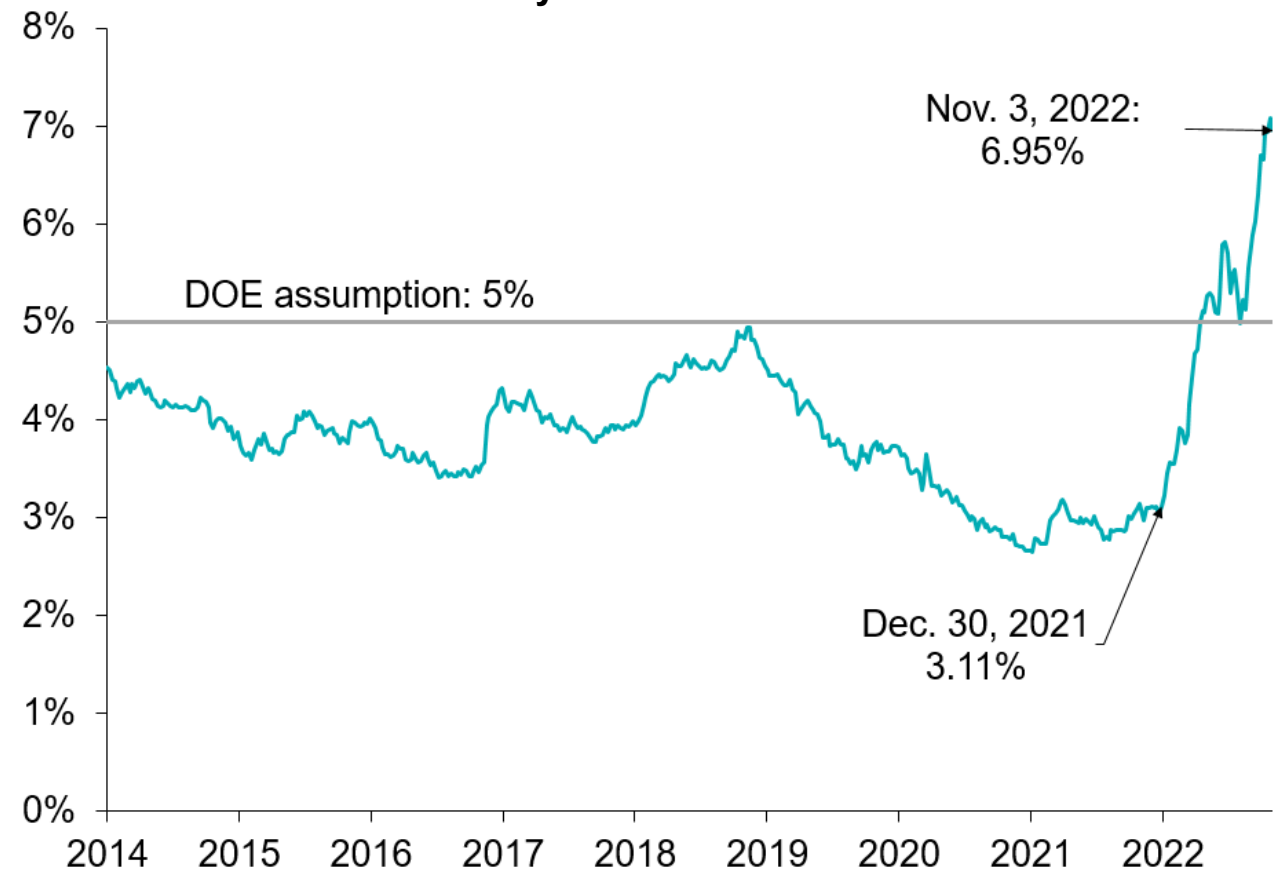
Note: Inflation estimates for PPI/CBRE series for 2022 and 2023 are from the "decreased demand" scenario of the CBRE's Construction Costs Index Forecast.

Sources: U.S. Bureau of Labor Statistics, Producer Price Index by Commodity: Special Indexes: Construction Materials [WPUSI012011], retrieved from FRED on October 30, 2022, Federal Reserve Bank of St. Louis, available at <https://fred.stlouisfed.org/series/WPUSI012011>; CBRE Research, "2022 U.S. Construction Cost Trends," July 2022, available at <https://www.cbre.com/insights/books/2022-us-construction-cost-trends>; U.S. Department of Energy, Manufactured Housing Life-Cycle Cost Analysis (LCC) Spreadsheet, May 18, 2022, available at <https://www.regulations.gov/document/EERE-2009-BT-BC-0021-1996>.

Mortgage Interest Rates Have Increased Above DOE's Assumptions

- DOE assumed interest rates of **5 percent** for mortgage loans and **9 percent** for personal property loans
- These assumptions were arguably conservative at the time, but mortgage rates have increased from approximately 3 to **7 percent**
- Industry interviews have suggested that personal property loan interest rates may be as high as **11.5 percent** for some borrowers
 - Moreover, DOE's own review of available evidence suggests that personal property loan interest rates are typically between 0.5 percentage points and 5 percentage points higher than real estate loan interest rates

**30-Year Fixed Rate Mortgage Average in the United States
January 2014 – November 2022**



Sources: Freddie Mac, 30-Year Fixed Rate Mortgage Average in the United States [MORTGAGE30US], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/MORTGAGE30US>, November 3, 2022; U.S. Department of Energy, "2022-05 Technical Support Document: Final Rule Energy Conservation Standards for Manufactured Housing, May 18, 2022, available at <https://www.regulations.gov/document/EERE-2009-BT-BC-0021-1999>, p. 8-4.

Energy Costs Have Increased As Well, Increasing Anticipated Savings

- Over the past year, energy costs have increased due to geopolitical and pandemic related disruptions
- The U.S. Energy Information Administration has increased its forecasted energy prices for 2023 and beyond based on its *Annual Energy Outlook* (AEO)
- The DOE LCC analysis relies on energy price forecasts from 2021

U.S. Energy Information Administration's Forecasted Energy Prices, by Forecast Year

