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Michigan Upper Peninsula Housing Baseline Study

June 15, 2021

AGENDA

Introduction

Methodology

Summary of Results

- Descriptive Characteristics Example
- Representativeness of Sample
- General Comments on Building Stock
- Vintage Analysis

Conclusions

PRESENTERS

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Introduction

Characteristic	Research Objective
Home Vintage	Gather descriptive data regarding home vintage
Equipment Efficiency	Identify the typical equipment efficiency levels in residential homes
Building Envelope	Illustrate the average building envelope characteristics for residential dwellings in the Upper Peninsula
Building Type	Include representative samples of single family and multi-family dwellings

- The baseline efficiency of existing homes is the foundation for the deemed energy savings calculations in the Michigan Energy Measures Database (MEMD).
- The overall objective of the study is to collect descriptive characteristics that will inform the assumed baseline and energy savings calculations.

Sampling Plan

Weather Zone	Building Type	Segment Sample	Total Sample
Weather Zone 6	Single Family	70	140
	Multi-Family	70	
Weather Zone 7	Single Family	70	140
	Multi-Family	70	

Methodology

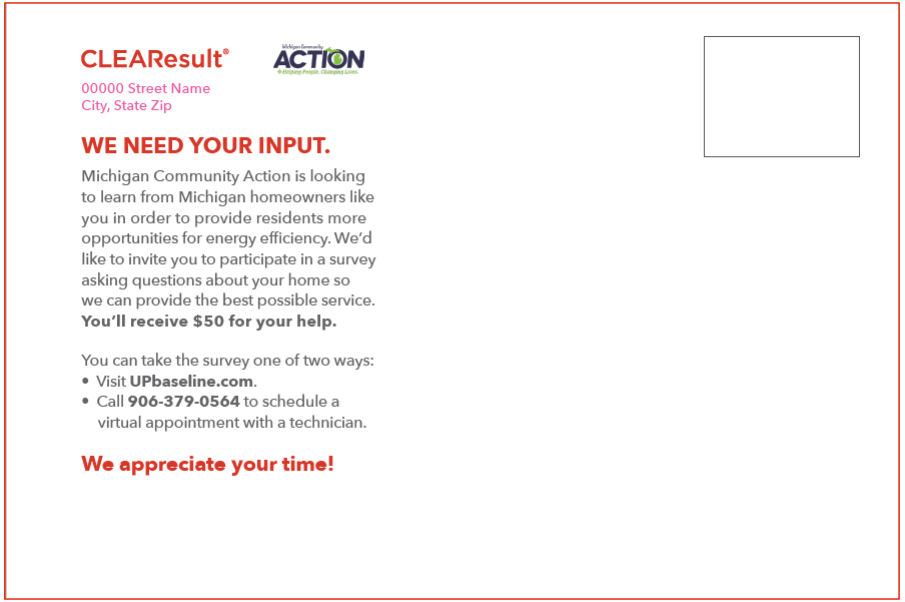
- Obtain a **UP residential dataset** to be the sample frame
- Experian Consumer Marketing Database

- Prepare a **direct mail instrument** to recruit study participants
- Offer incentive for telephone survey / virtual audit

- **Select random addresses** from the residential dataset to promote the offer
- **Mail postcard** to random sample of population

- **Conduct virtual audit**
- Technician led telephone call or Streem virtual audit (with video feed)

