



The 2018/19 Manufactured Homes Pilot

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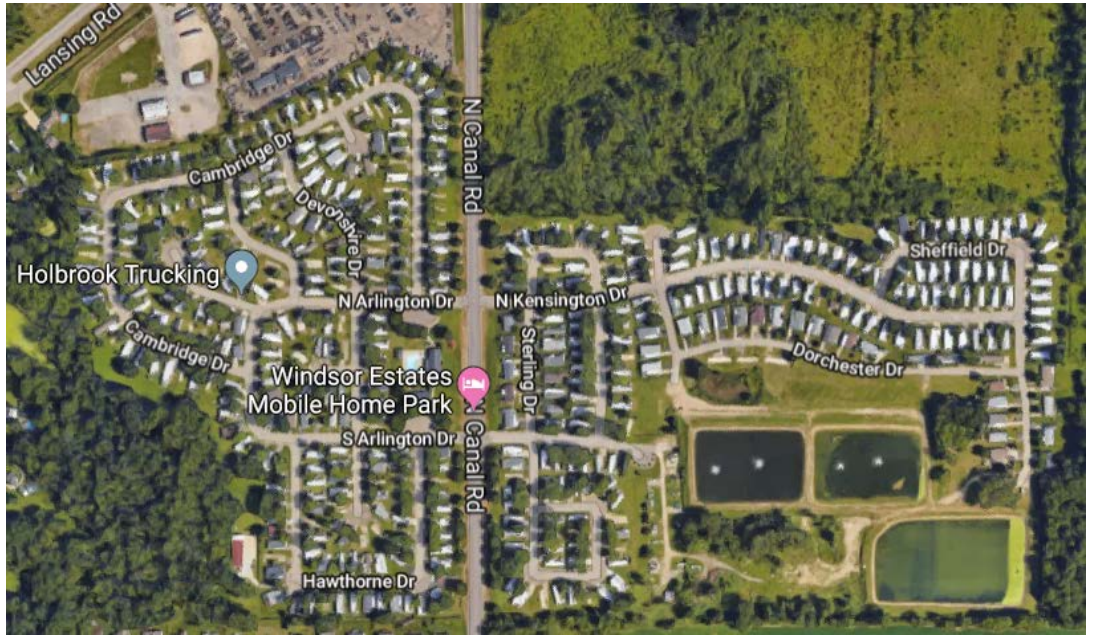
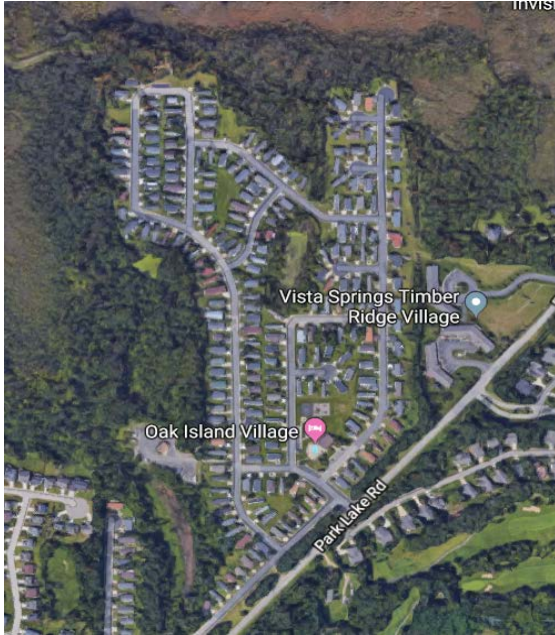
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What is a Manufactured Home?

- Manufactured homes, or mobile homes are prefabricated structures built in a factory on a permanent steel chassis, sometimes with wheels attached. This is so they can be moved, towed or trailered to the location where the owner will take residency.
- Manufactured homes may be single wide or double wide in size
- Manufactured homes are designed to meet the Department of Housing and Urban Development (HUD) code, the Federal building code from 1974
- Manufactured homes are typically located in a manufactured homes community, or park, on private property
- The majority of older manufactured homes occupants are of low or lower-income

Manufactured Home Parks

Are more prevalent than one might think. More than ten parks are located within eight miles of where we sit today. Manufactured homes represent a substantial and largely untapped opportunity to save energy. More than an estimated 60,000 manufactured homes exist in Michigan



