

# Introduction to Advanced Benchmarking

## Part C Energy Signatures

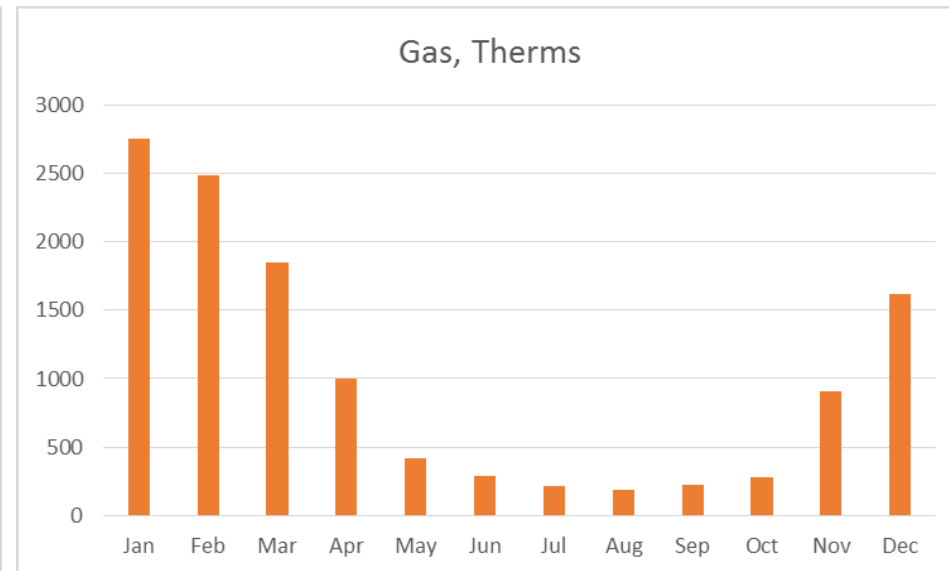
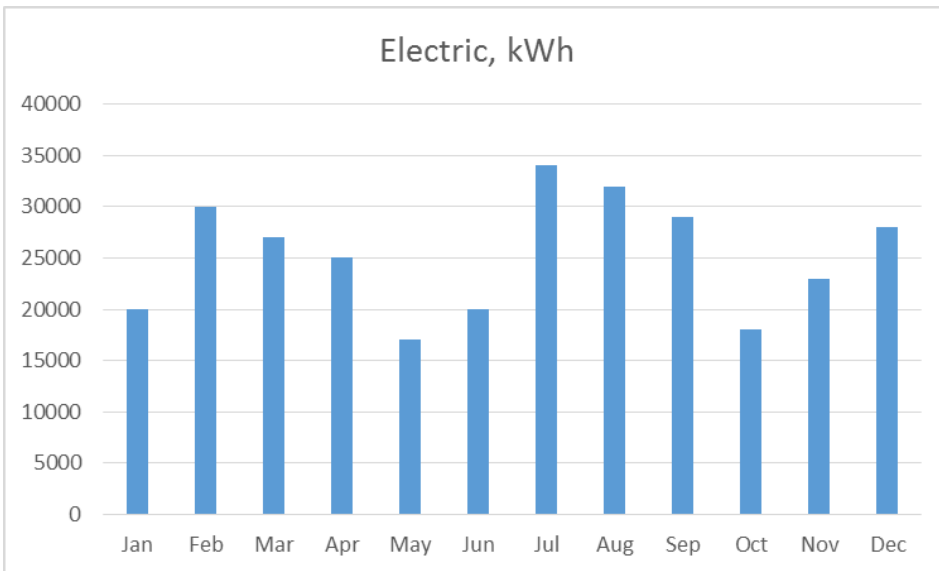
ALEXI MILLER, P.E.  
NEW BUILDINGS INSTITUTE

# What is an Energy Signature?

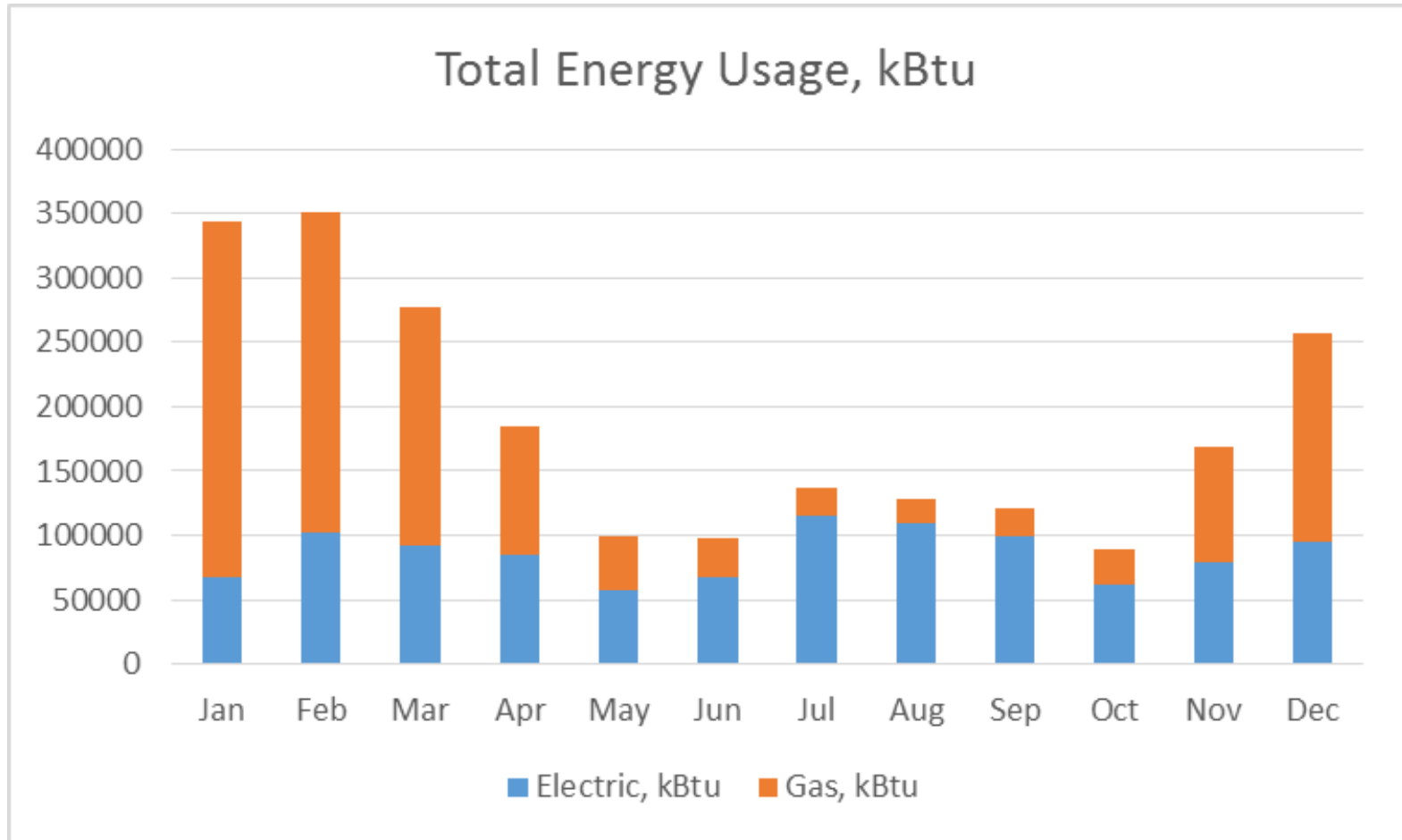
- An Energy Signature is a graphical representation of building energy usage compared to environmental conditions.
- Typically: monthly energy (all sources) vs. monthly average outside air temperature
- Can be normalized for building size or not
- Inherently weather-normalized