Direct Mail Instrument



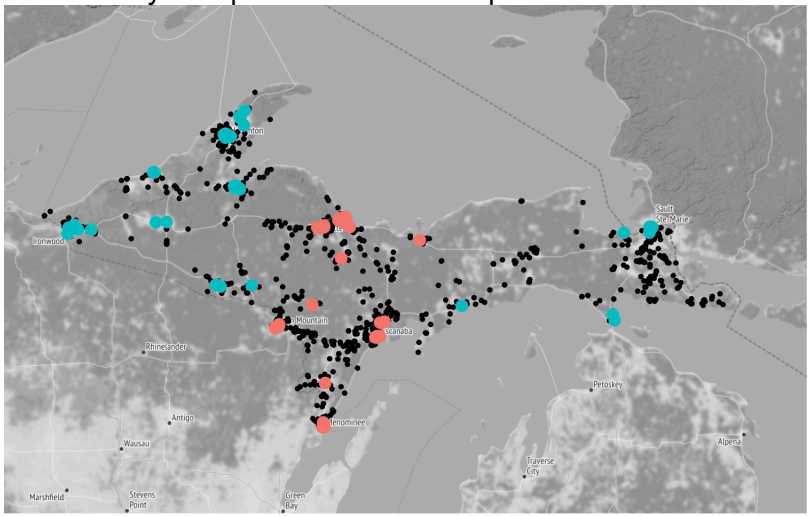
Completed Surveys

Weather Zone	Building Type	Target Sample	Actual Sample
Weather Zone 6	Single Family	70	75
	Manufactured		11
	Multi-Family	70	72
Weather Zone 7	Single Family	70	70
	Manufactured		24
	Multi-Family	70	61
	Total	**280**	**313**

- Experian data does not differentiate between site-built and manufactured homes
  - We collected data when manufactured home residents responded
- Participants strongly preferred telephone calls over Streem video calls
  - Only 5 video audits were completed