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DTE

Pilot Overview

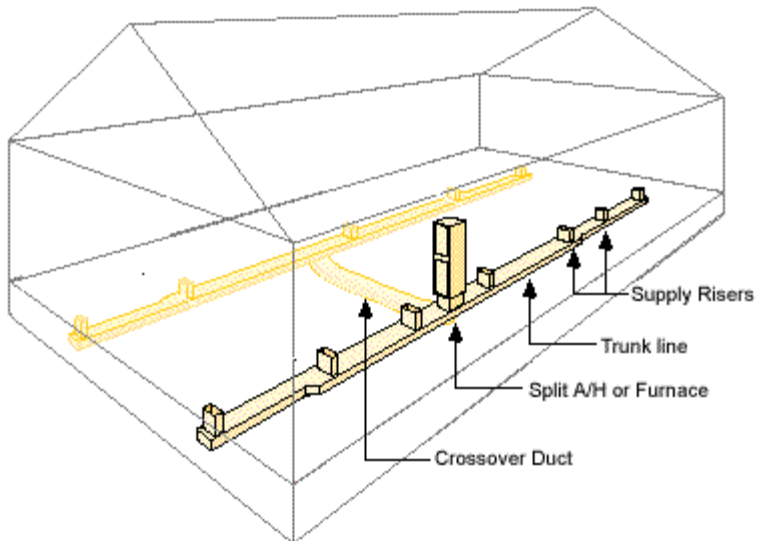
- The pilot was implemented during the period November 2018 to January 2019
- In all the pilot touched a total of 83 homes in three parks, with deep measures installed in 15 homes
- The pilot applied a broad mix of measures to test their viability specific to the manufactured homes environment
- The implementation process took a two phased approach, with the first phase implementing simple, easy to install measures, and the second phase installing more complex measures
- The pilot focused on properties constructed in 1995 or earlier, anticipating these would represent greater opportunities for savings
- The pilot served low-income customers as designated by the low-income census tract
- The pilot was offered at no charge to all participants

Michigan Manufactured Homes Physical Characteristics

Category	Description
Form Factor Types	Single wide (65%, n= 54), and Double wide (35%, n=29)
Roof	Many homes, particularly older homes do not have a cavity between the ceiling and the roof, or the size of the cavity is limited, compromising the installers ability to add additional insulation
Walls	Comprising 2" X 4" studs for newer homes, and in older homes 2" X 6" studs, with fiberglass wool insulation

Michigan Manufactured Homes HVAC System

- The design of the single wide home has duct work running down the center of the home, while double wide duct work takes an H shape with a crossover duct to distribute the treated air
- The air registers are located in the floor, with no air return ducting



Michigan Manufactured Homes HVAC System

Category	Description
Ducts	Duct sealing/leakage represents the single most effective opportunity for saving energy
	The air delivery system fails in multiple locations, and in particular at the connection between the duct work underneath the home and the floor register, allowing treated air to escape rather than enter the room above
	All homes fell short of the MEMD 6% leakage efficient case target for duct sealing, even after attempting fixes
	Air leakage sealing in the building shell is of limited usefulness unless combined with duct sealing
A/C	Cooling was provided independently of the duct system in the majority of cases

Pilot Implementation Process

- DTE contracted SEEL to implement the pilot
- Customers were recruited primarily by phone and through the distribution of printed marketing materials
- Customers were provided with a 1-800 number for information and registration
- A call center was available for customers to verify the legitimacy of the program, and to schedule appointments
- Customers were consistently informed the program was free, and informed of the purpose and estimated duration of the home visit

Measures Implemented

Category	Description
Lighting	9 watt, 11 watt and 17 Watt replacement LEDs, Candelabra, Nightlights and Outdoor lights
Water	Bathroom & Kitchen aerators, Low-flow showerheads (incl. hand held) (1.5 GPM), Pipe Wrap
Infiltration and Insulation	Caulking, Roof Insulation, Belly Insulation
HVAC	Duct Sealing, Furnace Tune-ups (including filter replacement), Tier 1 T-Stats

Measure End Use Opportunity

Category	Measure	Level of Opportunity	Comments
Lighting	9 watt	Medium	
	11 watt	Low	Existing CFL installed
	17 watt	Low	Existing CFL installed
	Candelabra	Medium	Fewer Candelabra options (ceiling fans)
	Outdoor	Low	
	Nightlights	Medium	Substitute from low wattage incandescent bulb
	Water	Aerators	High
Low-flow Showerheads		High	
Pipe Wrap		Low	Already implemented to avoid freezing pipes

Measure End Use Opportunity(continued)

Category	Measure	Level of Opportunity	Comments
Infiltration & Insulation	Caulking	High	
	Roof Insualtion	Medium	Limited by available cavity
	Belly Wrap	High	Underfloor access challenges
HVAC	Duct Sealing	High	Poor construction and sealing
	Tune-Ups	High	No regular maintenance
	T-Stats	High	Not Educated in value of programming