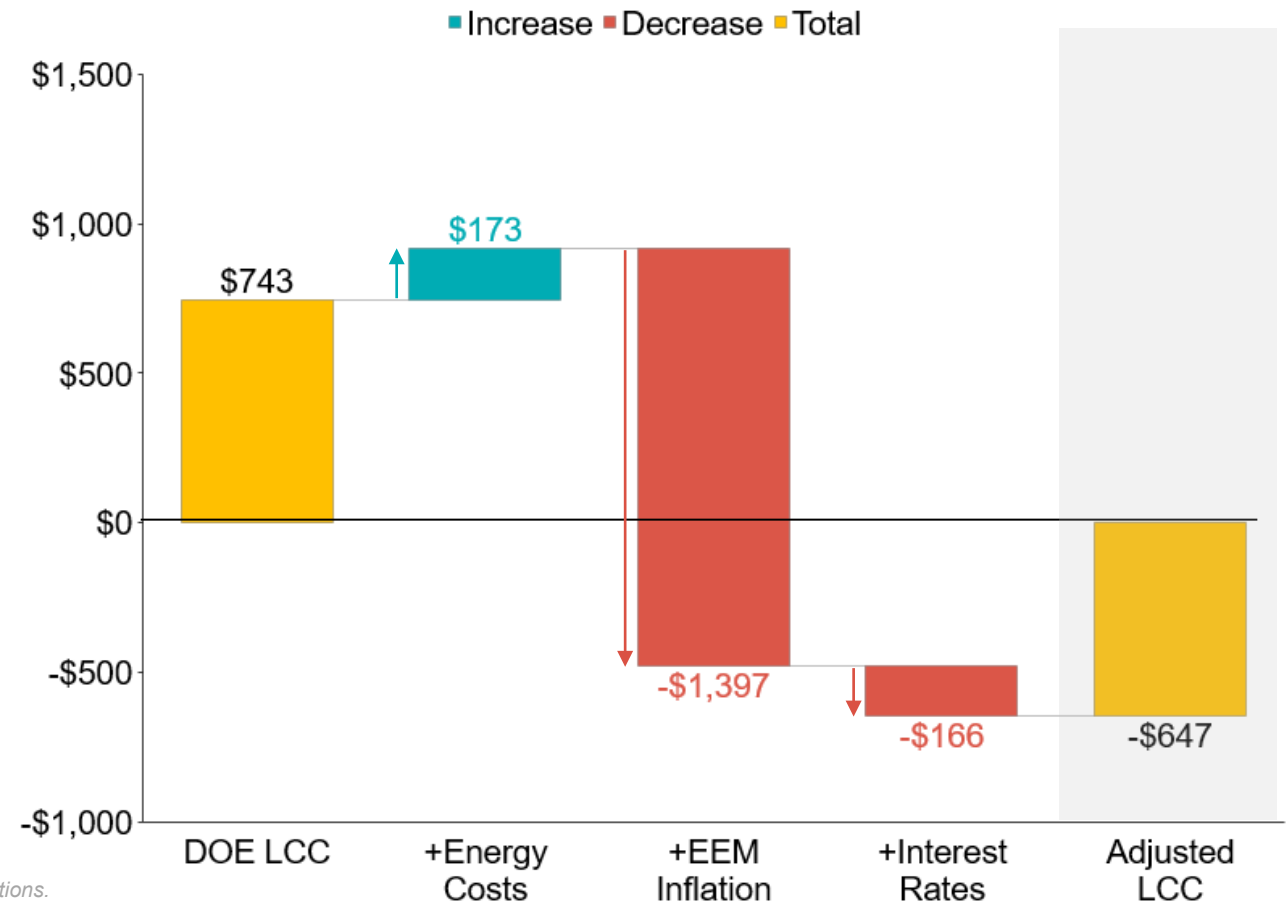
	Nominal Energy Prices			
	AEO 2021	AEO 2022	Units	% Change
	Assumptions	Assumptions		
Natural Gas	\$10.14	\$11.70	\$/Mbtu	+7.1%
Propane	\$17.30	\$21.49	\$/Mbtu	+10.8%
Elec Heat	\$0.13	\$0.14	\$/kWh	+1.9%
Elec Cool	\$0.13	\$0.14	\$/kWh	+1.5%
Elec Other	\$0.13	\$0.14	\$/kWh	+1.9%
Oil	\$17.75	\$21.71	\$/Mbtu	+10.0%

Sources: Annual Energy Outlook 2022, Table: Table 3. Energy Prices by Sector and Source, retrieved from U.S. Energy Information ; Short-Term Energy Outlook Data Browser, 2. Energy Prices, retrieved from U.S. Energy Information Administration on November 03, 2022, available at <https://www.eia.gov/outlooks/steo/data/browser/#/?v=8>.

On Net, Changes in the Recent Economic Environment Have Reversed Expected Cost Savings from the DOE Rule

- While increased energy cost forecasts have increased expected savings from the rule, the large increase in construction material costs since 2022 far outweighs these gains
- Additionally, adjusting for higher interest rates adds to expected increased costs
 - Real estate loan interest rates have been adjusted from 5 percent to **7 percent**
 - Personal property loan interest rates have conservatively been left at DOE's assumption of **9 percent**

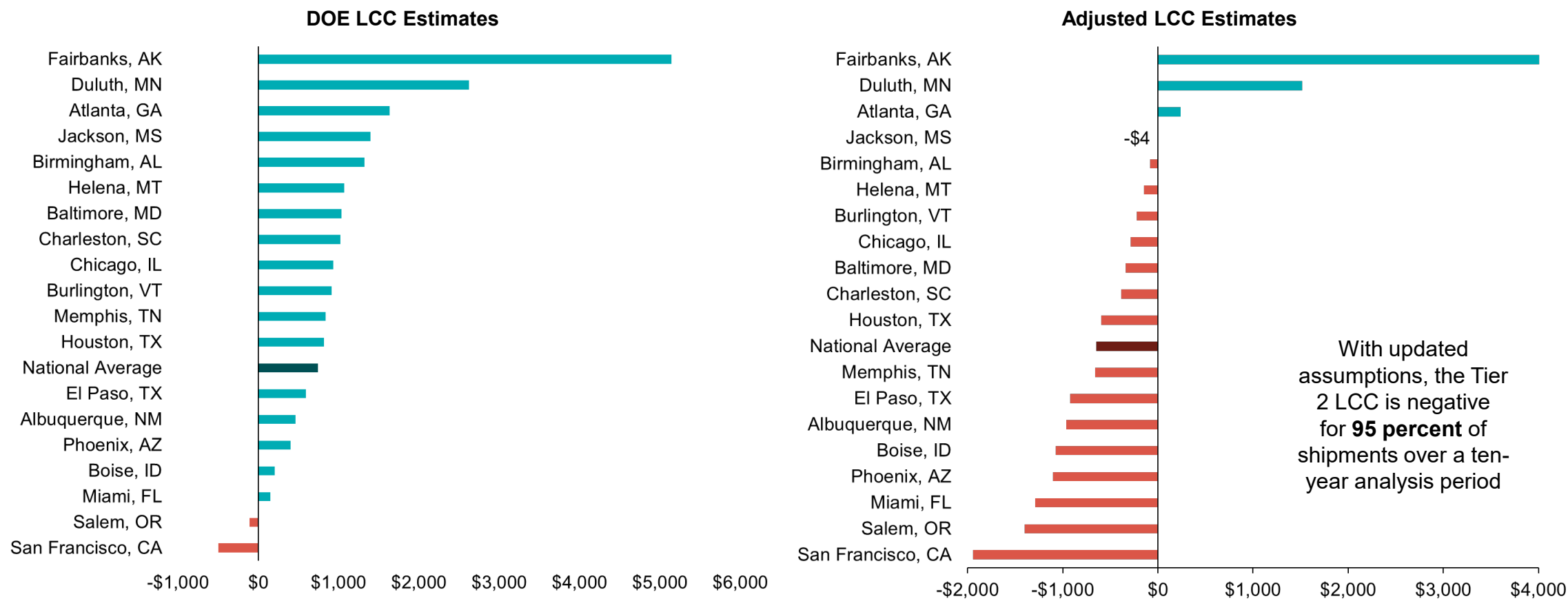
Tier 2 LCC Adjustments - 10-Year Analysis Period



Sources: U.S. Bureau of Labor Statistics, CBRE Research, Department of Energy, Freddie Mac, AG Calculations.

With Updated Costs, 10-Year Tier 2 LCC Negative For Most of the Country

Tier 2 LCC Adjustments, by City (10-Year Analysis Period)



Sources: U.S. Bureau of Labor Statistics, CBRE Research, Department of Energy, Freddie Mac, AG Calculations.

Summary of Preliminary Conclusions

DOE's conclusions on cost effectiveness disregard or do not sufficiently consider variation in key cost inputs over time and across groups for buyers and suppliers

1 Inflation and Cost Increases

DOE has failed to consider the impacts of considerable cost increases and supply chain constraints. Taking these into account, DOE's conclusion is invalid and the rule has a net cost to consumers rather than a benefit.

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3 Affordability and Credit Access

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4 Additional Costs

DOE has failed to consider potential costs of testing and compliance, transportation, and supply chain constraints.

