

# Energy Analysis for Navajo Housing Prototypes

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# Heating Fuel Cost

Propane is twice as expensive as electricity

Electricity is \$0.074/KWH

With electric heaters = \$0.022/Kbtu

Propane is \$3.50/Gallon

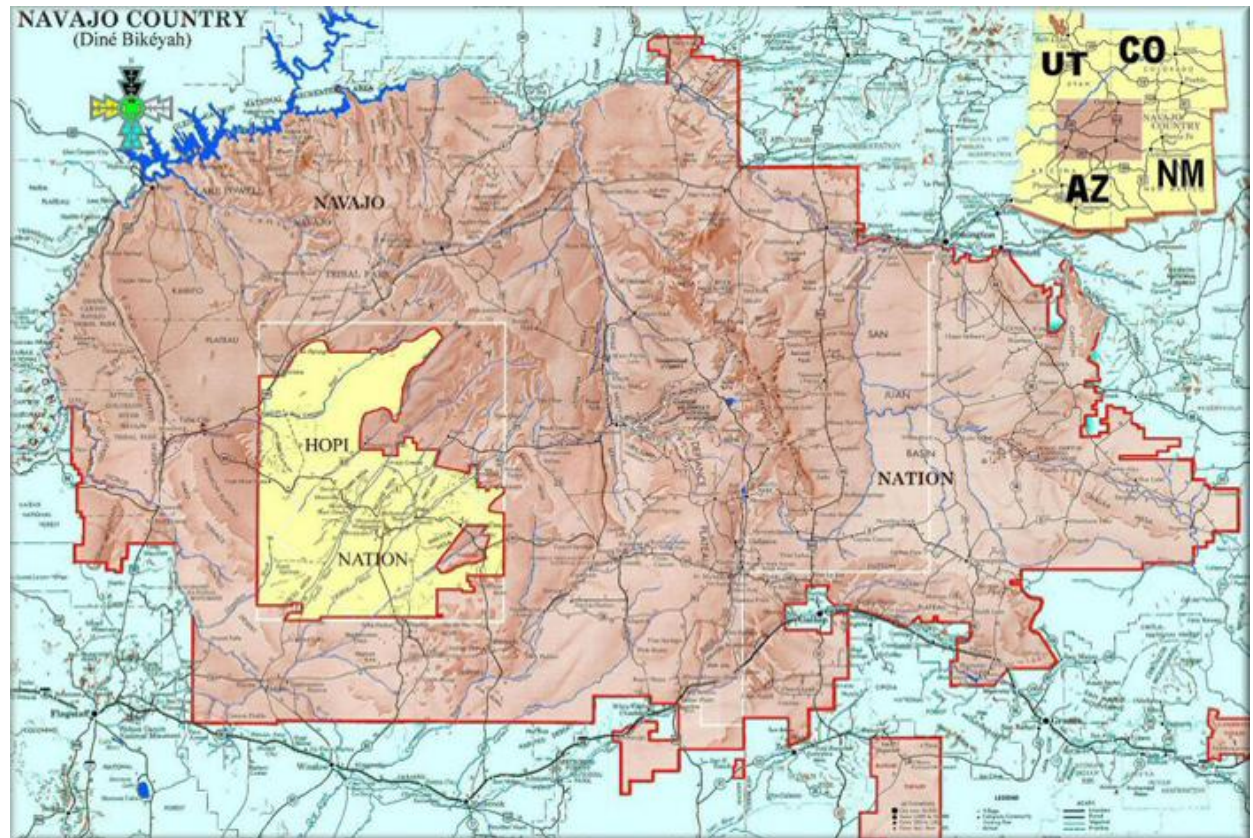
With propane furnace = \$0.045/KBtu

# Climate – Weather Files

Gallup NM  
•Ft. Defiance  
•Crown Point

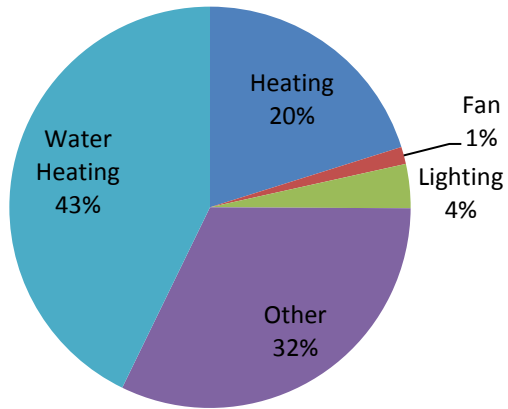
Farmington NM  
•Shiprock  
•Chinle

Page AZ  
•Tuba City

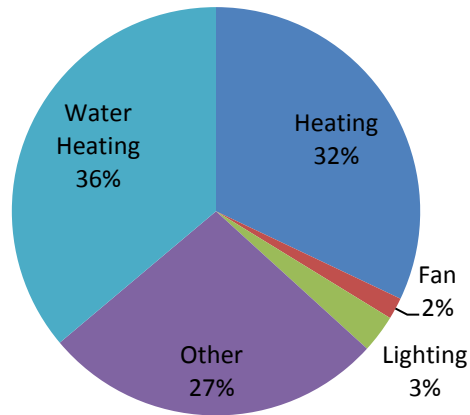


# Energy Use Breakdown

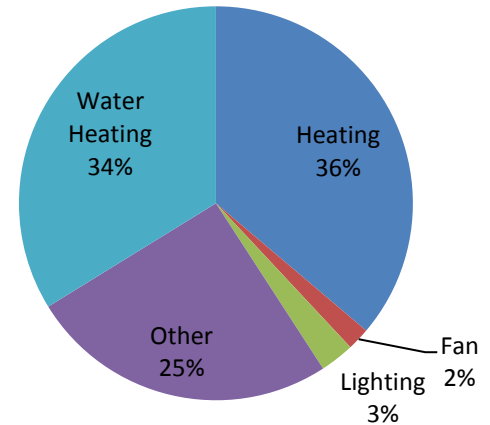