Cost Effectiveness Based on Current MEMD Savings

The pilot as fielded proved costly as compared to DTE's highest cost program, the Energy Efficiency Assistance Low-income program

Relative Cost Effectiveness	Measure	Comments
Low	Roof Insulation & Belly Wrap	Access challenges, complex install
Medium	Lighting	CFLs installed for higher wattages, better for candelabras/night light
	Caulking and Infiltration	Test-in/Test-Out procedure costs
	Duct Sealing	Accessibility and deemed savings
High	T-Stats	Validation of set-back compromises savings (IRAF)
	Tune-ups	
	Pipe Wrap	Few install options as already addressed by customer

Pilot Results, Averaged to Individual Home

MWH Savings	MCF Savings	AVERAGE COST
0.486 MWH	20.7 MCF	\$2,838

Results based on Phase 1 and Phase 2 measures combined for 15 homes

- Reflects best case opportunity to save (market opportunity) with available pilot portfolio mix of measures
- Economies of scale and process refinements can be expected to reduce costs

Other Considerations for Commercialization

Category	Description
Contractor Availability	Availability of contractors with the required skill set and experience specific to manufactured homes presents a challenge
Customer Engagement	Customers expressed some skepticism of the “free” offer Occupants were very time constrained, with inflexible work schedules. A high number of late cancelations compromised the install schedule
Installation Process	Proven to be both time consuming and somewhat complex due to restricted access for some of the measures Lengthy test-in and test-out procedures extended the duration of the install

Modelling Savings - Introduction

Modeling done using DOE-2.2 building energy simulation program for the Michigan, Detroit City Airport climate zone

MEMD manufactured home prototype modified based on pilot study results

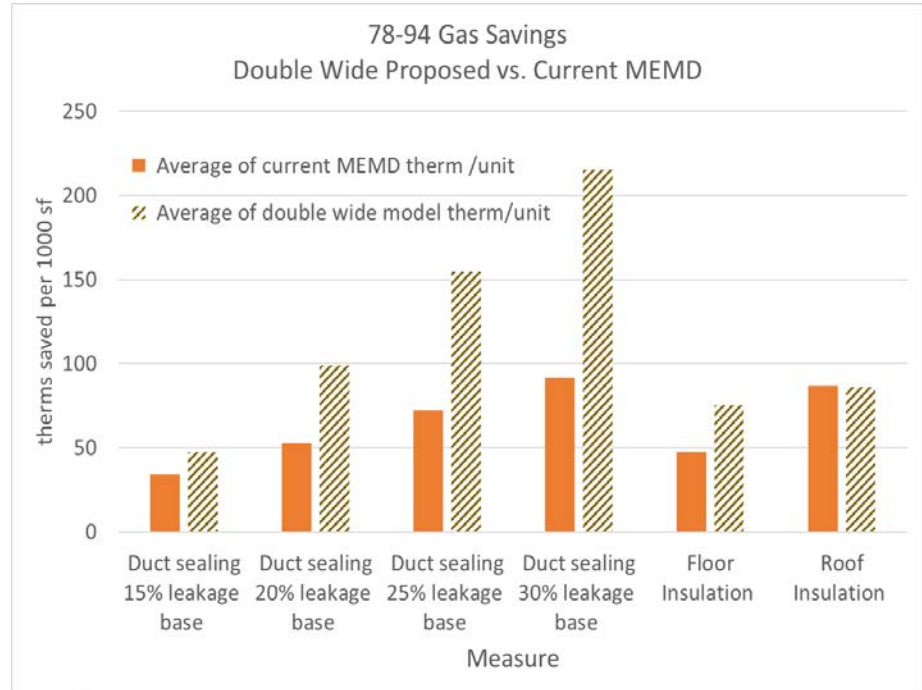
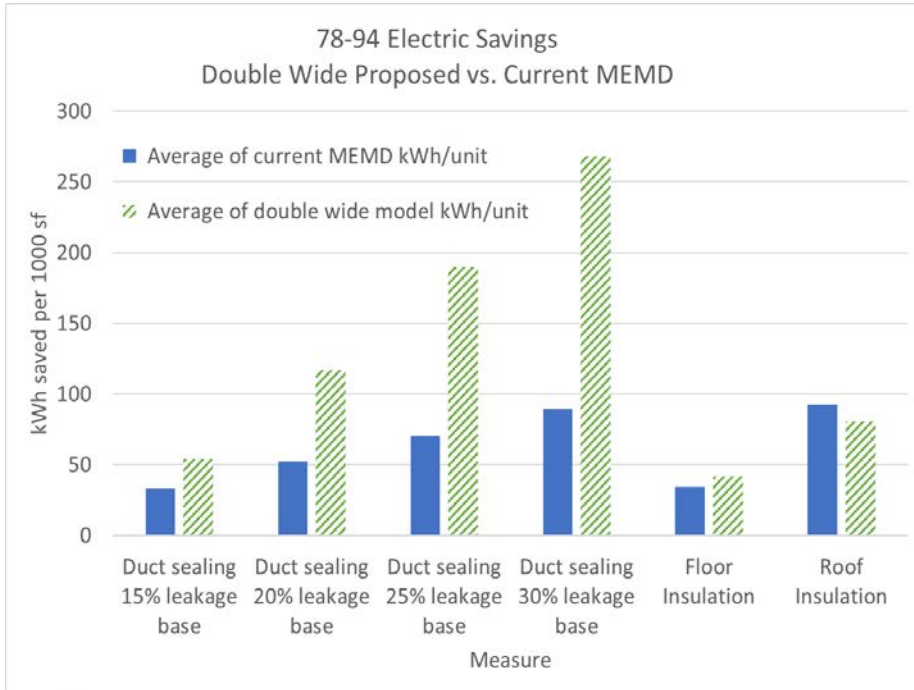
- Building characteristics data
- Energy consumption data