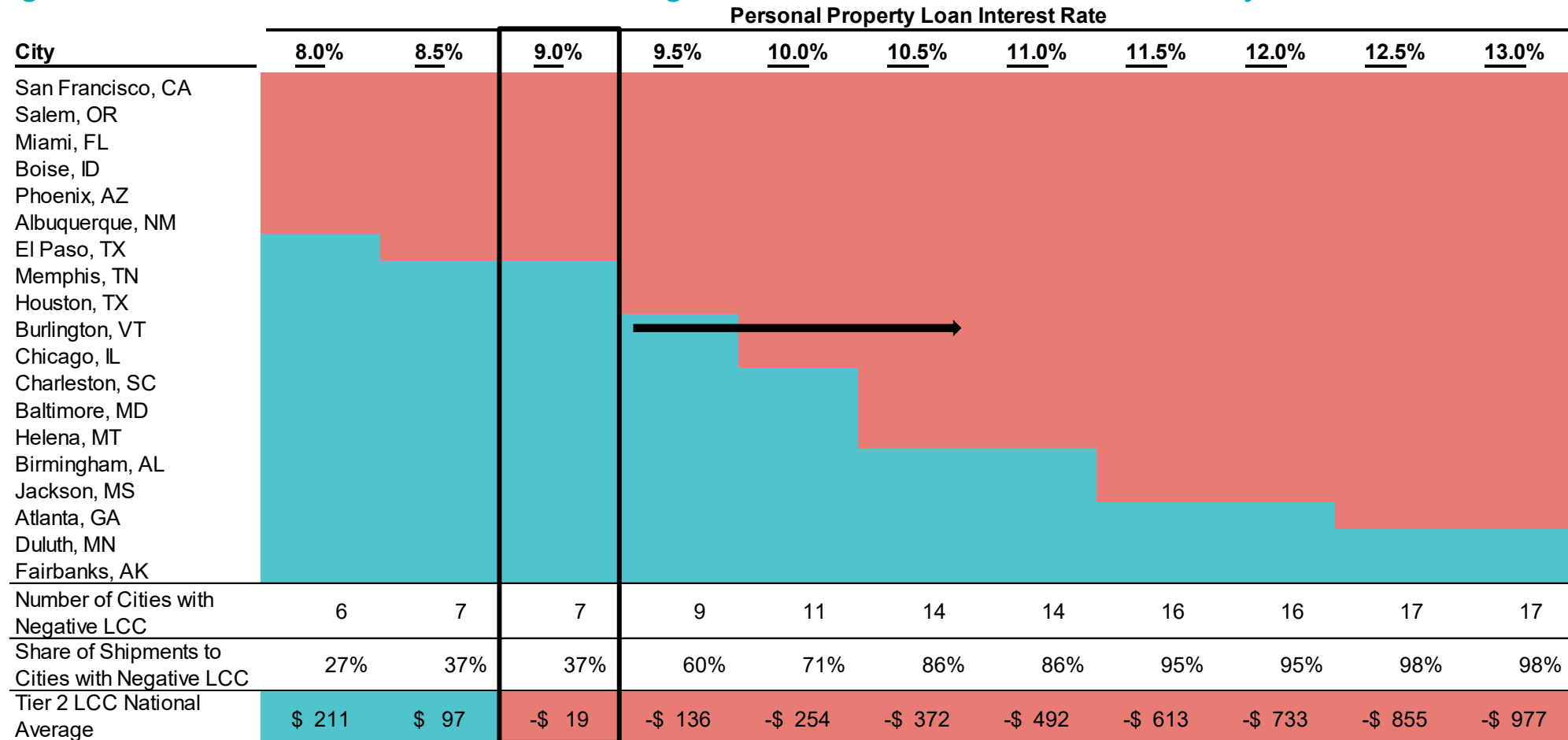
DOE's Average Buyer Analysis Masks Negative Outcomes for a Number of Subgroups

- DOE LCC calculation is an average of the LCCs for many types of buyers
- LCC estimates vary along many dimensions, including:
 - Loan type (personal property, real estate, cash)
 - Credit score
 - Home heating fuel type (e.g., natural gas, electric resistance, heat pump)
 - Climate zone/geography
- Ultimately, low-income and minority buyers are more likely to be negatively impacted by the rule
 - The Biden Administration has prioritized housing affordability and racial equity:
“The Federal Government has a critical role to play in overcoming and redressing... [its role in declining to invest in communities of color and in failing to provide equitable access,] and in protecting against other forms of discrimination by applying and enforcing Federal civil rights and fair housing laws. It can help ensure that fair and equal access to housing opportunity exists for all throughout the United States.”

Source: “Memorandum on Redressing Our Nation’s and the Federal Government’s History of Discriminatory Housing Practices and Policies,” *The White House*, January 26, 2021, available at <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/26/memorandum-on-redressing-our-nations-and-the-federal-governments-history-of-discriminatory-housing-practices-and-policies/>.

Under DOE's Original Assumptions, 10-Year LCC for Tier 2 Personal Property Loans is Negative

With Higher Interest Rates, LCC Becomes Negative for More Parts of the Country



Note: Red indicates negative LCCs and blue indicates positive LCCs. Darker colors correspond with higher absolute values. **Source:** DOE LCC Model.

Minority Buyers Are Relatively More Likely to Rely on Higher-Cost Personal Property Loans to Finance Purchases

- Many borrowers such as those with low credit scores or residents of Manufactured Housing communities face interest rates as high as 11.5 percent
- Minority buyers finance MH purchases with personal property loans at especially high rates compared to non-minority buyers

Share of Manufactured Home Purchases Financed by Personal Property Loans (vs. Real Estate Only), by Demographic Cohort

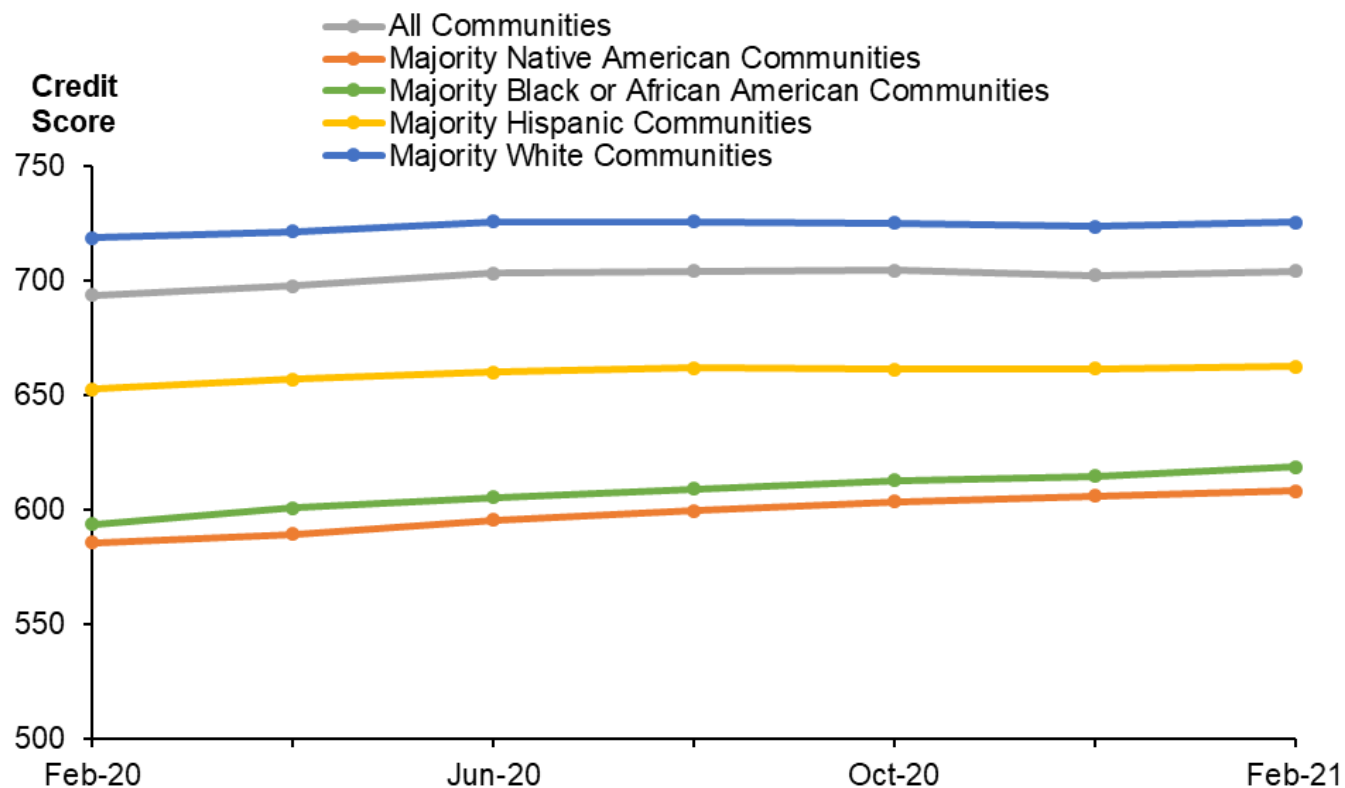
	Share of Personal Property Loans (vs Real Estate only)	Compared to All Households	Total Loans in Cohort (Personal Property and Real Estate)
All Households	42.8%	-	130,570
Low-Income Households	45.4%	+2.6%	65,583
Very Low-Income Households	45.1%	+2.3%	19,786
Hispanic	53.8%	+11.0%	16,224
Low-Income Hispanic Households	55.1%	+12.3%	8,406
Black or African American	65.1%	+22.3%	8,998
Low-Income Black or African American Households	66.7%	+24.0%	5,841
American Indian or Alaskan Native	54.7%	+11.9%	1,551
Low-Income American Indian or Alaskan Native Households	56.2%	+13.4%	840
Asian	48.6%	+5.9%	1,220