## Page



## Farmington



## Gallup

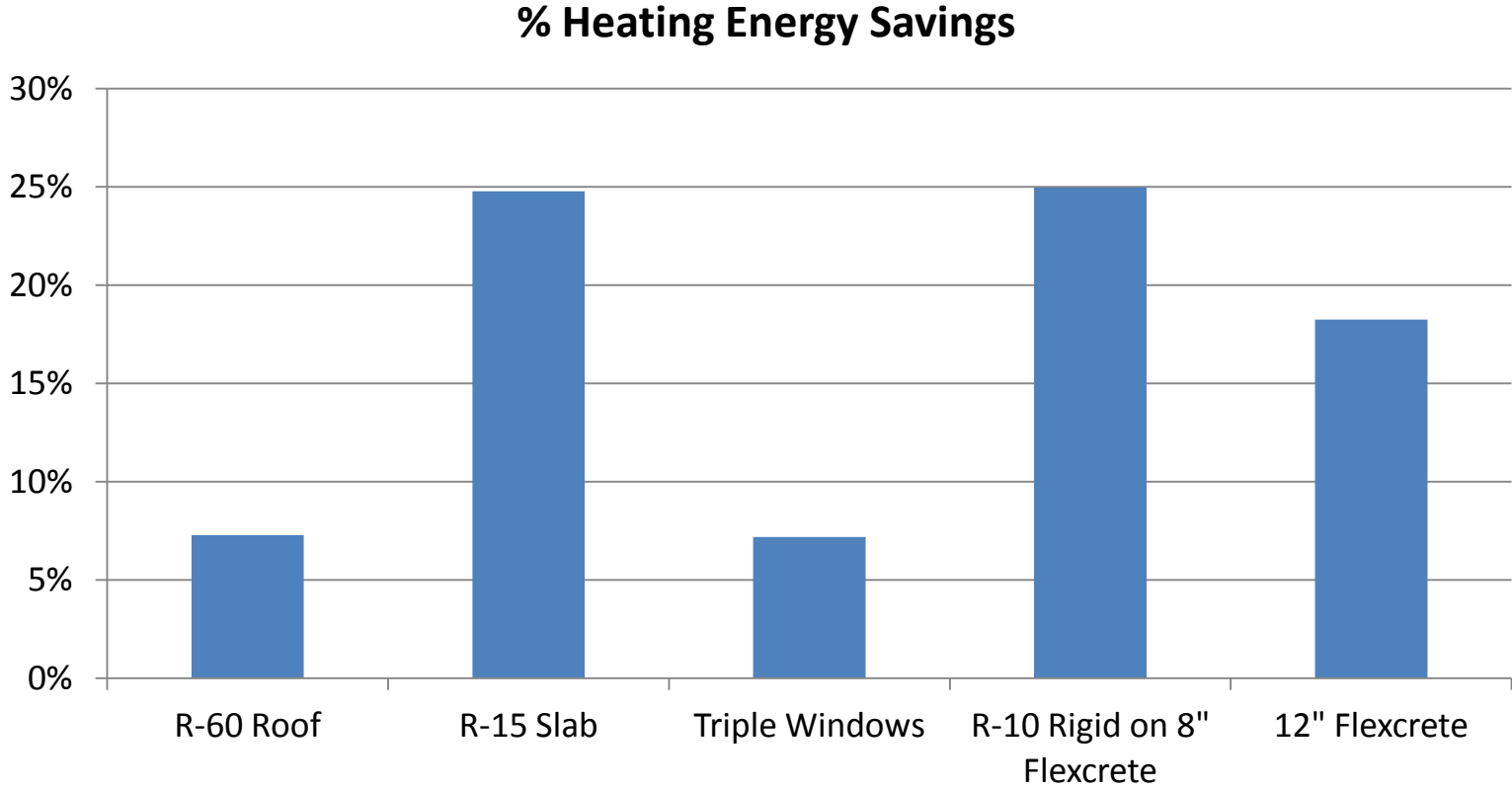


## Oak Prototype

# Envelope Measure Descriptions

- Walls:
  - Add 2-3" Rigid exterior insulation to 8" Flexcrete
  - 12" Flexcrete
- Windows: Upgrade the windows to triple pane; minimum U-value 0.22Btu/hr/SF/F.
- Slab: R-15 under-slab & perimeter insulation.
- Roof: Increase the attic insulation level to reach R-60.

# Average Heating Savings for Each Envelope Measure

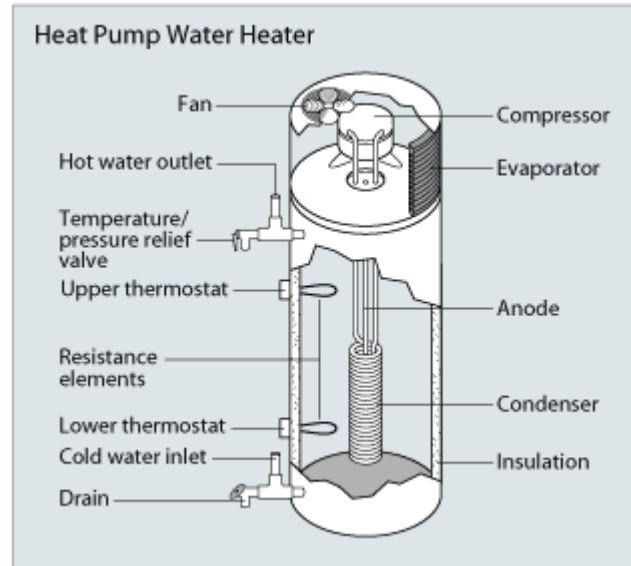


# HVAC Measure Descriptions

- Heating System:
  - Zonal electric heaters in lieu of propane furnace.
  - Ductless heat pump with electric back-up in bedrooms.
- Water Heating System:
  - Electric tank  $EF=0.93$  in lieu of propane hot water.
  - Heat pump water heater.

# Heat Pump Water Heater

- Locate in exterior closet
- Exhaust house to closet, closet to outside
- Includes electric back-up
- Cuts water heating in half
- \$1000 increase in total cost





# Ductless Mini-Split Heat Pumps (DHP)



## Manufacturers:

- Mitsubishi
- Daikin
- Sanyo
- LG
- Fujitsu

## Equipment:

- Indoor Unit
- Outdoor Unit
- Back-up electric in bedrooms



Provides heating and cooling.

Cuts heating bill by factor of 3.

\$2000 Increase in installation cost.