# Energy Signatures

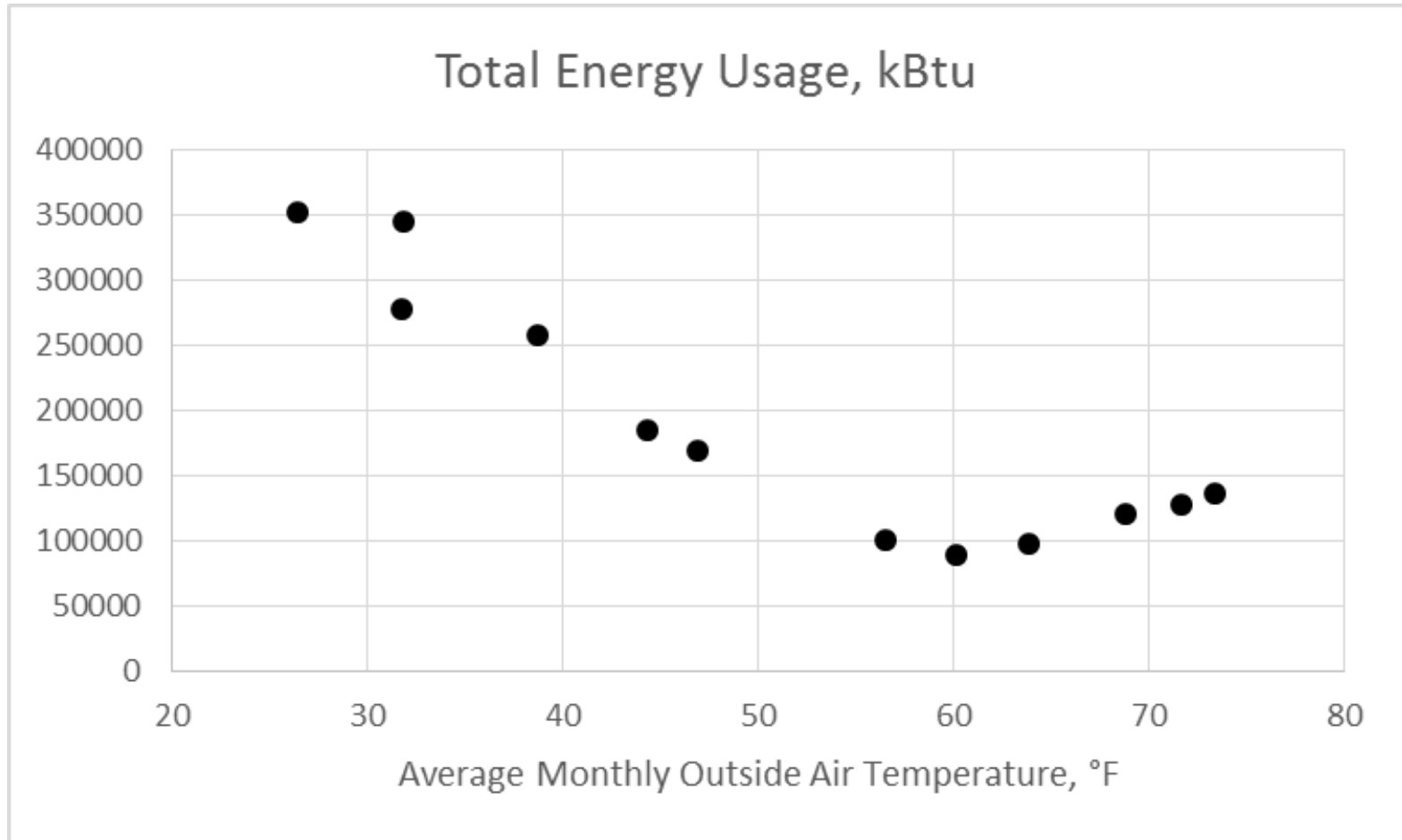
- Start with basic utility bills



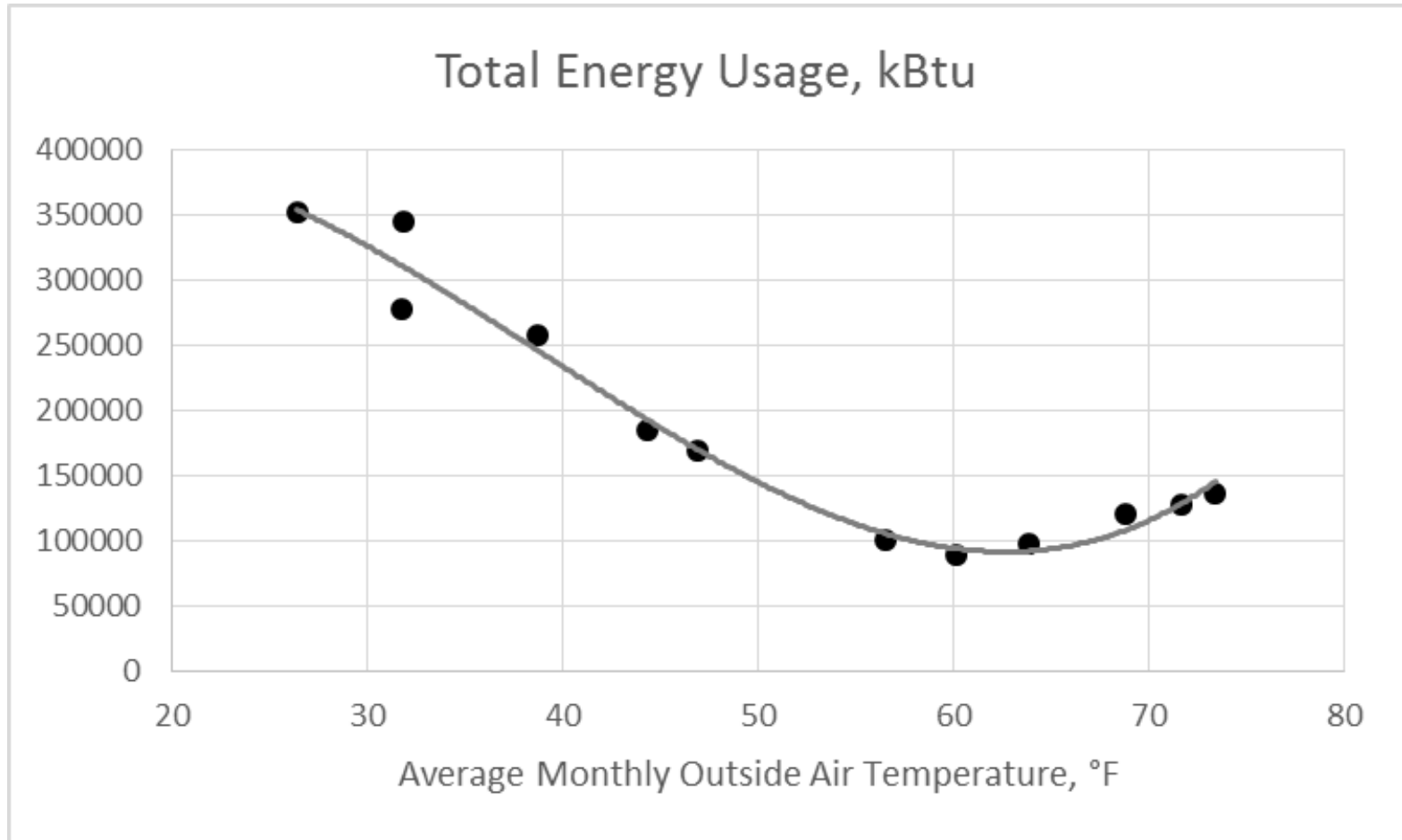
# Energy Signatures



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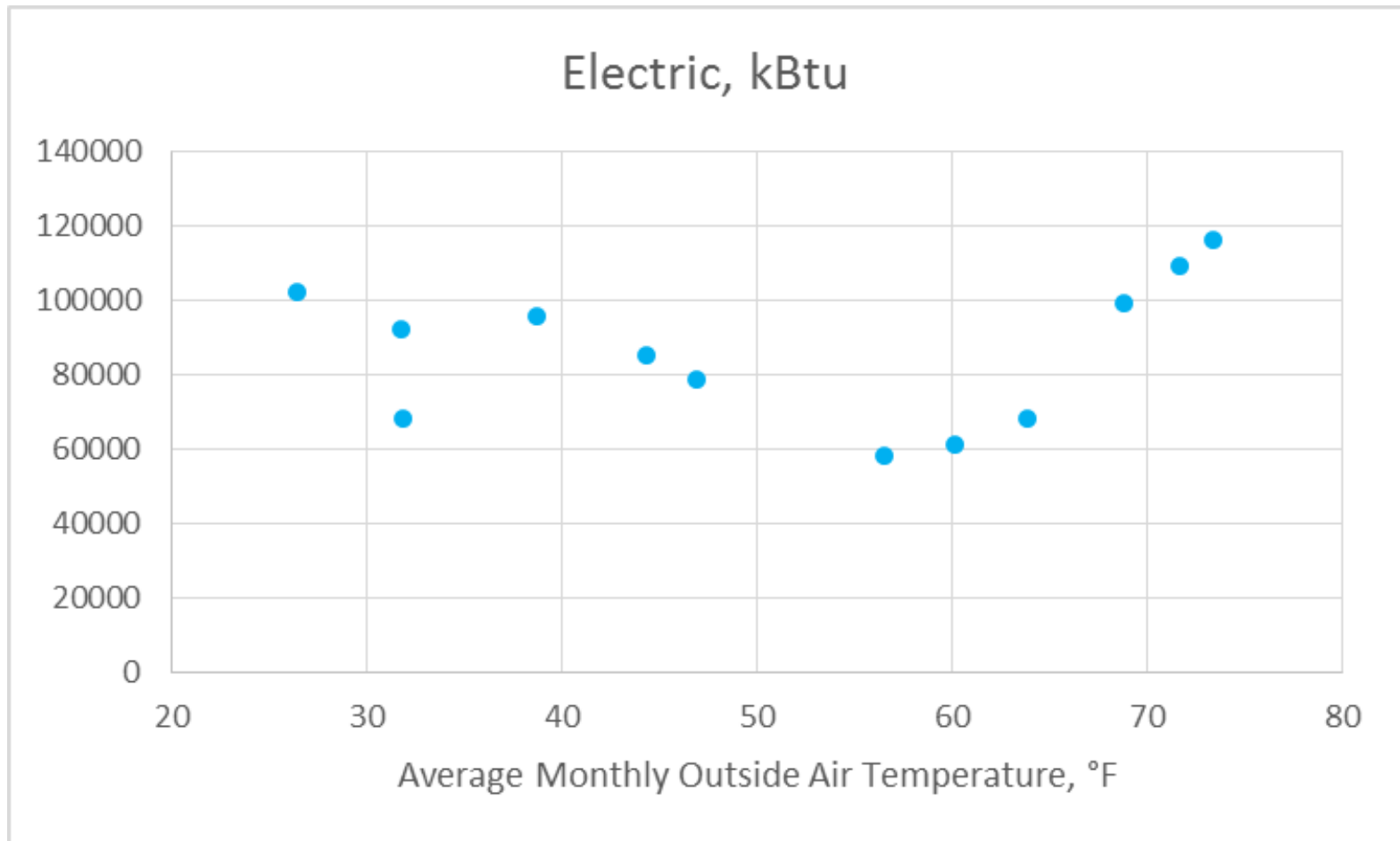
- How can we use these patterns?
  - Estimate disaggregation of end uses
  - Compare various buildings to spot differences in weather-dependent performance variables