Sources: 2021 Home Mortgage Disclosure Act, United States Census Bureau.

Low-Income and Minority Households Face Higher Borrowing Costs than the Median Household

- Residents of majority-minority communities tend to have lower credit scores than compared to white communities and the national average
- Low-income and minority buyers tend to face higher interest rates

Credit Scores of Residents in Majority-Minority Communities



Sources: Urban Institute Credit Bureau Data; 2021 Home Mortgage Disclosure Act.

The Negative Impact of DOE's Proposed Rule Can Be Illustrated With a Few Representative Borrowers

Quoted Rates from 21st Mortgage's Payment Estimator Help to Approximate Current Loan Terms

- The following slides illustrate several groups of representative borrowers, which differ according to the following characteristics:
 - City [E.g., Memphis, TN (Climate Zone 2)]
 - Credit Score [E.g., 650-680]
 - Home Cost [E.g., \$100,000]
 - Down Payment [E.g., 10%]
 - Loan Type [E.g., Home-only (Private Land)]
- 21st Mortgage's "Payment Estimator" tool estimates interest rates and loan terms, given these characteristics, which we then use to calculate LCC values
 - 21st Mortgage is the largest manufactured-home lender in the country, so rates give a general sense of terms facing a current prospective manufactured homebuyer
- Credit score and energy consumption patterns by geography are key drivers of differences in anticipated savings for prospective multi-section home buyers

Geographic Energy Consumption Patterns Drive Considerable Differences Across Cities for Prospective Tier 2 Borrowers

Buyers with Good Credit Would Have Significantly Negative LCC in Most Cities

Profile	Memphis	Miami	El Paso	Houston	Phoenix	Baltimore
City	Memphis (Climate Zone 2)	Miami (Climate Zone 1)	El Paso (Climate Zone 2)	Houston (Climate Zone 1)	Phoenix (Climate Zone 2)	Baltimore (Climate Zone 3)
Credit score	650-680	650-680	650-680	650-680	650-680	650-680
Home cost	\$110,000	\$110,000	\$110,000	\$110,000	\$110,000	\$110,000
Down payment	10%	10%	10%	10%	10%	10%
Loan type	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)
Quoted rates (21st Mortgage)						
Interest rate	9.35%	9.35%	9.35%	9.35%	9.35%	8.60%
Term	25 years	25 years	25 years	25 years	25 years	25 years
10-year LCC						
Given DOE Assumptions	-\$ 66	-\$ 612	-\$ 280	-\$ 29	-\$ 448	\$ 366
Updated EEM Costs, Energy Prices	-\$1,586	-\$2,077	-\$1,821	-\$1,462	-\$1,985	-\$ 988
30-year LCC*						
Given DOE Assumptions	\$1,712	\$ 605	\$1,323	\$1,638	\$1,052	\$2,452
Updated EEM Costs, Energy Prices	-\$ 143	-\$1,206	-\$ 565	-\$ 119	-\$ 837	\$ 773

Notes: Asterisk (*) indicates that estimates are from DOE's original model, i.e., without a correction for an error where loan payments after Year 15 are not included in the LCC calculation for personal property loans. Quoted rates are for a single applicant. From HMDA, roughly 58% of applications are from single applicants. Source: 21st Mortgage Corporation, Payment Estimator, accessed November 7, 2022, available at <https://www.21stmortgage.com/web/payment-estimator.nsf/q1.html>; U.S. Department of Energy, Manufactured Housing Life-Cycle Cost Analysis (LCC) Spreadsheet, May 18, 2022, available at <https://www.regulations.gov/document/EERE-2009-BT-BC-0021-1996>.

Excellent-Credit-Score Borrowers are the Only Credit Score Group with Positive Tier 2 10-Year LCCs (e.g., Memphis)

Based on Industry Interviews, Only 1/3 of MH Buyers Have Credit Scores Over 675

Profile	Poor Credit	Average Credit	Good Credit	Good Credit	Excellent Credit	Excellent Credit
City	Memphis	Memphis	Memphis	Memphis	Memphis	Memphis
Credit score	Under 600	600-650	650-680	680-700	700-750	750+
Home cost	\$110,000	\$110,000	\$110,000	\$110,000	\$110,000	\$110,000
Down payment	10%	10%	10%	10%	10%	10%
Loan type	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)	Home only (Private Land)
Quoted rates (21st Mortgage)						
Interest rate	11.45%	10.10%	9.35%	9.35%	8.35%	8.35%
Term	25 years	25 years	25 years	25 years	25 years	25 years
10-year LCC						
Given DOE Assumptions	-\$ 578	-\$ 259	-\$ 66	-\$ 66	\$ 209	\$ 209
Updated EEM Costs, Energy Prices	-\$2,202	-\$1,818	-\$1,586	-\$1,586	-\$1,252	-\$1,252
30-year LCC*						
Given DOE Assumptions	\$ 630	\$1,288	\$1,712	\$1,712	\$2,355	\$2,355
Updated EEM Costs, Energy Prices	-\$1,255	-\$ 578	-\$ 143	-\$ 143	\$ 516	\$ 516

Notes: Asterisk (*) indicates that estimates are from DOE's original model, i.e., without a correction for an error where loan payments after Year 15 are not included in the LCC calculation for personal property loans. Quoted rates are for a single applicant. From HMDA, roughly 58% of applications are from single applicants. Source: 21st Mortgage Corporation, Payment Estimator, accessed November 7, 2022, available at <https://www.21stmortgage.com/web/payment-estimator.nsf/q1.html>; U.S. Department of Energy, Manufactured Housing Life-Cycle Cost Analysis (LCC) Spreadsheet, May 18, 2022, available at <https://www.regulations.gov/document/EERE-2009-BT-BC-0021-1996>.

