# Baseline Housing Study – Results Discussion

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**TRC** 

CADMUS



MORGAN MARKETING PARTNERS

DTE



# Agenda



# **Background & Overview**

# 2018

## Identified Need for the Study

 Review of program implementer data and other TRMs

## Identified Key Characteristics

- Envelope
- Heating and cooling
- Water heating

## **Sample Stratification**

- By climate zone
- By home type
- By income

# 2019

## **Completed Pilot Phase**

- Collected data on 20 homes
- Analyzed results
- Presented results in July

#### **Began Main Phase**

 Collected data on 90 homes

# 2020

#### **Continued Main Phase**

- Added furnace metering
- Completed 50 visits in spring

# Lockdown halted study for six months

- Updated plan in July
- Completed 55 additional visits in August and September
- Data cleaning and prep
- Began thermostat logger
   retrieval



Source: www.energycodes.gov

# **Study Objectives**

- Characterize envelope and equipment efficiency in Michigan homes based on the age of the dwelling.
- Stratify the study sample across key parameters of interest including:
  - Climate zone (CZ-5, CZ-6) of the lower peninsula (Note: The MPSC commissioned a separate study of the upper peninsula)
  - Home type (single family and multifamily)
  - Household income (<\$40,000 and >\$40,000/year)
  - Home ownership (own and rent)
- Propose an update or alternative to the vintage schema in the MEMD (via a whitepaper).
- Recommend EWR program implementer data collection protocols to ensure all critical data points are captured.

# **Field Visit Results**

DRAFT RESULTS ARE UNWEIGHTED AND INTENDED FOR INFORMATIONAL DICUSSION





# 93

Single family detached homes (101% of target)

102

Multifamily attached homes (91% of target)

# 180

Thermostat loggers deployed (98% of target)

# 54

Furnace monitors deployed (87% of target)



# Inspected

324 heating systems198 cooling systems238 thermostats188 water heaters45 dehumidifiers

# Measured

176,000 sq. ft. of attics and ceilings
244,000 sq. ft. of above grade walls
96,000 sq. ft. of foundation walls
2,116 windows and doors

# Multifamily homes have a lower rate of high-efficiency heating. Nearly half of single family homes in Climate Zone 6 have high-efficiency heating.



Climate Zone 5 (n=36)



#### Single Family Fuel Fired Efficiencies by Climate Zone



#### **Central Cooling Efficiency by Percentage of Sampled Systems**

# The majority of central cooling systems in Climate Zone 5 are 11 SEER or lower. High-efficiency cooling is uncommon across all strata.





## 11

#### Thermostat Types by Percentage of Sampled Thermostats



Manual thermostat are by far the most common type installed. Single family homes have a higher rate of advanced thermostats.

## Heating Trends from Thermostat Logger Data

- Indoor temperature will lag setpoint.
- 43% of thermostats monitored indicate a greater than 2°F differential, indicating a setback.

| Thermostat Type      | Average Temperature Difference |
|----------------------|--------------------------------|
| Smart<br>Thermostats | 2.0°F (n=4)                    |
| Web-Enabled          | 2.0°F (n=3)                    |
| Programmable         | 3.2°F (n=24)                   |
| Manual               | 1.6°F (n=25)                   |



## **Cooling Trends from Thermostat Logger Data**

- Indoor temperature will lag setpoint.
- Homes with programmable and manual thermostats show similar cooling patterns.

| Thermostat Type      | Average Temperature Difference |
|----------------------|--------------------------------|
| Smart<br>Thermostats | 3.0°F (n=4)                    |
| Web-Enabled          | 2.9°F (n=3)                    |
| Programmable         | 2.5°F (n=14)                   |
| Manual               | 2.4°F (n=15)                   |



# Older homes have more effective insulation than the MEMD assumes. Newer homes have less effective insulation than the MEMD assumes.

40 Old Existing New 35 Effective Insulation (R-Value) 30 25 20 15 10 5 ..... ..... 0 1840 1860 1880 1900 1920 1940 1960 1980 2000 2020 Year Built (n=172 households) Field Data Effective R MEMD Effective R

Effective Insulation Level Compared to MEMD

\*Note: Effective insulation values include known, rim and band joists, walls, floors, foundations, and ceilings and construction characteristics. MEMD insulation levels are estimated from 2021 weather sensitive documentation.

#### Effective Insulation of Sampled Homes by Household Income

# Moderate correlation between homes' effective insulation levels and age. No significant correlations found between insulation levels and household income.



\*Note Effective insulation values of known, rim & band joints, walls, floors, foundations, and ceilings with construction characteristics.

#### **Effective Insulation of Sampled Homes by Home Ownership**

# Renters are more common in multifamily homes, which limits comparisons. No significant correlations found between insulation levels and home ownership.



Single Family Effective Insulation Amounts by Owners and Renters



#### Effective Insulation of Sampled Homes by Climate Zone

## Newer multifamily homes in Climate Zone 6 indicate increasing insulation levels. Single family homes in Climate Zones 5 and 6 show similar trends.



Multifamily Heating Efficiency by

# Income does not clearly correlate to heating efficiency. Higher income single family homes have more high-efficiency heating systems.



#### Single Family Heating Efficiency by Household Income



# Multifamily homeowners have a higher rate of high efficiency heating. Single family homeowners and renters have similar heating efficiency.

#### Multifamily Heating Efficiency by Home Ownership



Owner (n=26)
 Renter (n=43)

#### Single Family Heating Efficiency by Home Ownership



Owner (n=76)
 Renter (n=11)

# **Conclusions, Recommendations** & Next Steps

# Conclusions

- The year of construction is one of the stronger drivers for energy efficiency
- Homes are exceptionally variable; there is no "typical" home
- Opportunity for electric savings in homes with room air conditioners
- The MEMD overestimates thermostat setbacks, which
  may underestimate savings
- The MEMD overestimates cooling efficiency, which may underestimate electric savings
- The MEMD underestimates heating efficiency, which may overestimate gas savings
- The MEMD overestimates older home insulation and underestimates newer home insulation

# **Recommendations**

#### Update parameter values in the MMED home vintages

- Home envelope characteristics including insulation levels
- HVAC types to incorporate room cooling
- HVAC efficiencies, especially among existing homes
- Thermostat setpoints using thermostat logger data

#### Modify baseline characteristics for envelope upgrades

- Update measure baseline characteristics to align with study findings
- Consider additional tiers of baseline conditions for home insulation upgrades
  - Could require additional QC from evaluators and implementers
- Consider including measures that target newer homes Adjust data collection procedures for program implementers
- Align with updated MEMD

# **Next Steps**



# Thank you, questions?

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#### ATTIC







#### KNEEWALL

Kneewall missing insulation Stacked insulation batt Multiple insulation types



#### RIM JOIST

Conditioned basement (unfinished) Uninsulated rim joist Plumbing penetrations unsealed





#### CRAWLSPACE

Unconditioned crawlspace Zero insulation Floor not insulated Crawlspace walls not insulated







#### BASEMENT WALL

Conditioned basement (unfinished) Uninsulated rim joist Missing wall insulation Unsecured wall insulation