  - Track a building's energy performance over time
  - Diagnose potential building performance issues

# Energy Signatures

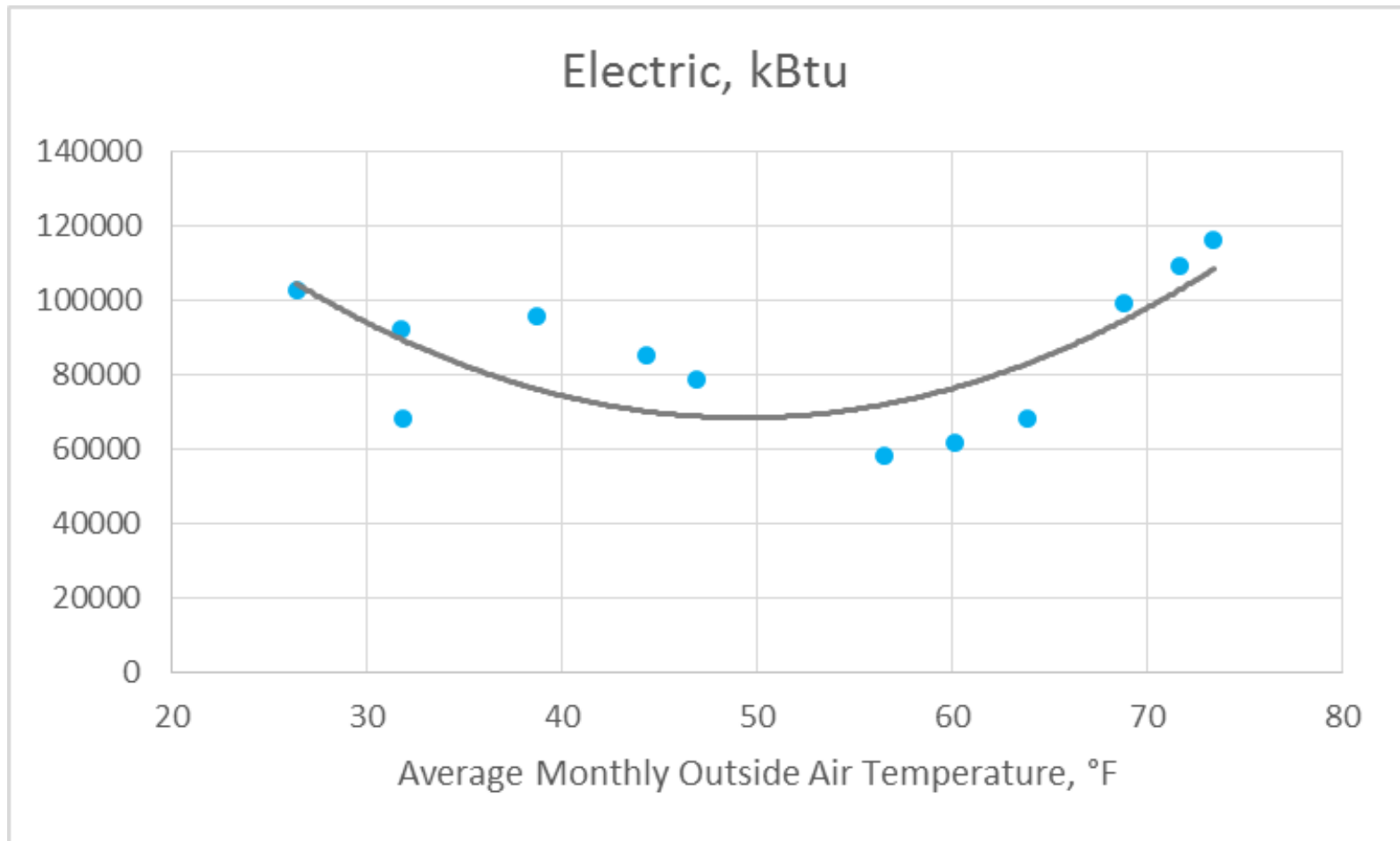
- **Space Heat:**
  - Direct Heating, Ventilation, Related
- **Cooling:**
  - Direct Cooling, Ventilation, Related
- **Thermal Baseload:**
  - Water Heating, Cooking, Laundry
- **Electric Baseload:**
  - Lights, Plugs, Fans, Pumps, IT