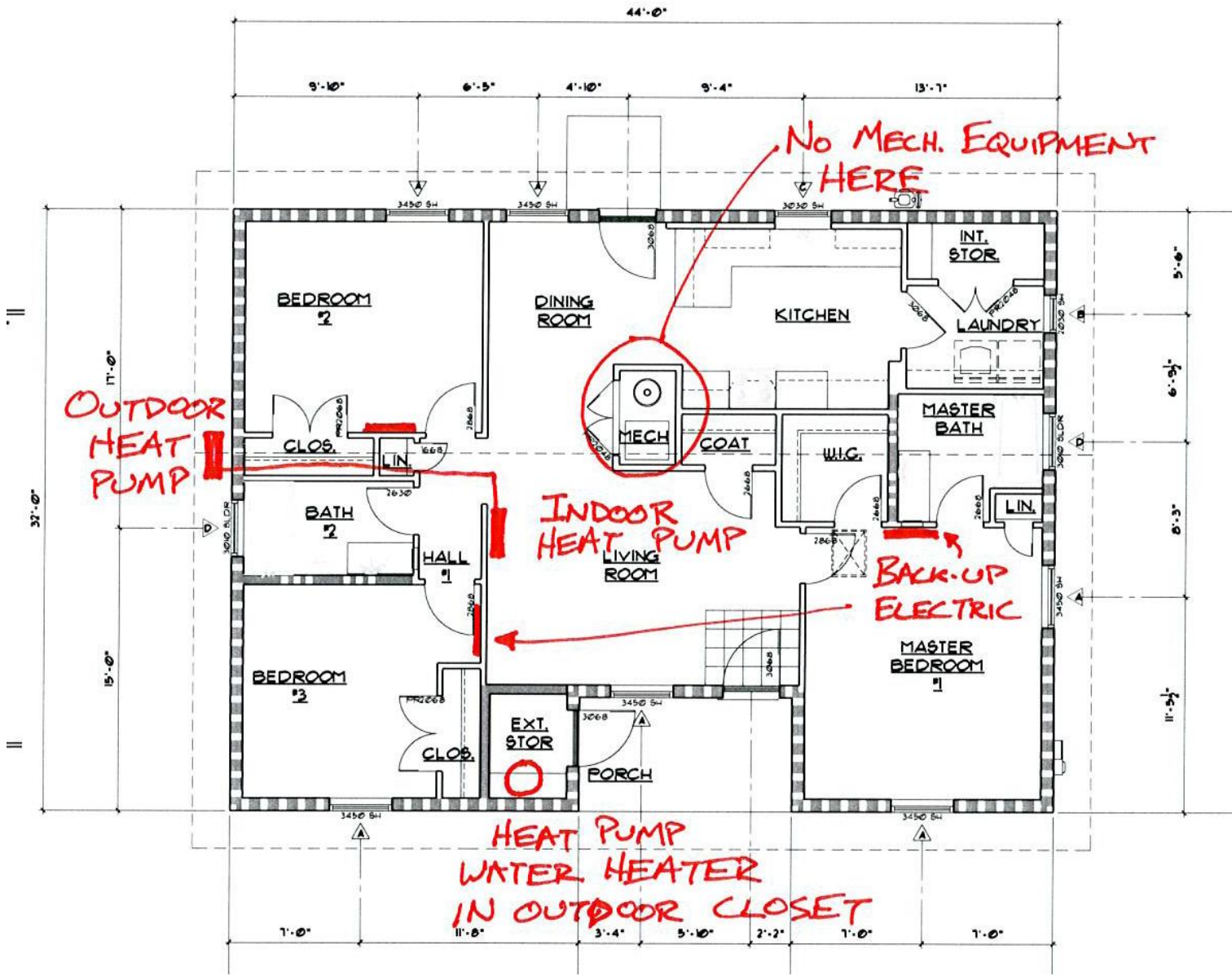
Requires filter change twice per year.

Requires HVAC technician for refrigerant management at installation (15-20 year).