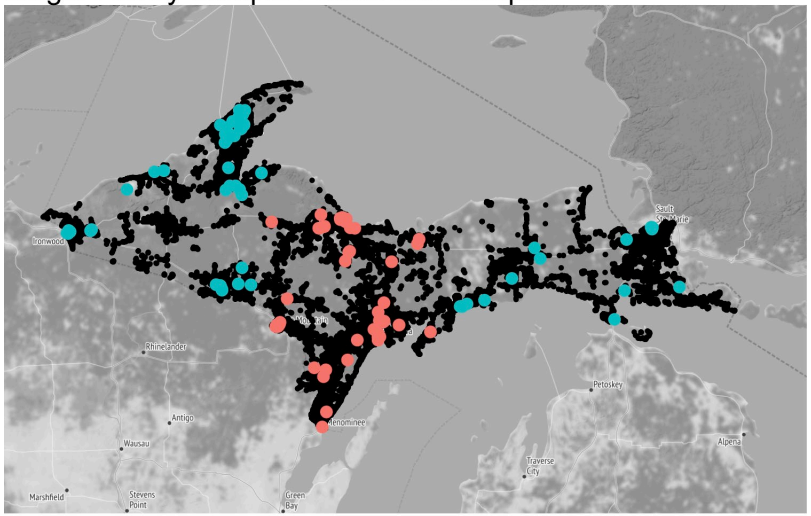
Sample Frame and Sample Mapped

Multi-Family Sample Frame and Sample



Climate Zone
- 6
- 7

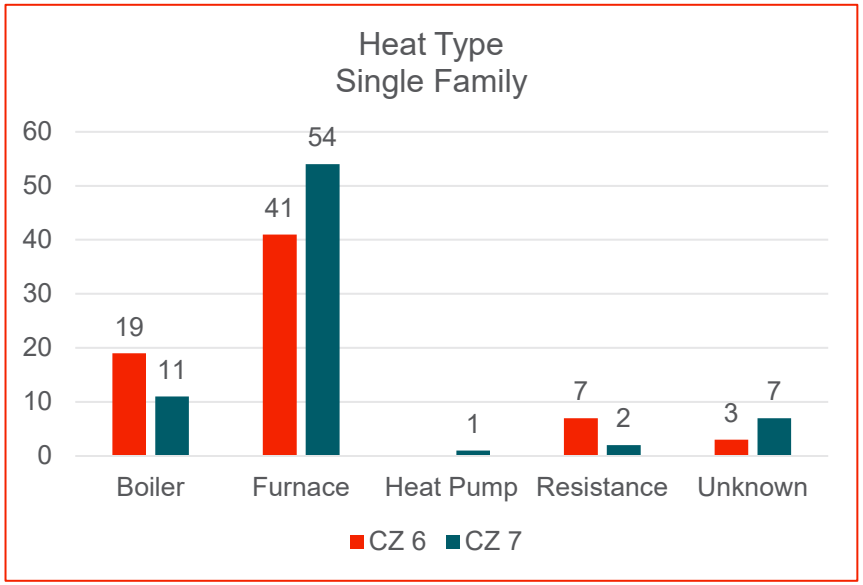
Single-Family Sample Frame and Sample

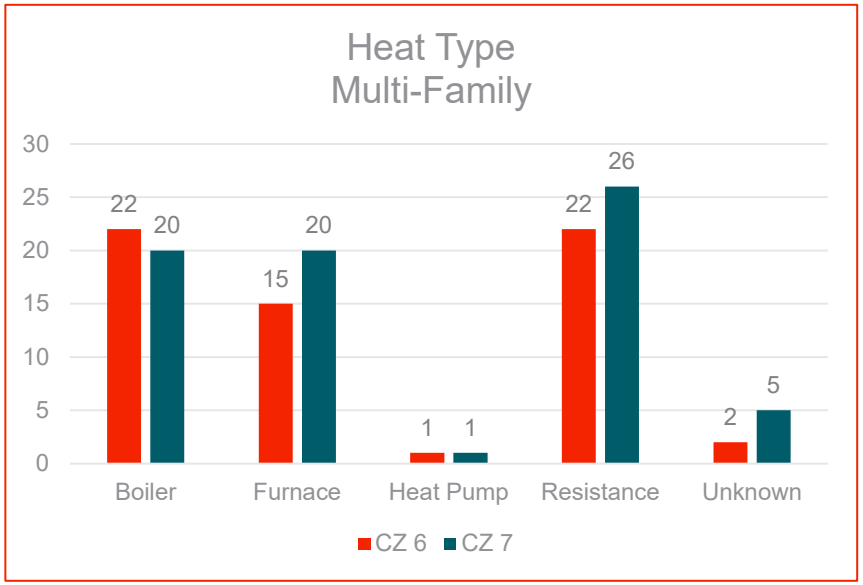


Climate Zone
- 6
- 7

Descriptive Characteristic Example: Heat Type

- Typical summary in report by climate zone and building type





Representativeness of Sample

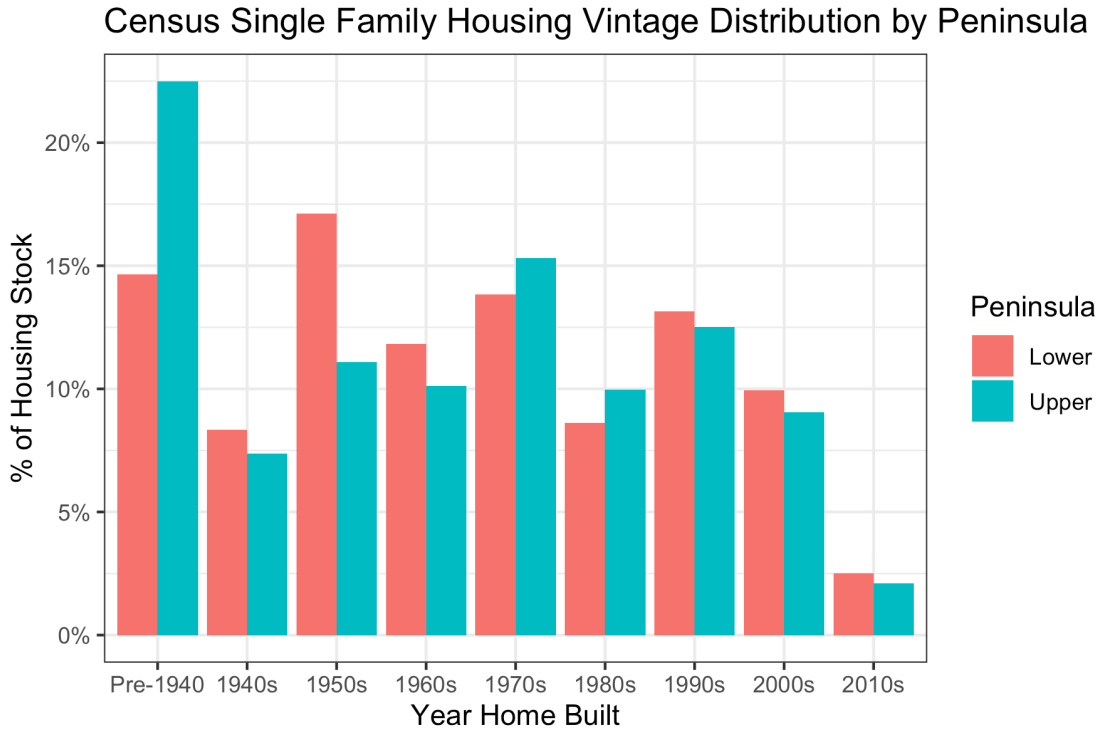
- Study distributions were compared to US Census* distributions for five attributes
  - Year built
  - Primary / Secondary home
  - Heating fuel
  - Household income
  - Owner / Renter status