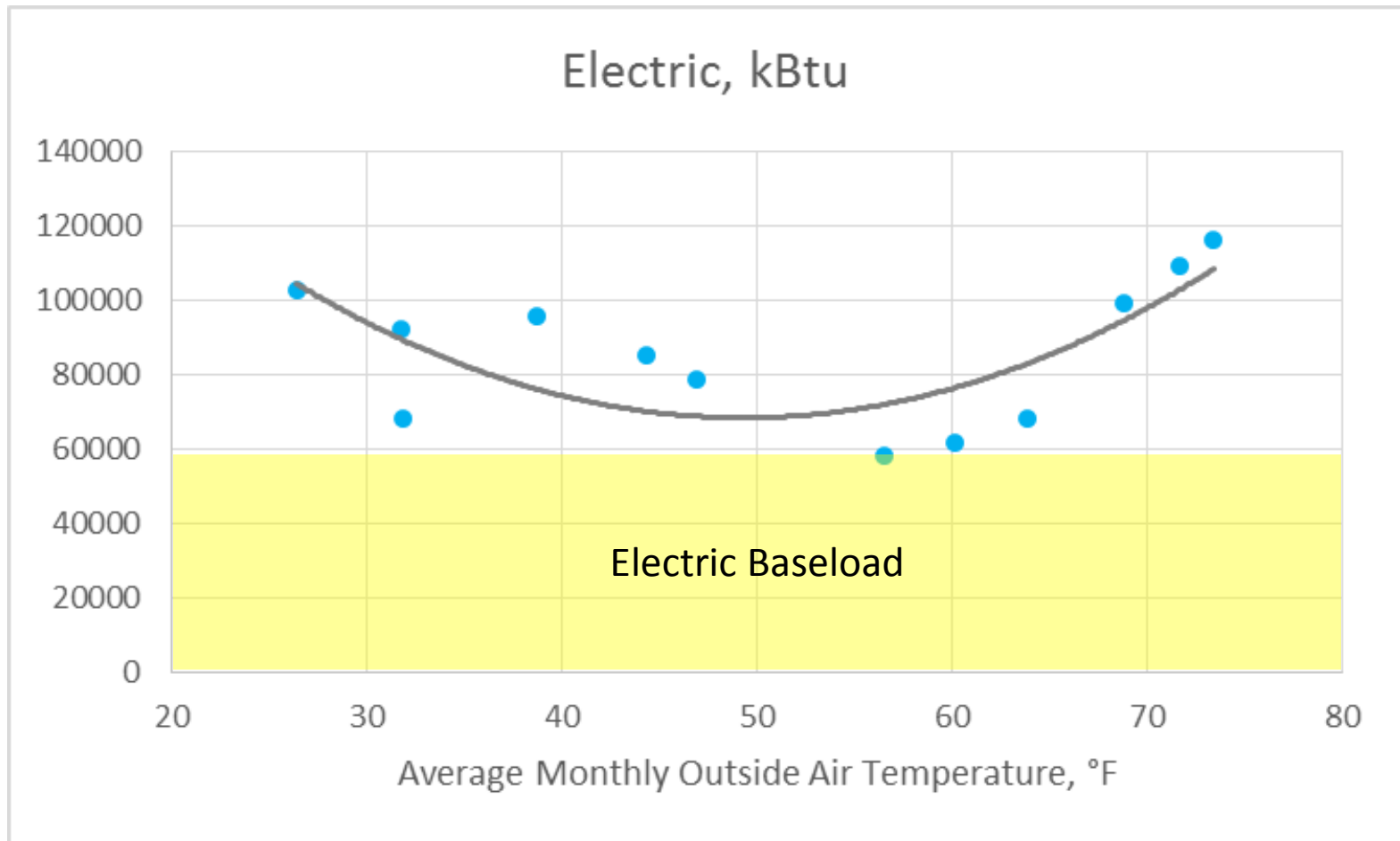
# Energy Signatures - Electric



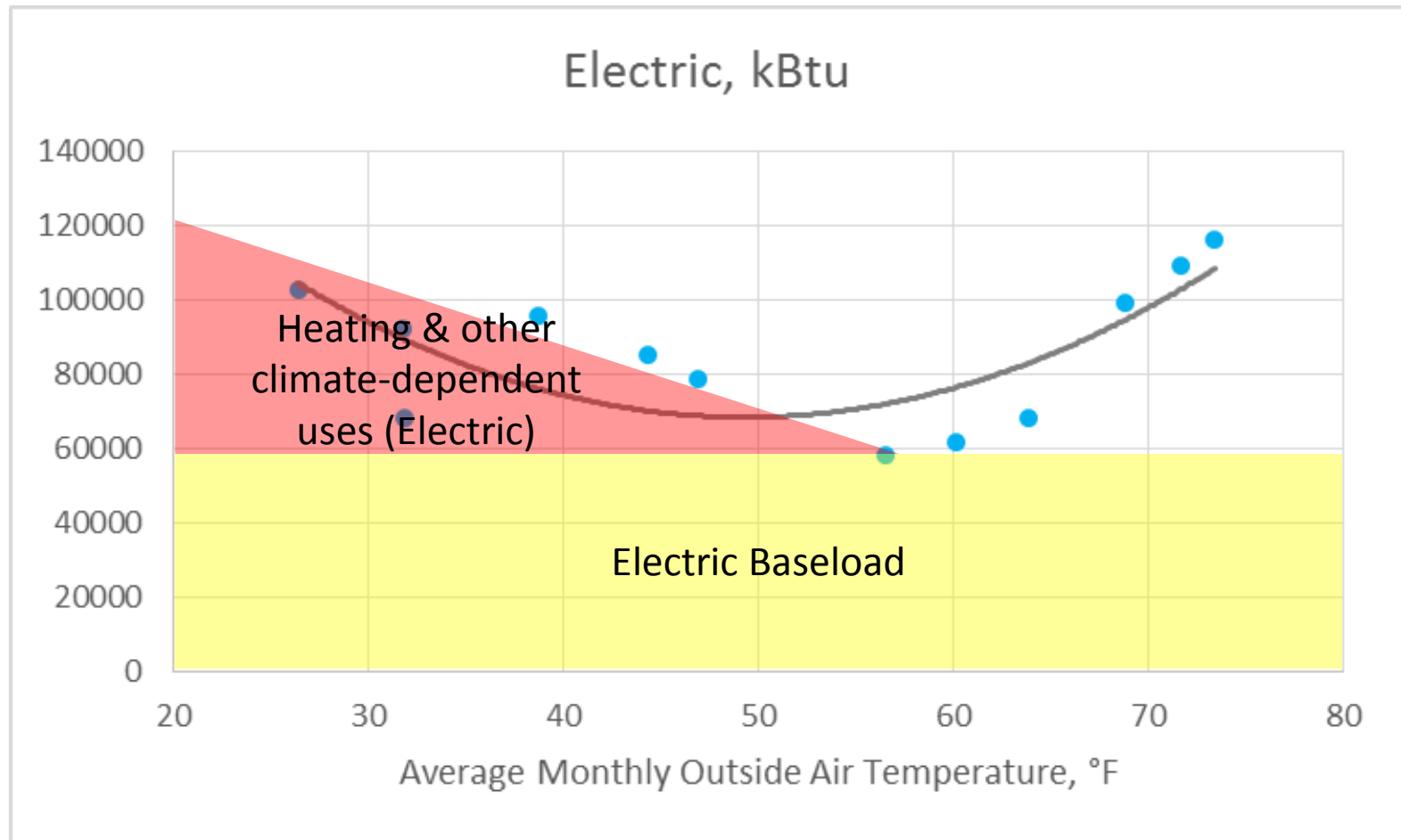
# Energy Signatures - Electric