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Increased Costs Will Likely Impact Ability to Qualify for Financing

- Debt-to-income ratio is one of the top reasons why potential buyers of manufactured homes are denied loans
 - In 2021, **42 percent** of denied loans for MH purchases listed the applicant's debt-to-income ratio as a reason for denial
- The cost of owning a new manufactured home has increased by over 40 percent since 2020, according to an industry source
 - Additionally, the cost of construction materials has increased by at least 35 percent since 2020, increasing the cost of compliance
 - Together, these two factors are likely to increase the debt-to-income ratio for potential applicants for manufactured home loans, increasing the likelihood of loan denial
- Minority buyers tend to have lower incomes, and therefore the impacts of the rule have the potential to fall disproportionately on historically marginalized communities
 - Low-income buyers are likely to be disproportionately impacted for similar reasons

Sources: 2021 Home Mortgage Disclosure Act, Industry Interviews.

DOE's Reliance on Elasticity of Demand Estimates Understates Likely Impact on Affordability & Housing Access

- DOE has likely underestimated the affordability impact by assuming **relatively low price-sensitivity**
 - For example, AG's updated EEM cost estimates suggest that the cost of Tier 2 homes will increase by **6.1 percent**
 - Under DOE's assumption, a 6.1 percent increase in price leads to **2.9 percent fewer sales annually**
 - However, according to 2021 estimates of price sensitivity by the National Association of Home builders, the same 6.1 percent increase in price would lead to **6.4 percent fewer sales annually**
 - DOE's own sensitivity analysis, based on a study HUD has cited in prior rulemakings, suggests that this 6.1 percent price increase would lead to **14.6 percent fewer sales annually**
- Additionally, DOE has likely underestimated impacts on affordability due to:
 - DOE has arguably **underestimated compliance costs** and the expected increases in MH prices due to the rule
 - The **recent increase in retail prices** of MHs may have made ownership unaffordable for many consumers already
 - Consumers may be increasingly sensitive to price increases at higher baseline prices
- DOE's assumption understates the decreased demand by *thousands* of potential manufactured home buyers per year, all of whom would have to choose from worse alternatives

Sources: DOE Technical Support Document, pp. 8-3, 10-7 – 10-9; NAHB (2021); EERE-2009-BT-BC-0021-1997_content, Sheet "Price Elasticity," Cells E3:E4; AG Calculations.

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DOE Has Not Accounted for Costs of Testing and Compliance, Which Could Entirely Offset Anticipated Life-Cycle Cost Savings

- DOE has not specified requirements for duct system testing and air leakage testing, which are required by the IECC
- The costs of these possible testing requirements were also not included in DOE's LCC analyses
- Industry interviews have suggested that the costs of compliance may range up to and possibly **over \$1,000/house** for in-field testing of homes in more remote locations
- A \$1,000 testing cost could nearly wipe out anticipated savings across all tiers and analysis periods

DOE and Adjusted LCC Values, by Tier and Analysis Period

	10-Year LCC		30-Year LCC*	
	Tier 1	Tier 2	Tier 1	Tier 2
DOE LCC	\$720	\$743	\$1,594	\$3,573
Adjusted LCC	\$549	-\$647	\$1,395	\$1,361
Adjusted LCC, with \$1,000 Testing Cost	-\$194	-\$1,330	\$426	\$338

Note: Asterisk (*) indicates that the 30-year LCC estimates rely on DOE's original model, which erroneously excludes mortgage payments after the 15th year of personal property loans and therefore overestimates anticipated savings.

Transportation Costs May Further Reduce or Negate Anticipated Savings

- Interviews with industry experts, as well as public comments submitted to DOE, have suggested that DOE has underestimated additional transportation costs due to additional height and weight required to comply with the rule
 - Additional insulation and framing requirements may increase the weight of manufactured homes, requiring an additional axle, which may cost **at least \$400 to \$500/multi-section house**
 - The rule may require homes in CZ2 and CZ3 to use 2' x 6' studs instead of standard 2' x 4' studs, which increases package height. Height increases may require re-routing deliveries around areas with height restrictions, such as in the Northeast
- Additionally, transportation costs have increased in general during the pandemic, e.g., as fuel and labor costs have increased
- Incremental transportation costs were not included in DOE's LCC estimates

Pandemic-Related Supply Chain Shortages May Persist into 2023

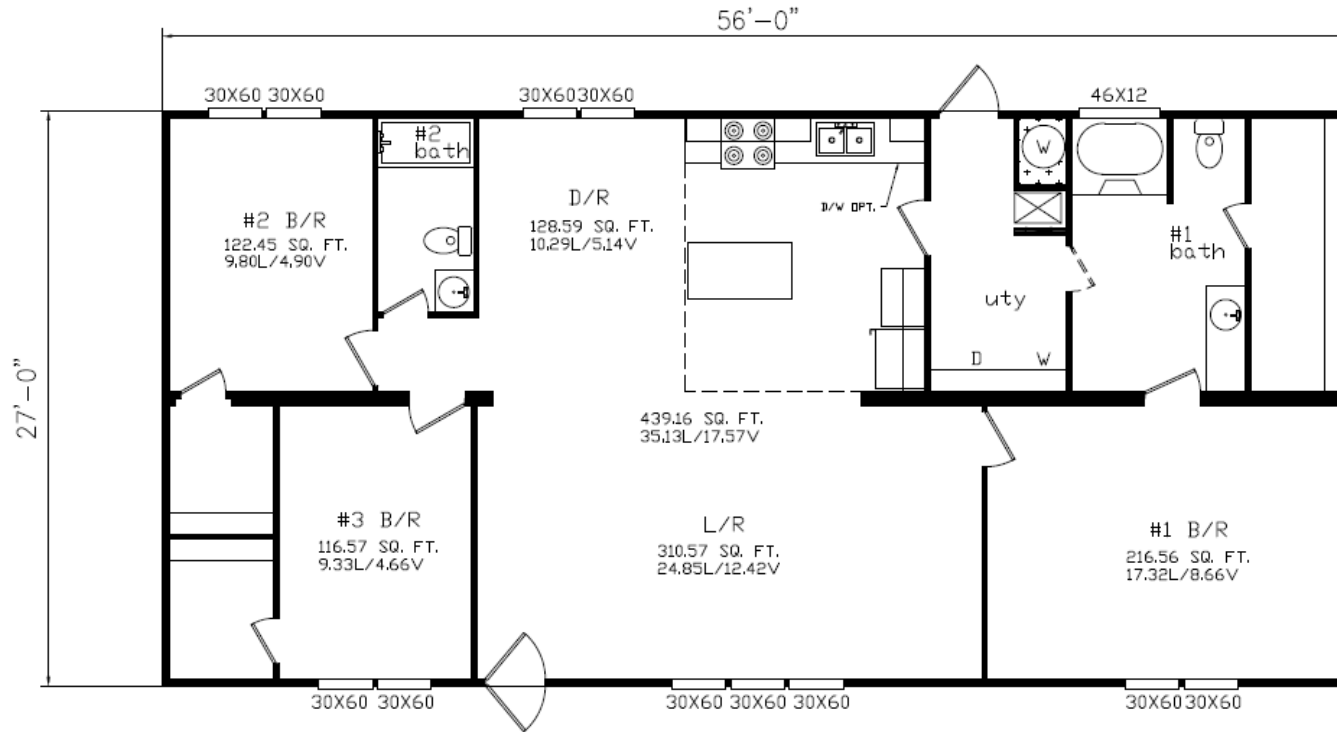
- Industry interviews have predicted that pandemic-related supply chain shortages are likely to persist into 2023
 - For example, one interview noted that there were already insulation shortages, with additional cost increases coming in January 2023
 - New fiberglass insulation plants are capital-intensive and take time to build, and therefore insulation shortages are likely to persist in the medium term
 - Therefore, increased demand from the manufactured housing sector due to the DOE rule may further exacerbate existing insulation shortages
 - Without sufficient fiberglass insulation, manufacturers may be forced to substitute to spray foam insulation for parts of the production process, increasing costs significantly and reducing the total number of homes that can be produced per day
- Additionally, CBRE has predicted that pandemic-related delays and labor shortages will continue in the short term