- Note: ACS categories align to decade boundaries. Comparisons use slightly modified bins

Cadmus Proposed Bins	Bins Used for Comparisons
Through 1978	Through 1979
1979-1997	1980-1999
1998-2015	2000-2015
2016-current	2016-current

* 2015-2019 ACS 5-year Public Use Microdata Sample

General Comments on Building Stock



Representativeness of Sample

- Vintage distribution
  - Single family sample has more older homes than Census
  - Multi-family sample is closer

	Single-Family		Multi-Family	
Vintage Bin	Sample	Census	Sample	Census
Through 1979	81%	66%	58%	65%
1980-1999	9%	22%	30%	23%
2000-2015	10%	11%	9%	12%
2016-current	1%	<1%	2%	<1%

- Secondary / Seasonal Homes
  - UP has a large proportion of seasonally occupied homes
  - Sample did not find these homes
    - Study timing: October-February
    - Experian sample frame did not include most seasonal homes

	Single-Family		Multi-Family	
Description	Sample	Census	Sample	Census
Occupied Full Time	99%	66%	100%	80%
Occupied Seasonally	1%	27%	0%	4%
Vacant	-	7%	-	16%

Representativeness of Sample

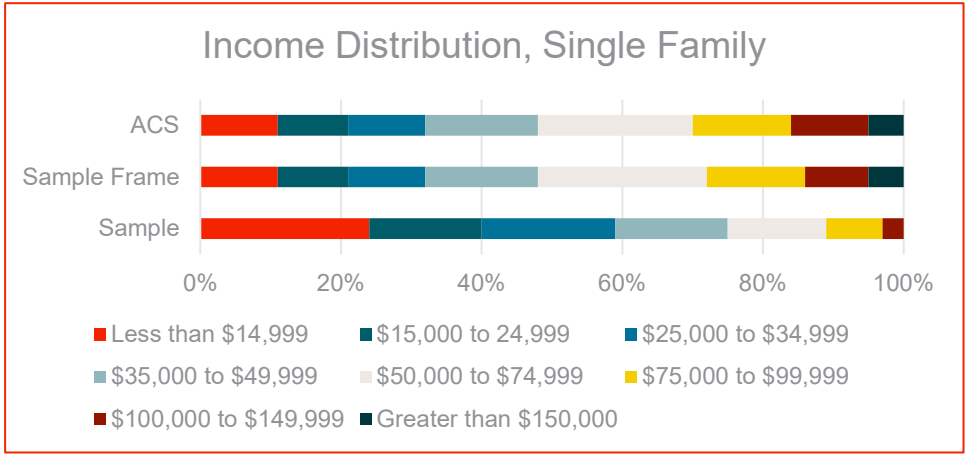
Heating Fuel	Single-Family		Multi-Family	
	Sample	Census	Sample*	Census
Utility Gas	76%	56%	57%	58%
Delivered Gas	14%	23%	0%	2%
Wood	0%	11%	0%	<1%
Electricity	7%	6%	42%	35%
Fuel Oil	3%	3%	0%	<1%
Other/None	0%	1%	0%	5%