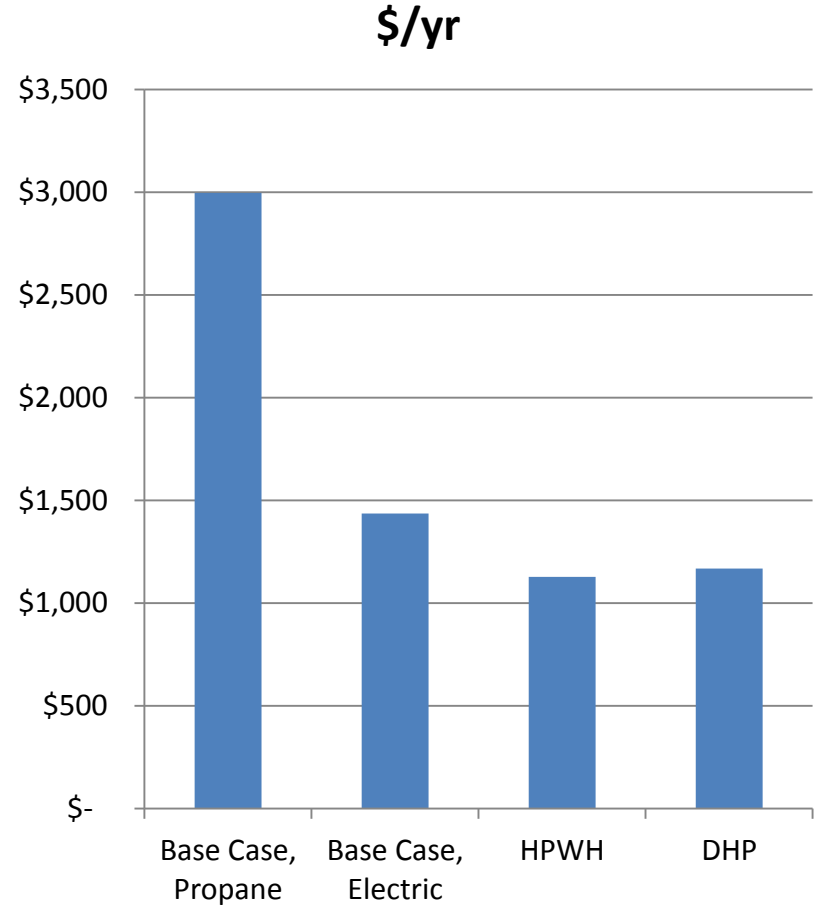
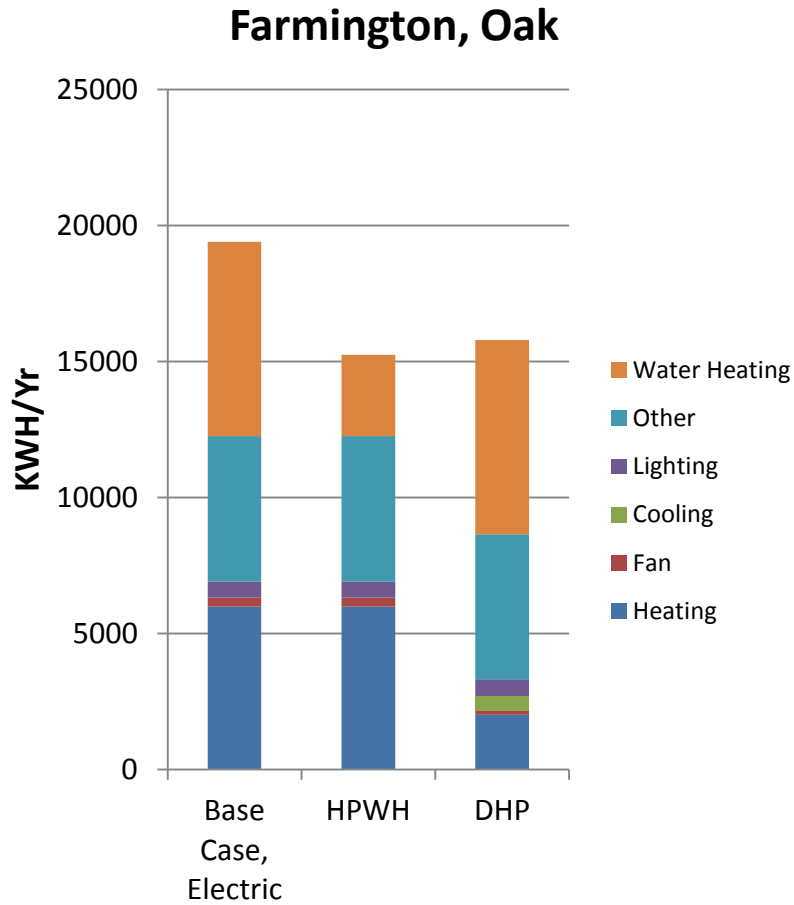
# Zonal Electric Heaters