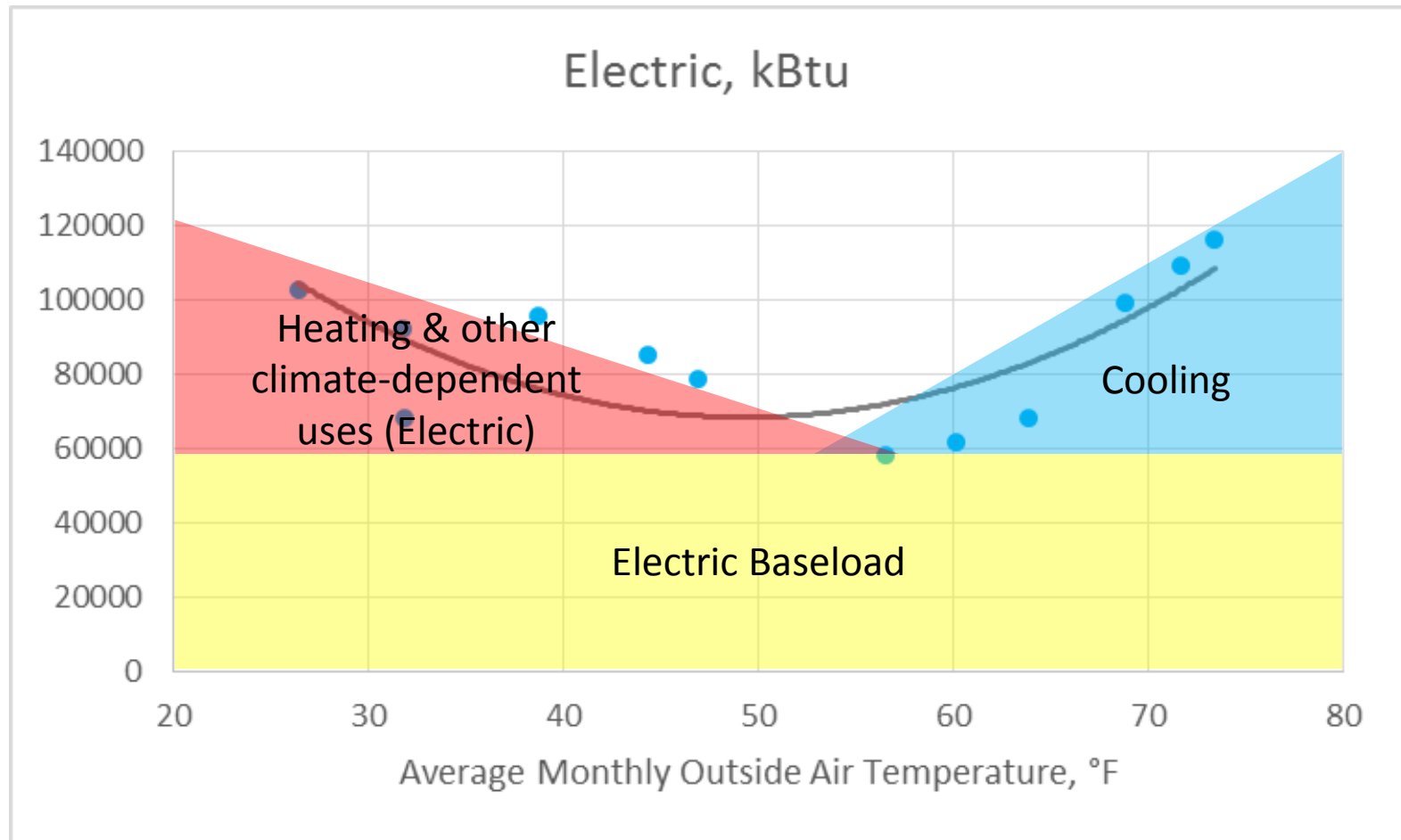
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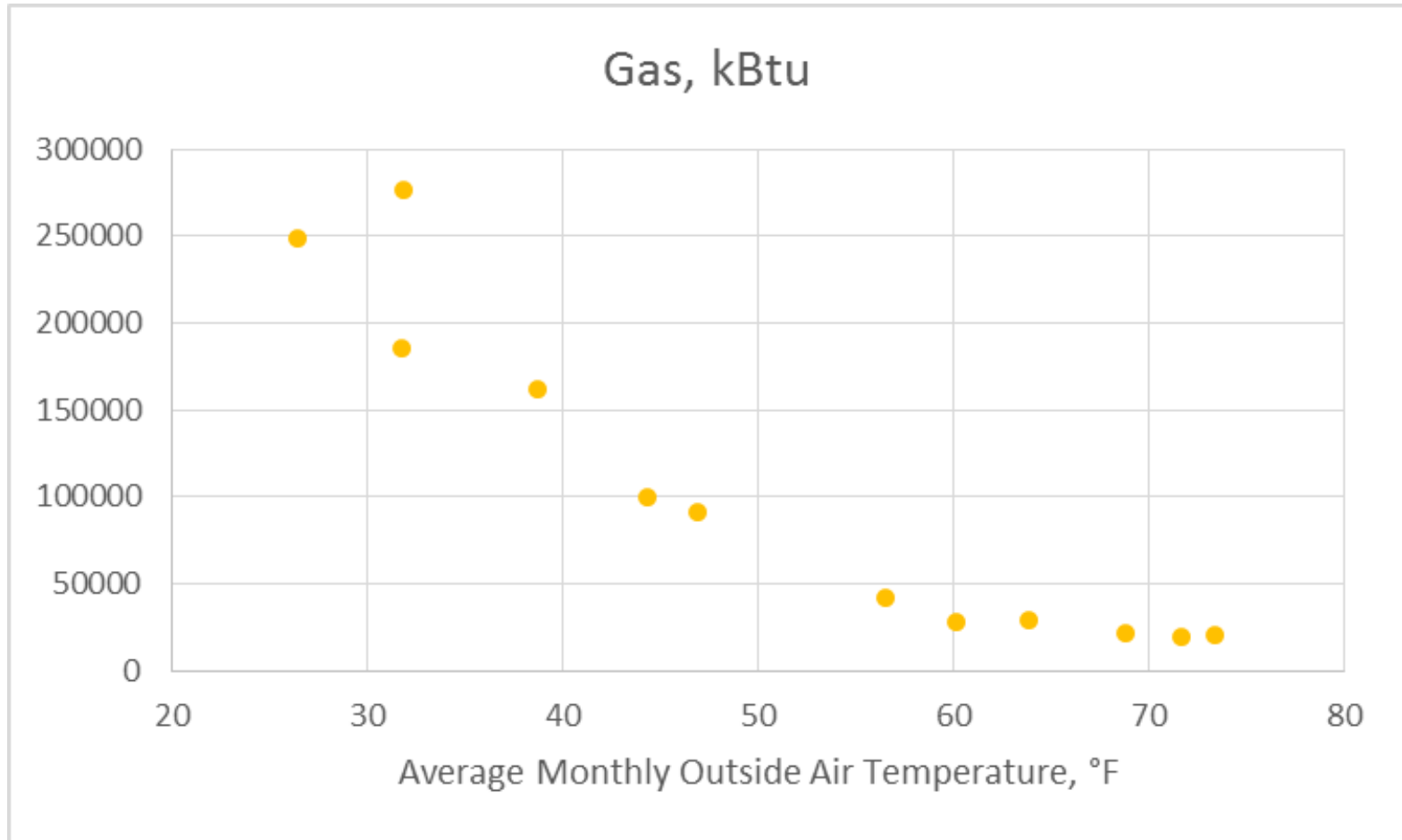
# Energy Signatures - Electric