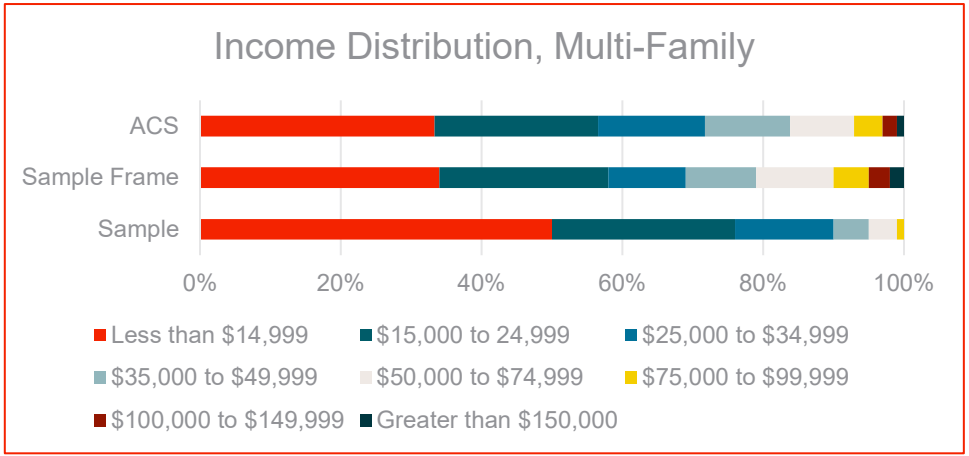
- Heating fuel distribution
  - For single family homes, large differences between sample and Census for top three fuels
    - More utility gas in sample and less delivered gas (propane)
    - No use of wood reported--survey asked about **primary** heating fuel only
    - Data sufficiency filter removed some newer and more dispersed homes from the sample frame
  - For Multi-family homes, sample is consistent with Census

Representativeness of Sample

Income Distribution

- Skew towards lower income is expected with a cash incentive
- Census data shows households with higher incomes tend to live in newer homes
- May explain additional homes in the oldest vintage bin





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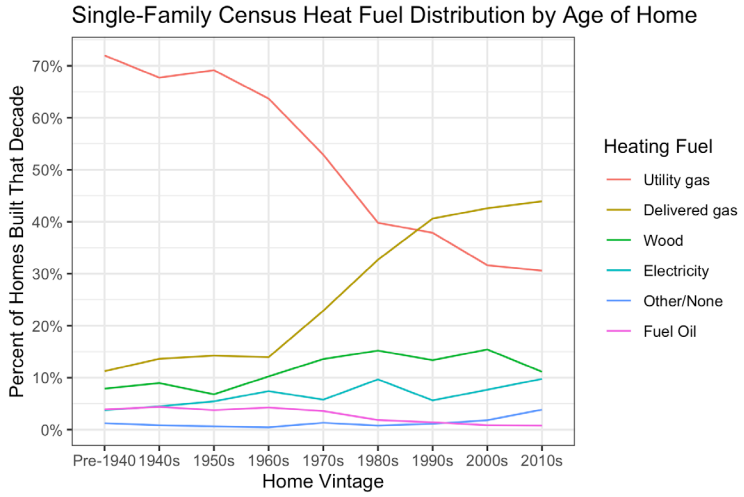
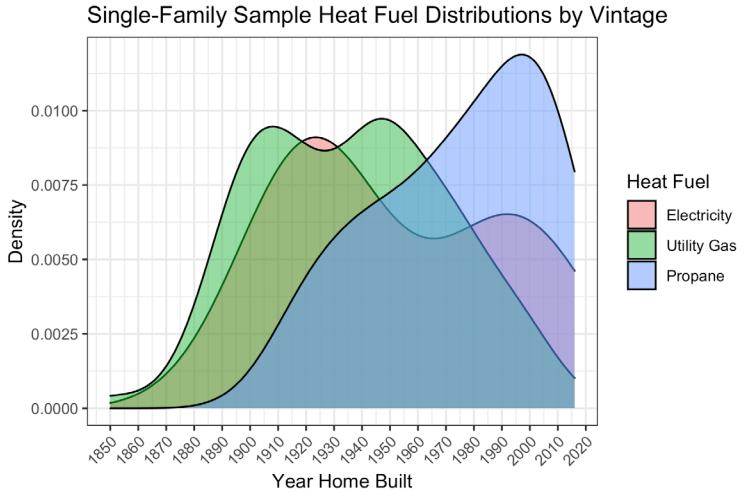
Vintage Analysis

- Is there evidence for UP-specific vintage bin boundaries or weighting?
  - Remote audits limited data collection on envelope R-values, heat loss, etc.
  - 81% of sample fell into oldest (pre 1979) vintage bin. Remaining sample is too small to verify boundaries of the three more recent (proposed) bins.
- Analyses focused on attributes relevant to construction / weighting of prototypes
  - A detailed look at heat fuel by vintage: comparison of Census to the sample
  - Exploratory analysis of other attributes

