


## HUDSON PASSIVE TOWNHOMES

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## FEATURES

- Developer: Columbia County Habitat for Humanity, Hudson, NY
- Type: Three story, single family attached duplex
- Energy targets: Comply with Passive House criteria and certified under ENERGY STAR v3.0
- Design heating load: 6.7 kbtu/hr per unit
- Size: 1,614 sf per unit
- Construction costs: \$110 per sf
- Annual energy cost: \$1,211 per unit



## MATERIALS AND PRODUCTS

Item	Specification	
Slab	Neopor EPS R-55 under	
Foundation wall	R-52 Neopor EPS	
Above grade walls	Zip system on double stud with R-43 cellulose	
Roof	Main R-89 blown cellulose. Rear shed R-46 Neopor SIP	
Windows /doors	Intus triple pane overall (U-value 0.15; SHGC 0.62)	
Infiltration	0.58 ACH50	
Heating/cooling	Mitsubishi ductless heat pump 12 kBtu/hr, SEER 23, HSPF 10.5	
Ventilation	UltimateAir Recouperator ERV	
Water heating	Rheem Marathon Electric tank EF 0.93	

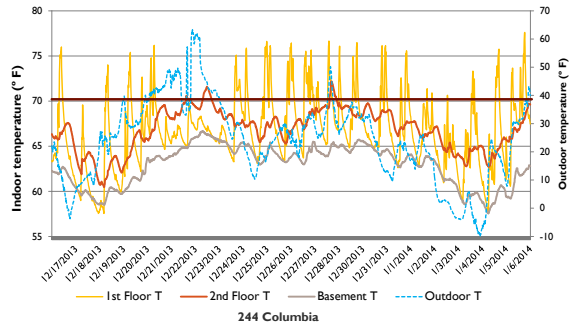
## CHALLENGE

- In low-load homes, homeowners doing what seems like the right thing can actually undermine energy performance and reduce comfort.



## THE ISSUE

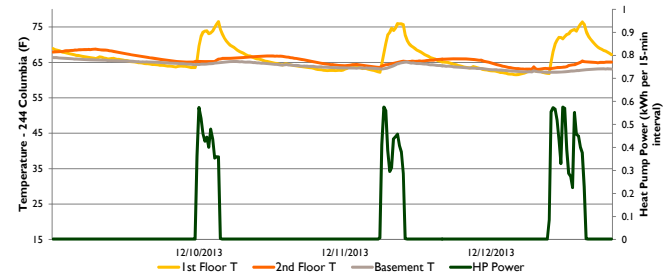
- Intermittent operation of the single-head mini-split heat pump caused wide temperature swings



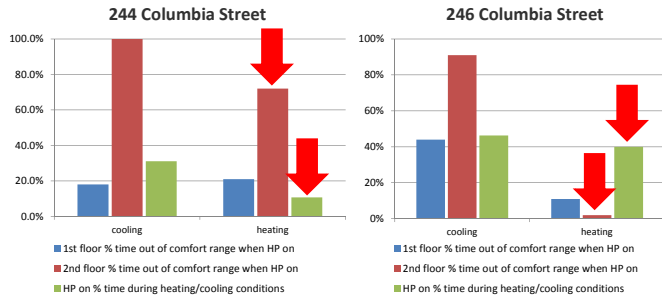
## HEAT PUMP OPERATION - UP CLOSE

- Intermittent equipment operation keeps the indoor temperature from stabilizing

Conditions 244 Columbia	Time total (%)	Time on during load (%)
Cooling (OAT > 70°F)	6.6	31.1
Heating (OAT < 50°F)	70.1	10.7
Overall	76.7	12.4



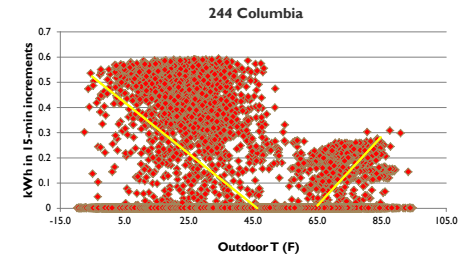
## COMFORT IMPACTS



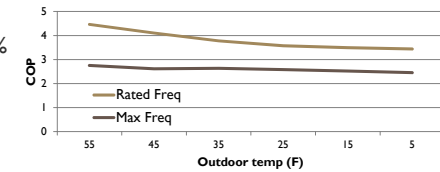
- Running more frequently addresses this issue with small impact on overall energy use

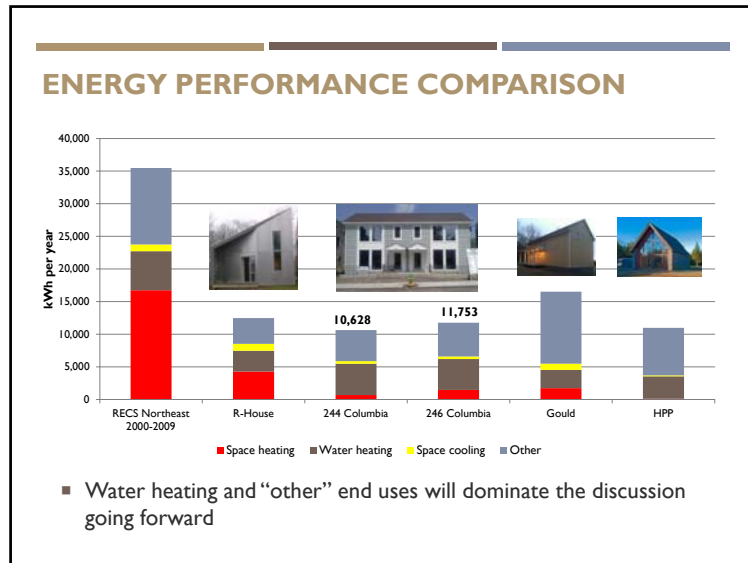
## IMPACT ON OPERATING EFFICIENCY

- Operating mini-split intermittently forces it to run at maximum capacity much of the time, reducing overall efficiency



- At maximum power COP decreases 30-40%





- ### CONCLUSIONS AND NEXT STEPS
- **Conclusions**
    - ◆ Low-load homes with low-capacity equipment can be more sensitive to unpredictable operation
    - ◆ As heating and cooling loads are minimized, home operation plays a larger role in total energy use. “Other” loads begin to dominate energy use suggesting the need for home owner education.
  - **Research needs**
    - ◆ How can design mitigate potential comfort problems? i.e., location of heat pump; overall floor plan configuration.
    - ◆ Can other distribution methods improve comfort? i.e., transfer fans
    - ◆ Can natural ventilation be relied upon to improve cooling comfort?

### QUESTIONS?

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