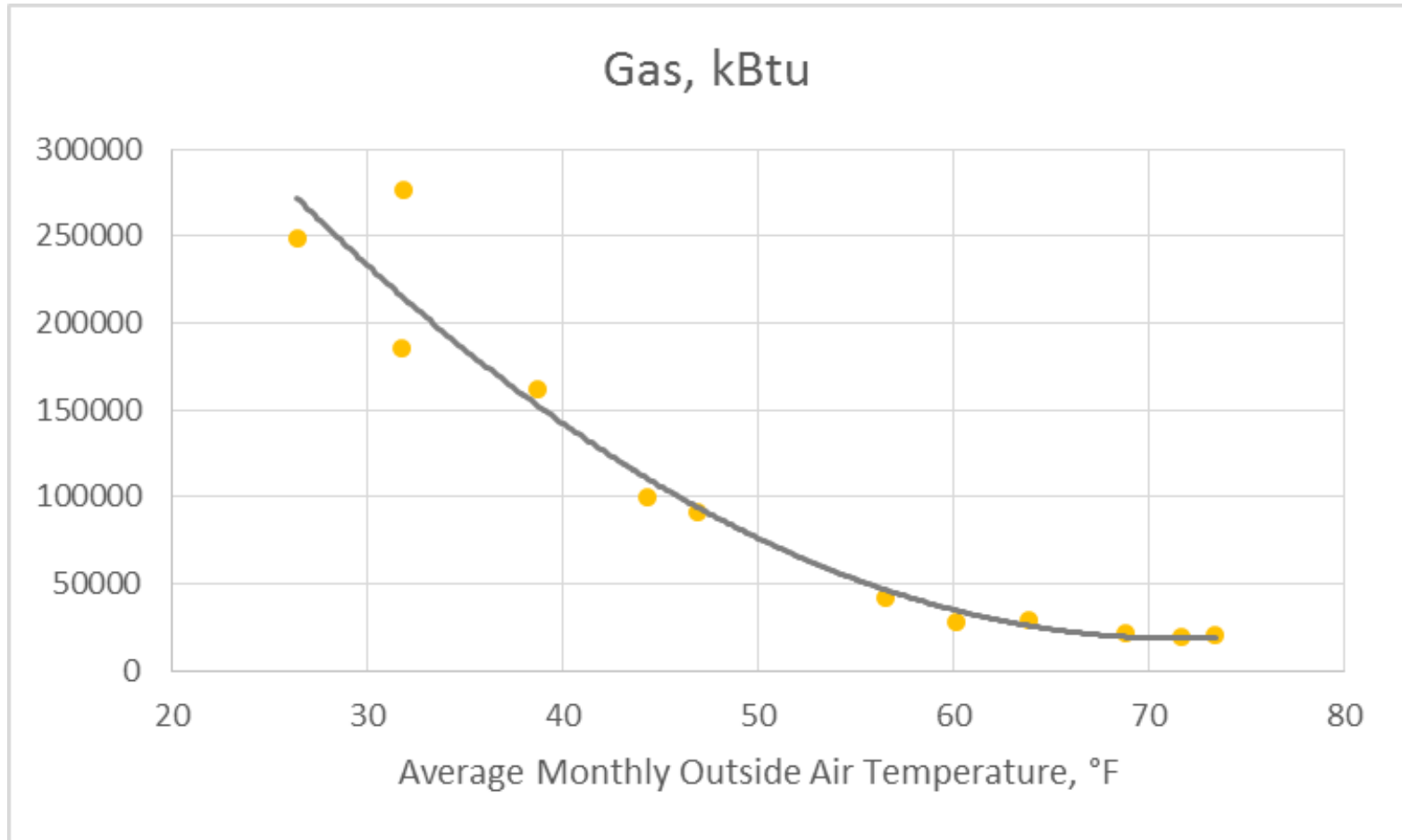
# Energy Signatures - Electric



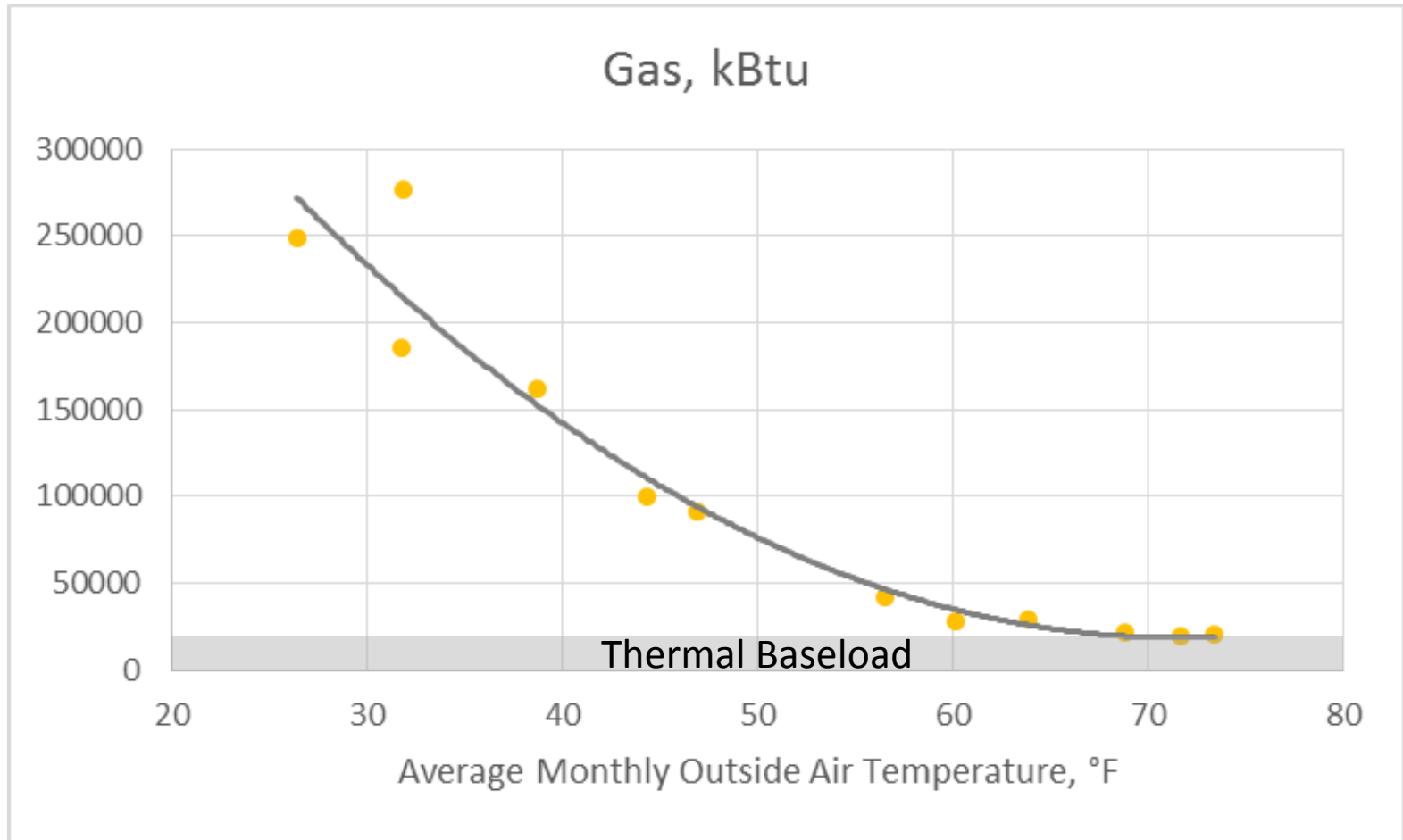
# Energy Signatures - Gas