Exhibit C

Architectural Drawings

CURRENTLY BUILT MULTI WIDE – BOX SIZE 27x56

HEATED AREA – 1457 SQUARE FEET



TYPICAL ZONE 3 CONSTRUCTION

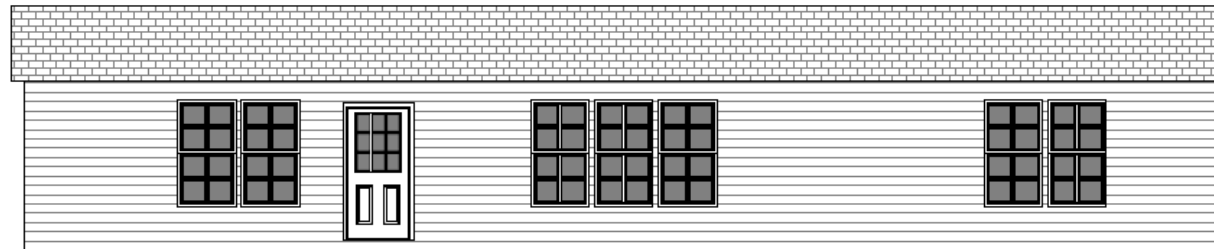
INSULATION – 22 FLOOR / 11 WALL / 28 CLG

2x4 WALLS

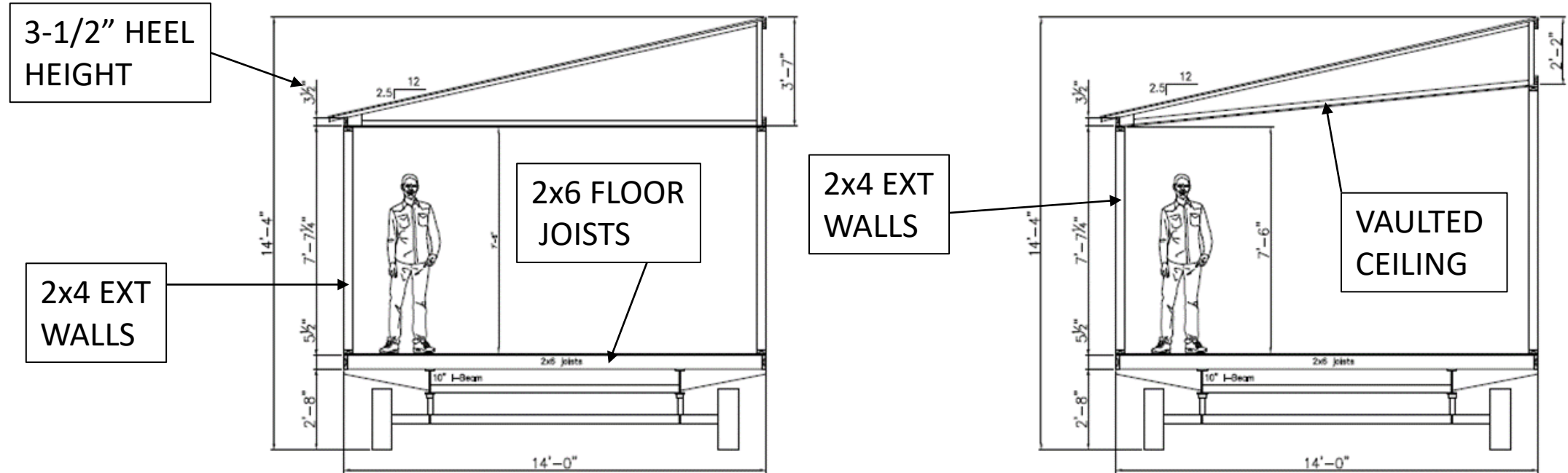
2x6 FLOOR JOISTS

142 SQUARE FEET OF WINDOWS

WINDOW U-VALUE = 0.34



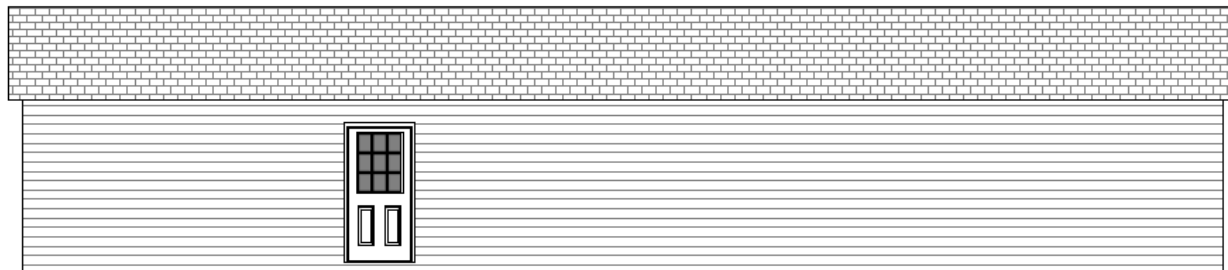
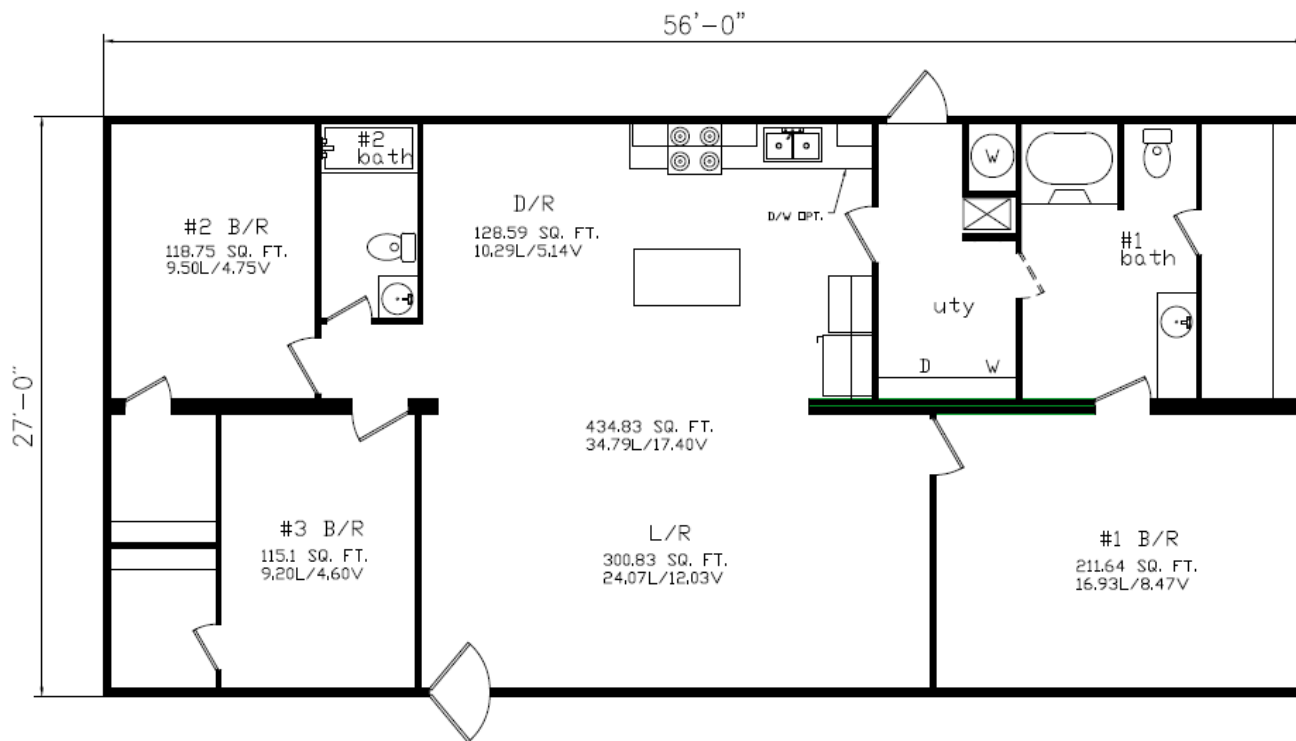
CURRENT TYPICAL CROSS SECTIONS