Vintage Analysis, Heat Fuel

- Proportion of utility gas declined starting in the 1960s
- Notable switch to propane gas spanning the 1970s to the 1990s.
- In the newest homes, propane is more common than utility natural gas.
- DHW fuel showed a similar pattern--increased propane for the newest homes--with a larger share of electricity
- Heat fuel mix has been changing since the 1960s; No specific shift ~1980





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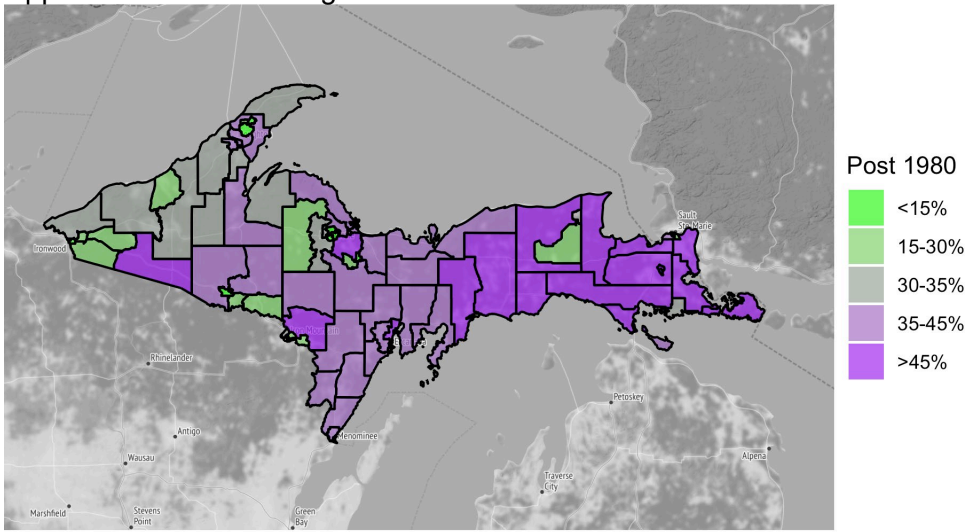
Vintage Analysis

- Why do newer homes have the most delivered fuel?
- Timing and location of new construction
  - More developed areas such as Houghton, Iron Mountain, Ishpeming have more of the oldest homes with most on natural gas
  - Post-1980 development is more dispersed and in areas that may not have utility gas

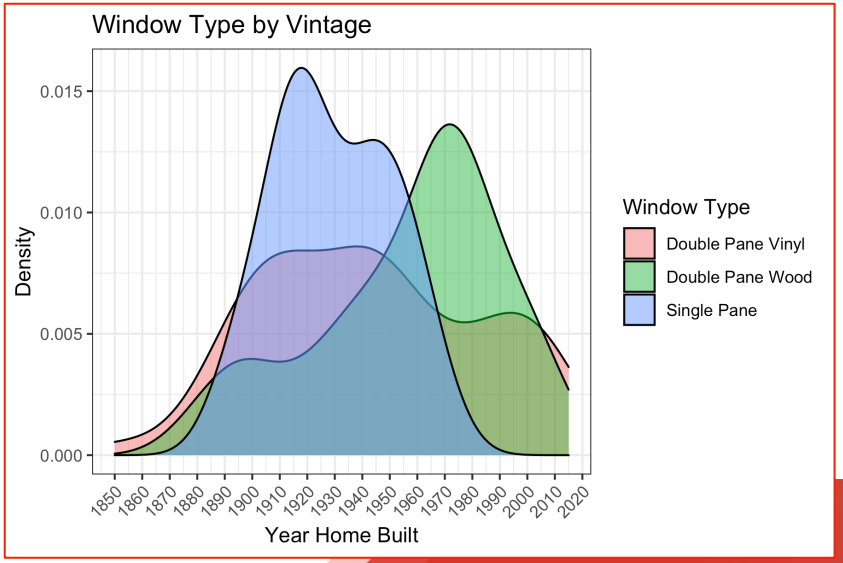
Upper Peninsula Housing Stock Built Post-1980 From Census



Vintage Analysis, Window Type

- Transition to all double pane windows appears to have happened around 1960
- Crossover from single pane to double pane wood around 1960.