Most important modification was to duct system design assumptions

- Moved ducts from attic to belly
- Eliminated return ducts
- Supply leakage effects on infiltration

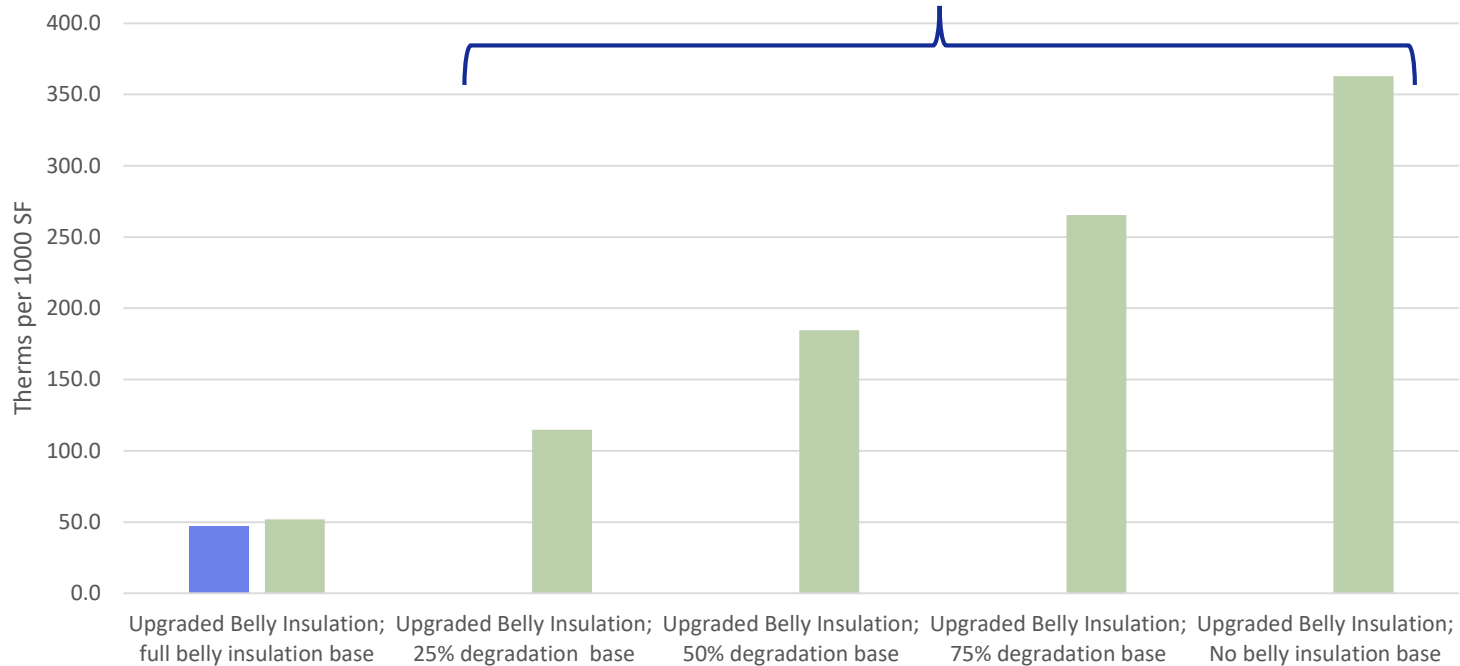
Also modeled belly insulation at various baseline coverage levels