TYPICAL ZONE 3 CONSTRUCTION: SHIPPING HEIGHT 14'-4"
OPTIONAL VAULT CEILING
7'-6" SIDEWALL HEIGHT
3-1/2" TRUSS HEEL HEIGHT

IMPACT DUE TO DOE PROPOSED MULTI WIDE – BOX SIZE 27x56

HEATED AREA – 1457 SQUARE FEET



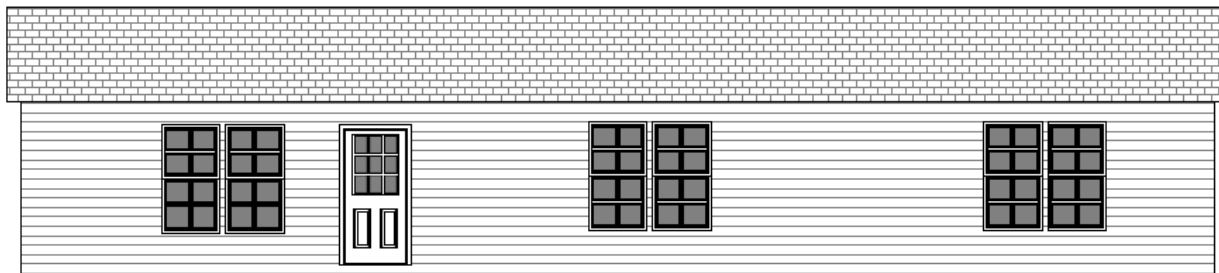
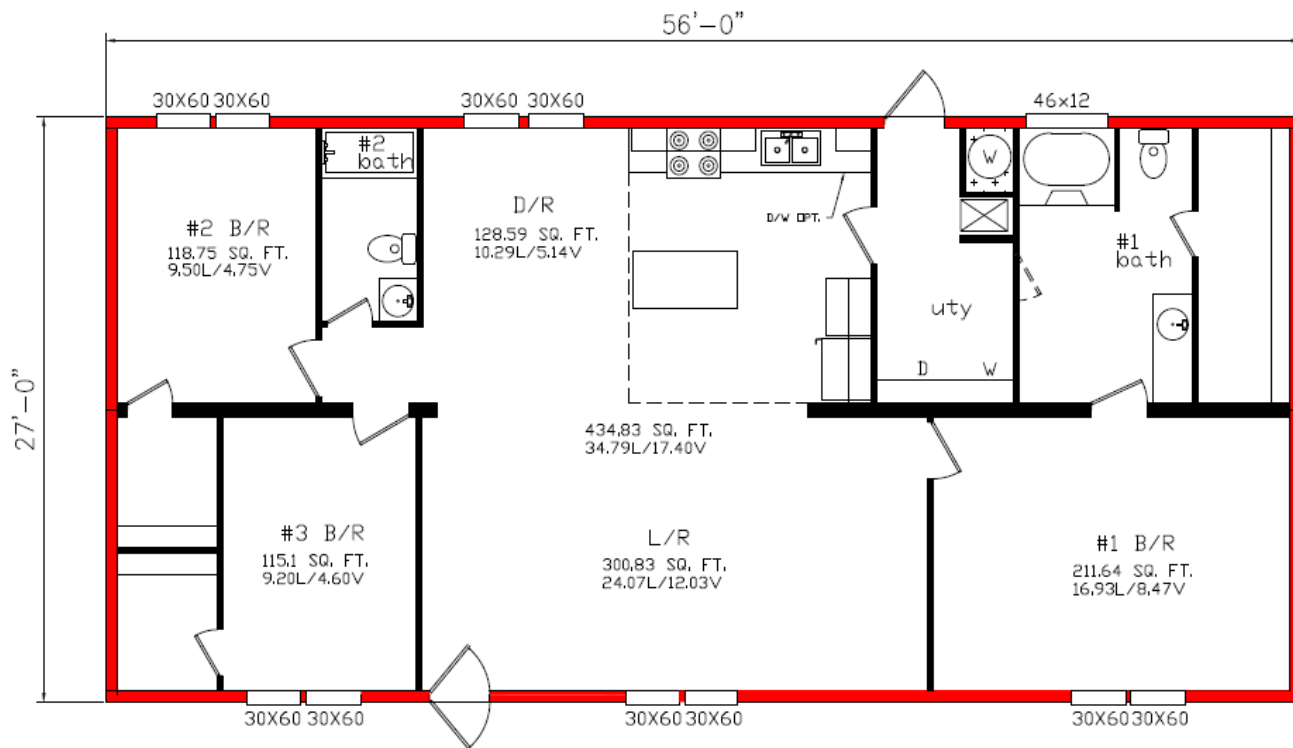
PROPOSED ZONE 3 CONSTRUCTION
INSULATION – 33 FLOOR / 15 WALL / 28 CEILING
2x4 WALLS
2x6 FLOOR JOISTS
ZERO WINDOWS
WINDOW U-VALUE = 0.32

NOTES:

- THIS SLIDE SHOWS THE CHANGES REQUIRED IN ORDER TO REACH THE REQUIRED U-VALUE (0.055) WITHOUT CHANGING THE HOME CONSTRUCTION .
- FLOOR INSULATION WAS CHANGED TO R-33, WALL INSULATION WAS CHANGED TO R-15, AND CEILING INSULATION REMAINED R-28. THESE INSULATION VALUES ARE THE MAXIMUM POSSIBLE VALUES THAT CAN BE INSTALLED WITHOUT CHANGING THE HOME CONSTRUCTION FRAMING.
- WITH THIS CONSTRUCTION, I WAS ONLY ABLE TO GET THE OVERALL U-VALUE DOWN TO 0.055 IF ALL WINDOWS WERE REMOVED.
- PLEASE NOTE THAT IT IS NOT POSSIBLE TO CONSTRUCT A HOME WITHOUT WINDOWS DUE TO LIGHT, VENTILATION, and EGRESS REQUIREMENTS.