Year Built	Double Pane Vinyl	Double Pane Wood	Single Pane Wood	Total
Pre-1940	29	11	14	**57**
1940s	12	1	2	**15**
1950s	1	3	3	**7**
1960s	2	6	1	**10**
1970s	4	7	0	**11**
1980s	2	2	0	**4**
1990s	6	2	0	**8**
2000s	5	3	0	**10**
2010s	1	0	0	**2**
Total	**62**	**35**	**20**	**124**



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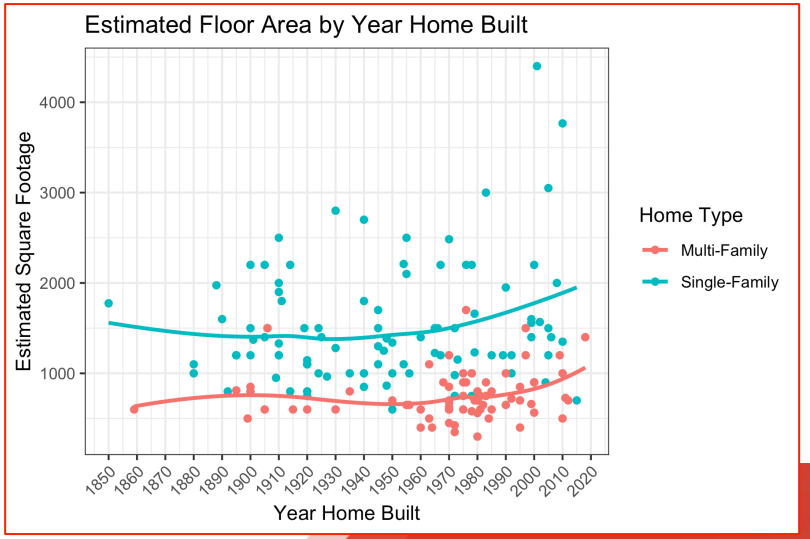
Vintage Analysis
Added Insulation, Floor Area

- Survey: Has insulation been added to attic, walls, or floor?
  - Table includes results for single family homes.
  - Supports 1980 as a boundary for changes in shell characteristics for single family homes
    - Built before 1980, 80% of such homes now have some kind of added insulation
    - Built after 1980, only 27% have added insulation

- Average home size has increased since 1980 for both single family and multi-family homes

Added Insulation	No	Yes	Percent Yes
Pre-1940	8	43	84%
1940s	2	12	86%
1950s	2	5	71%
1960s	2	6	75%
1970s	2	8	80%
1980s	3	1	25%
1990s	7	1	13%
2000s	6	3	33%
2010s	0	1	-
Total	**32**	**80**	**71%**



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Conclusions

- The housing stock of the UP features a high prevalence of older homes, seasonally occupied homes, and delivered fuels.
  - The multi-family housing sample resembled the overall building stock reasonably well.
  - The single-family housing sample appeared to have been skewed towards older homes and utility gas.
  - In both segments the occupants reported lower incomes on average than suggested by the Census for comparable dwellings.

- The offer of a cash incentive and use of Experian data for a sample frame created a bias for lower income households in relatively more urbanized settings
  - Larger deviations were observed for single family than for multi-family
  - The sample frame did not include most seasonal homes;
    October through February recruitment further reduced the response

Conclusions, continued

- In terms of vintage bin boundaries or weighting
  - Due to the age of the housing stock and the older skew of the sample, these data say very little about potential adjustments to the three post-1979 vintage bins.
  - In terms of the oldest vintage bin, even if the overall weighting may be similar between peninsulas, the UP contains a larger share of the oldest, pre-WWII homes. This could be considered in the development of prototypes.

- Although a video audit and a telephone audit were both offered, the vast majority of participants opted for the phone audit,
  - It should be noted going forward that the UP population was in general not amenable to remote video interactions via smartphone

Conclusions

- The survey did not ask about a secondary heat source. This may have contributed to the alleged lack of wood heat among the sampled homes.
  - Any subsequent effort would benefit from the inclusion of a survey question on secondary heat sources.

- In terms of recruitment success, the mailers achieved a 1.3% response rate for single-family (including manufactured who responded) and 0.4% for multifamily.
  - Any future efforts in the region can use estimated response rates around 1% for the purposes of planning and budgeting (higher for single-family, lower for multi-family).
  - Recruitment of multi-family was more difficult and necessitated repeated mailers to the same addresses.