# Energy Signatures - Gas

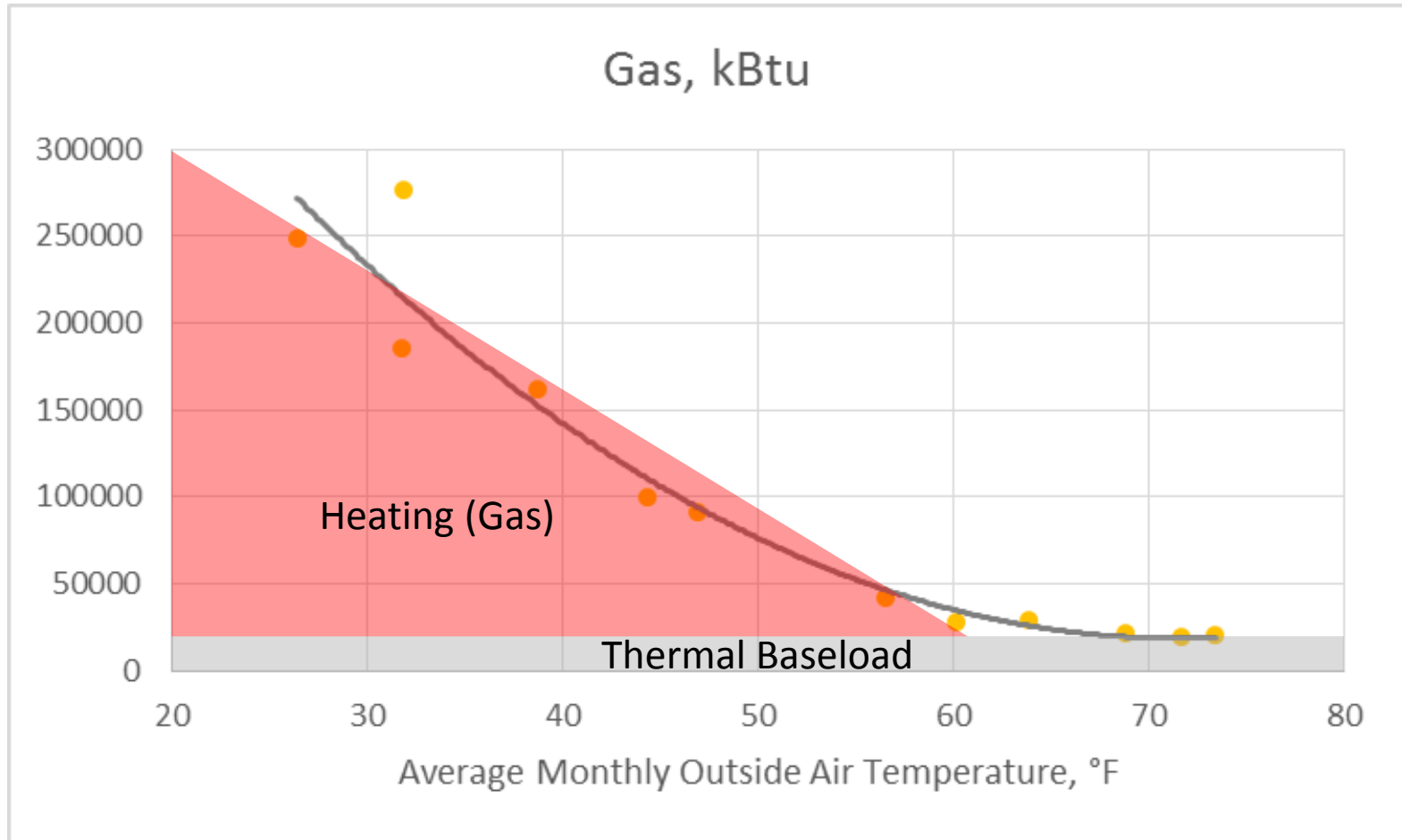


# Energy Signatures - Gas

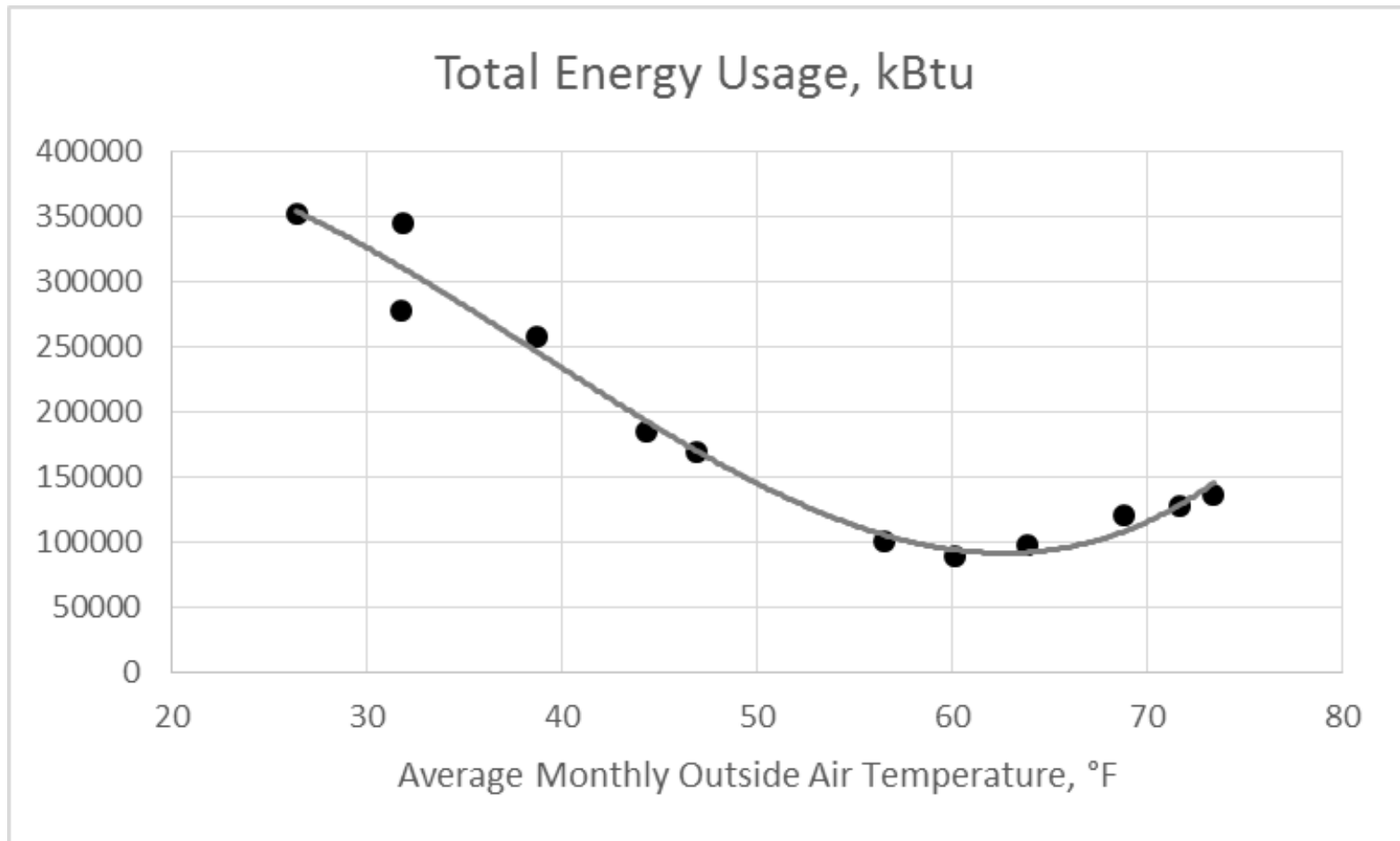