IMPACT DUE TO DOE PROPOSED MULTI WIDE – BOX SIZE 27x56

HEATED AREA – 1430 SQUARE FEET



PROPOSED ZONE 3 CONSTRUCTION

INSULATION – 30 FLOOR / 21 WALL / 38 CEILING

2x6 WALLS

2x8 FLOOR JOISTS

129 SQUARE FEET OF WINDOWS

WINDOW U-VALUE = 0.30

HEEL HEIGHT CHANGED TO 5.5 inches

NOTES:

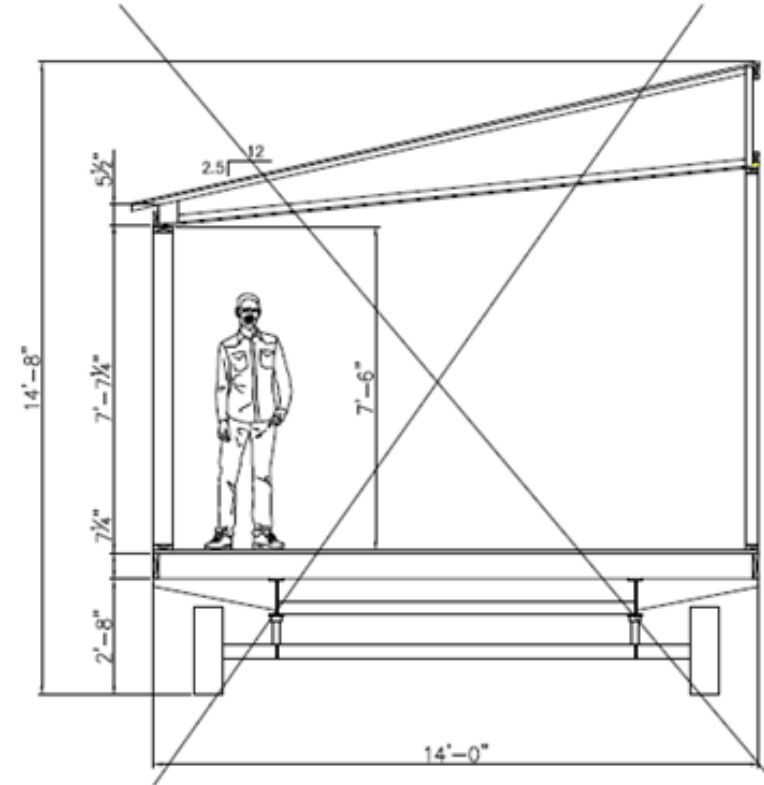
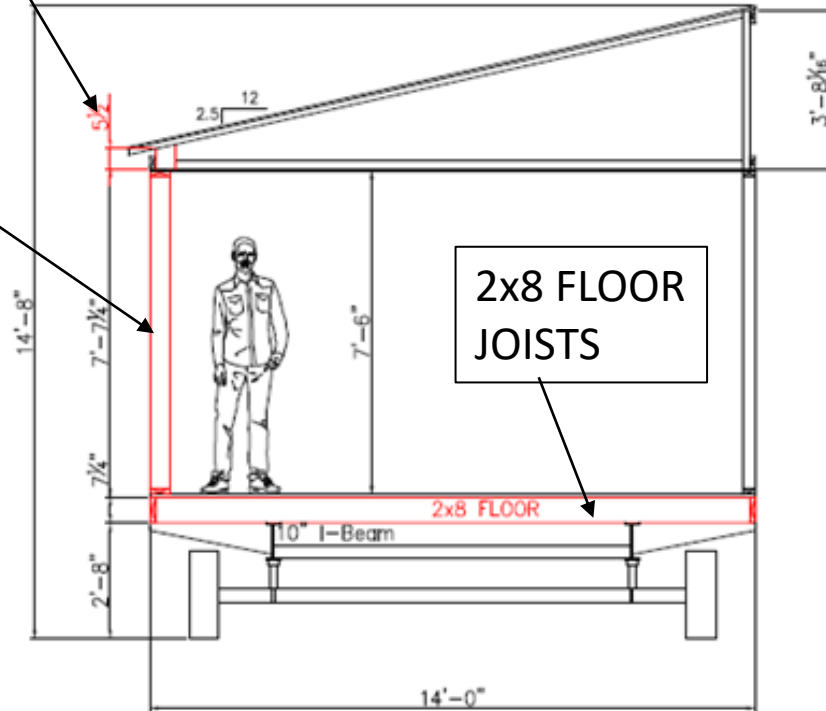
- IN ORDER TO REACH THE REQUIRED U-VALUE (0.055) THE FLOORS WERE CHANGED TO 2x8, THE WALLS WERE CHANGED TO 2x6 AND THE INSULATION PACKAGE WAS CHANGED TO THE VALUES LISTED IN THE PRESCRIPTIVE SECTION OF THE PROPOSED CODE. HOWEVER, IT WILL BE VERY DIFFICULT TO BUILD THE HOME WITH THIS INSULATION PACKAGE USING CURRENTLY AVAILABLE MATERIALS.
- HEATED AND COOLED INTERIOR SPACE REDUCED BY 27 SQUARE FEET DUE TO THE INCREASED WALL THICKNESS.
- R-30 IN THE FLOOR WILL REQUIRE BATT INSULATION TO BE INSTALLED BETWEEN THE FLOOR JOISTS COMBINED WITH A BLANKET BELOW THE JOISTS. CURRENTLY, MOST MANUFACTURER'S DO NOT USE THIS FLOOR INSULATION TECHNIQUE.
- R-21 IS AVAILABLE, BUT IN SMALL QUANTITIES
- R-38 WILL BE PROBLEMATIC TO GET INTO THE ROOF CAVITY DUE TO THE REQUIRED THICKNESS AND AVAILABLE SPACE IN THE ATTIC.
- ADDED BACK 11 OF THE PREVIOUSLY REMOVED 12 WINDOWS. UPGRADED THE WINDOWS TO U-VALUE EQUAL TO 0.30. HOWEVER, IT SHOULD BE NOTED THAT THESE UPGRADED WINDOWS ARE NOT AVAILABLE IN THE MARKET TODAY.
- SHIPPING HEIGHTS WILL BE INCREASED DUE TO TALLER FLOORS AND TALLER HEEL HEIGHT TRUSS.
- THE OPTION FOR A VAULTED CEILING WILL NOT BE POSSIBLE DUE TO THE INCREASED INSULATION THICKNESS IN THE ATTIC.
- OPTIONS FOR 8 FEET OR 9 FEET WALL HEIGHTS AND TRANSOM WINDOW WILL ALSO BE IMPACTED.

PROPOSED TYPICAL CROSS SECTIONS

5-1/2" HEEL
HEIGHT

2x6 EXT
WALLS

2x8 FLOOR
JOISTS



ZONE 3 CONSTRUCTION:

SHIPPING HEIGHT INCREASED TO 14'-8"

OPTIONAL VAULT CEILING IS NO LONGER AVAILABLE DUE TO INSULATION THICKNESS

7'-6" SIDEWALL HEIGHT

5-1/2" TRUSS HEEL HEIGHT

2x8 FLOORS

ADDITIONAL PROPOSED CHANGES

- PROPOSES USING ACCA MANUAL S AND ACCA MANUAL J FOR HEATING AND COOLING EQUIPMENT. HOWEVER, USING ACCA MANUAL J AND ACCA MANUAL S FOR THE DESIGN OF HEATING AND COOLING EQUIPMENT WILL BE PROBLEMATIC, ESPECIALLY IN THERMAL ZONE 3. ACCA MANUAL J REQUIRES KNOWLEDGE OF THE ORIENTATION OF THE HOME WITH RESPECT TO THE SUN FOR COOLING LOAD ANALYSIS. BECAUSE THE ORIENTATION OF THE HOME IS OFTEN UNKNOWN UNTIL INSTALLED, THE PROPOSED RULE MUST ESTABLISH A DEFAULT ORIENTATION. ACCA MANUAL S ESTABLISHES SIZING LIMITS FOR HEATING AND COOLING EQUIPMENT, THESE LIMITS PRESUME THAT THERMAL LOADS ARE ESTABLISHED FOR A SPECIFIC LOCATION AND SPECIFIC BUILDING ORIENTATION. THE VARIATION IN DESIGN PARAMETERS WITHIN A SINGLE THERMAL ZONE EXCEEDS THE SIZING LIMITS OF ACCA MANUAL S. ADDITIONAL GUIDANCE WILL BE REQUIRED TO PROPERLY USE ACCA MANUAL S AND ACCA MANUAL J.