- Better efficiency with zonal control
- Gain back closet space devoted to furnace
- Panel or oil-filled baseboards are silent, low temperature
- Cheapest system to install





# HVAC Measure Impacts

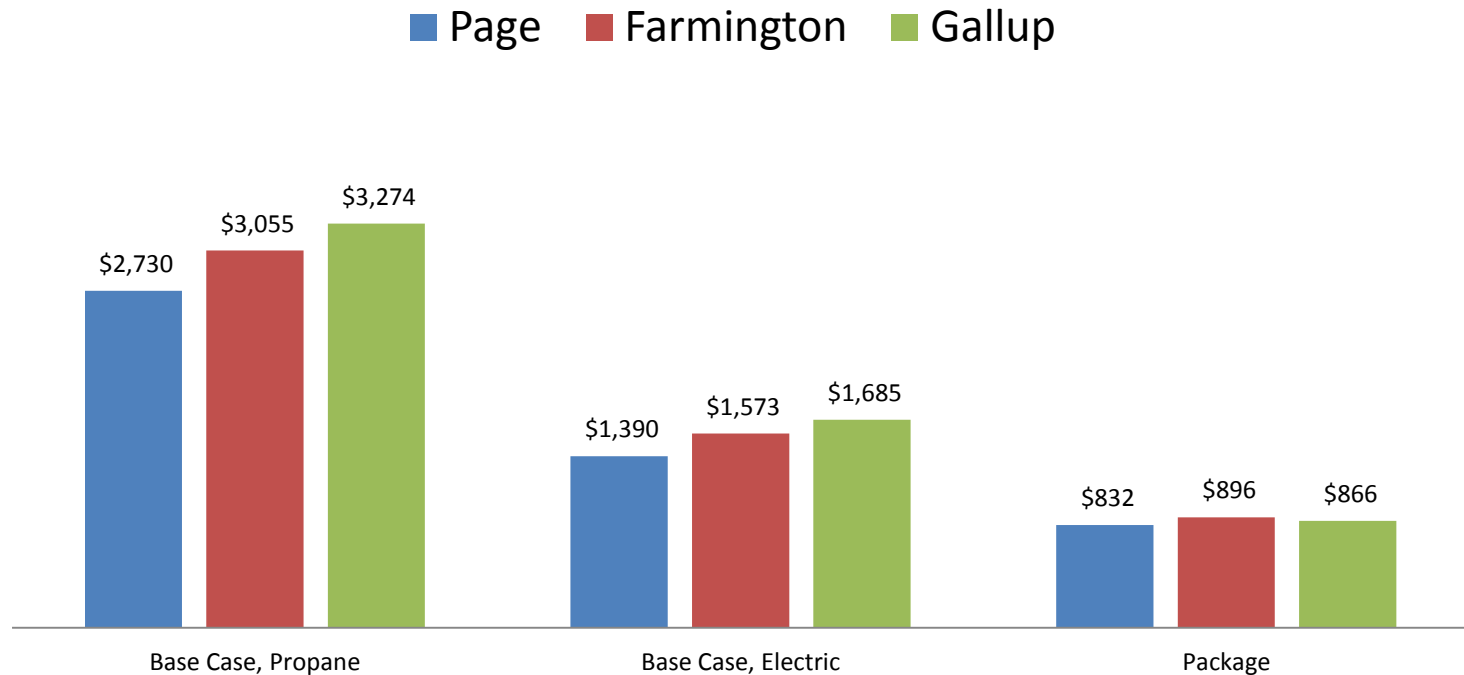


# Process Measure Descriptions

- Energy Star & Low Flow Fixtures – Install all Energy Star Rated Appliances & Lighting. Reduce fixture flow rates to 1.75 GPM showers, 1.0 GPM Kitchen Sink and Lavs

# Total Annual Energy Cost (\$/yr)

- Envelope: R-60 roof, 12" walls, triple windows, Insulate slab
- HVAC: Ductless Heat Pump, Heat Pump Water Heater
- Other: Low Flow fixtures, EnergyStar Appliances, Fluorescent Lights



## Effect of South Glass on Soace Heat Energy (Gallup, NM)