Modified Electric and Gas Savings, Original MEMD vs. Revised for 1978-1994 vintage. Savings is higher for most measures, as indicated



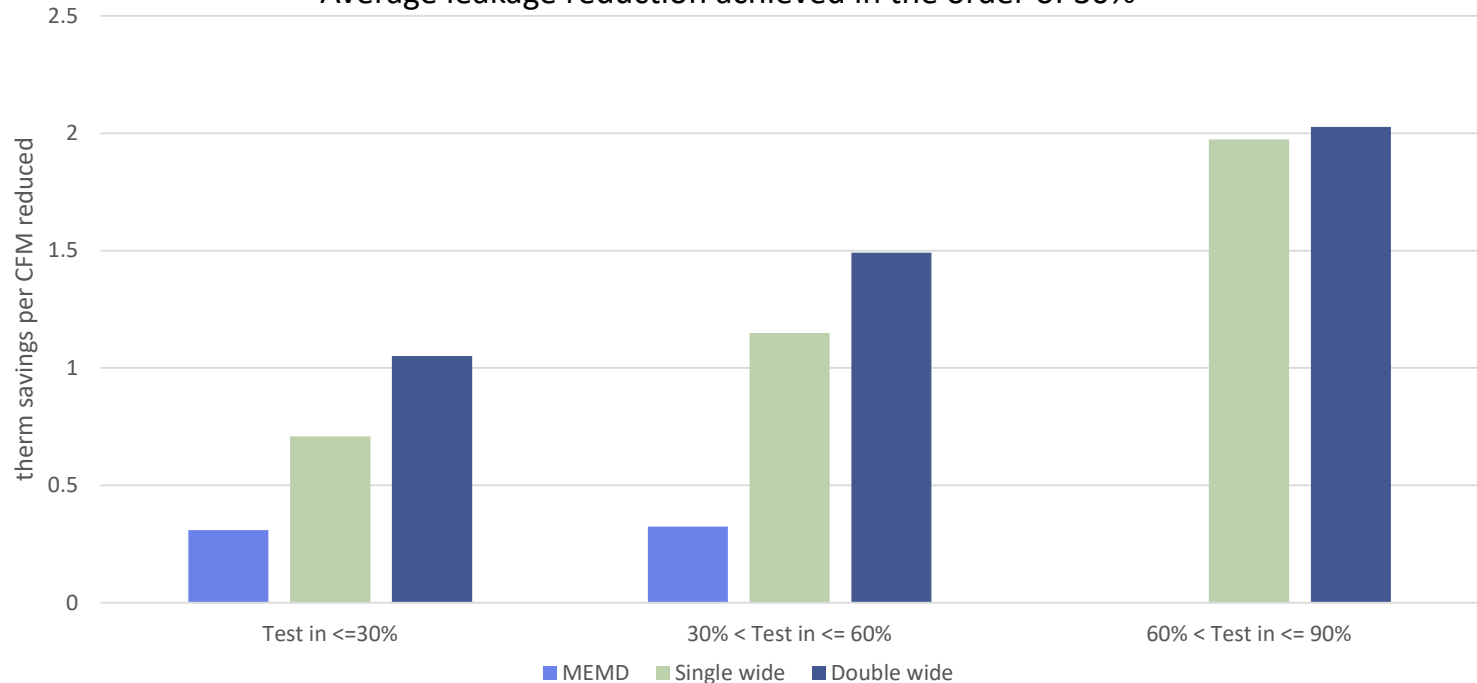
Single Wide Model Belly Insulation Therm Savings Comparison 78-94 Vintage

New measure accounting for baseline insulation degradation



Manufactured Home Duct Sealing Savings Per CFM Reduced 78-94 Vintage

Majority of homes found to have test-in duct leakage in the 30% to 55% range
Average leakage reduction achieved in the order of 30%



Next Steps

- In process: Utilize pilot field data to modify 2020 MEMD as modelled for the Michigan single-wide and double-wide manufactured homes vs. the current savings allocation based on a single size, similar to the double-wide home
- Pending: Consider opportunities to apply deemed savings values, reducing installation measurement and validation costs, and explore opportunities to simplify installation process and utilize greater economies of scale

Questions and Feedback?