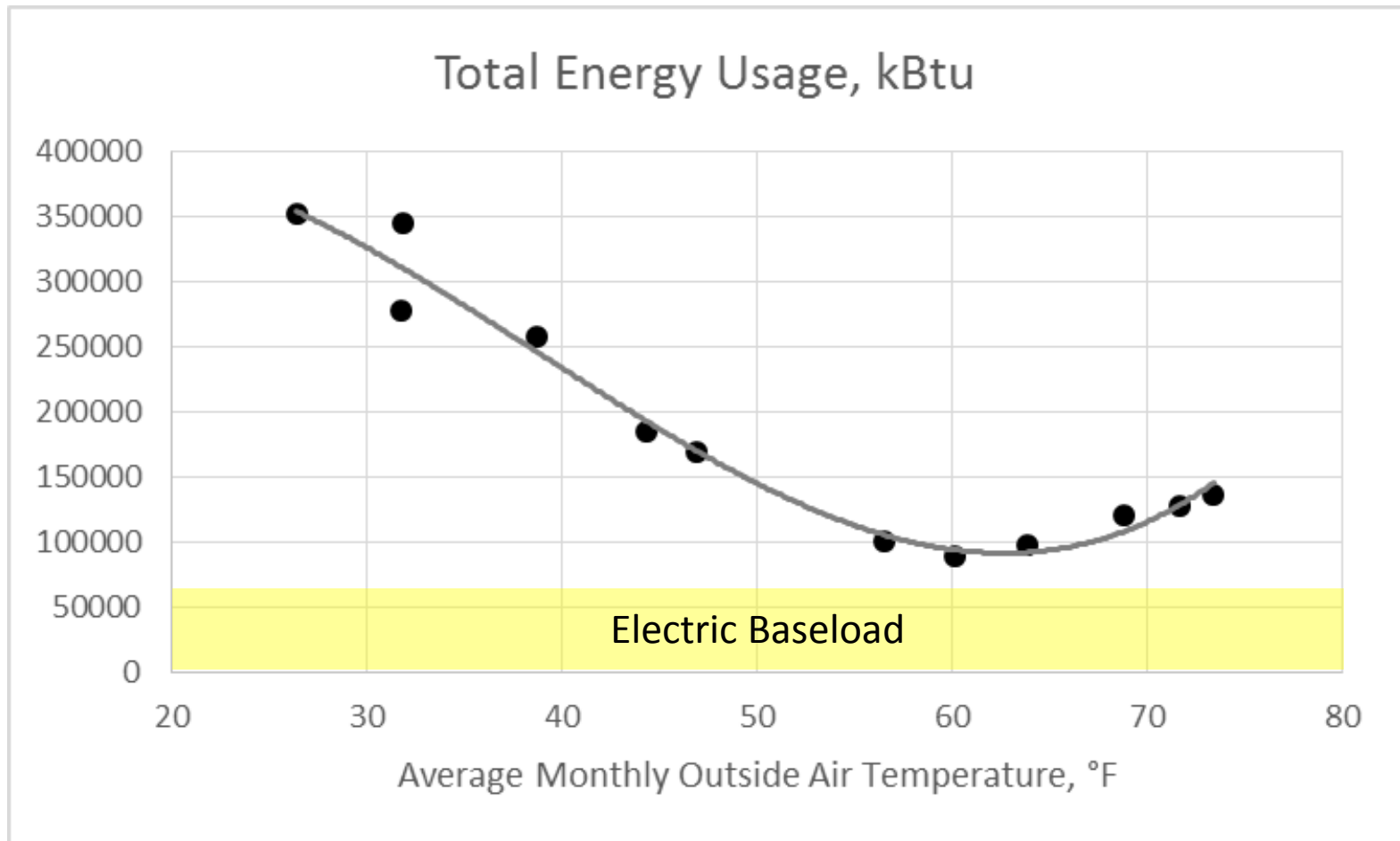
# Energy Signatures - Gas



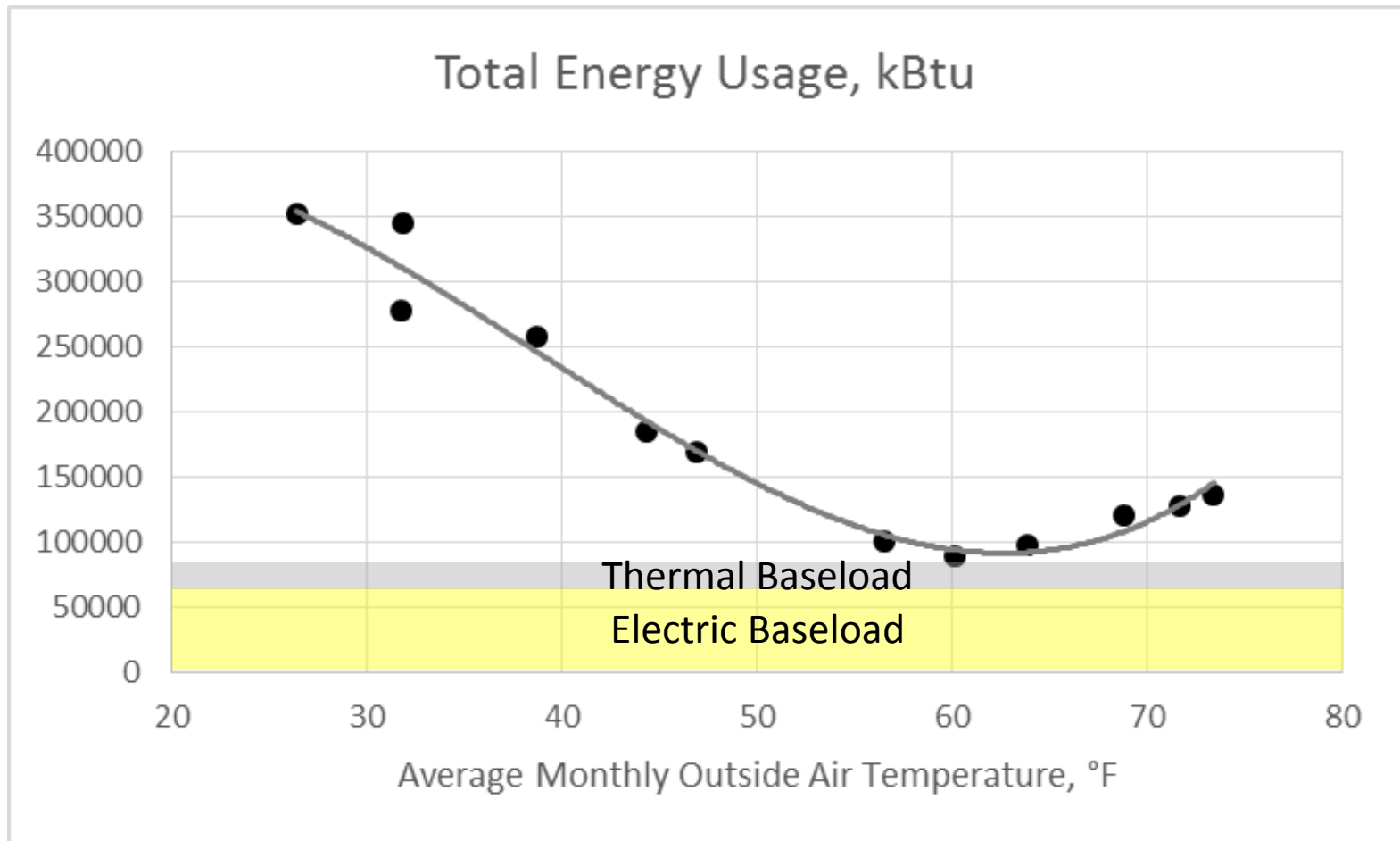
# Energy Signatures - Total



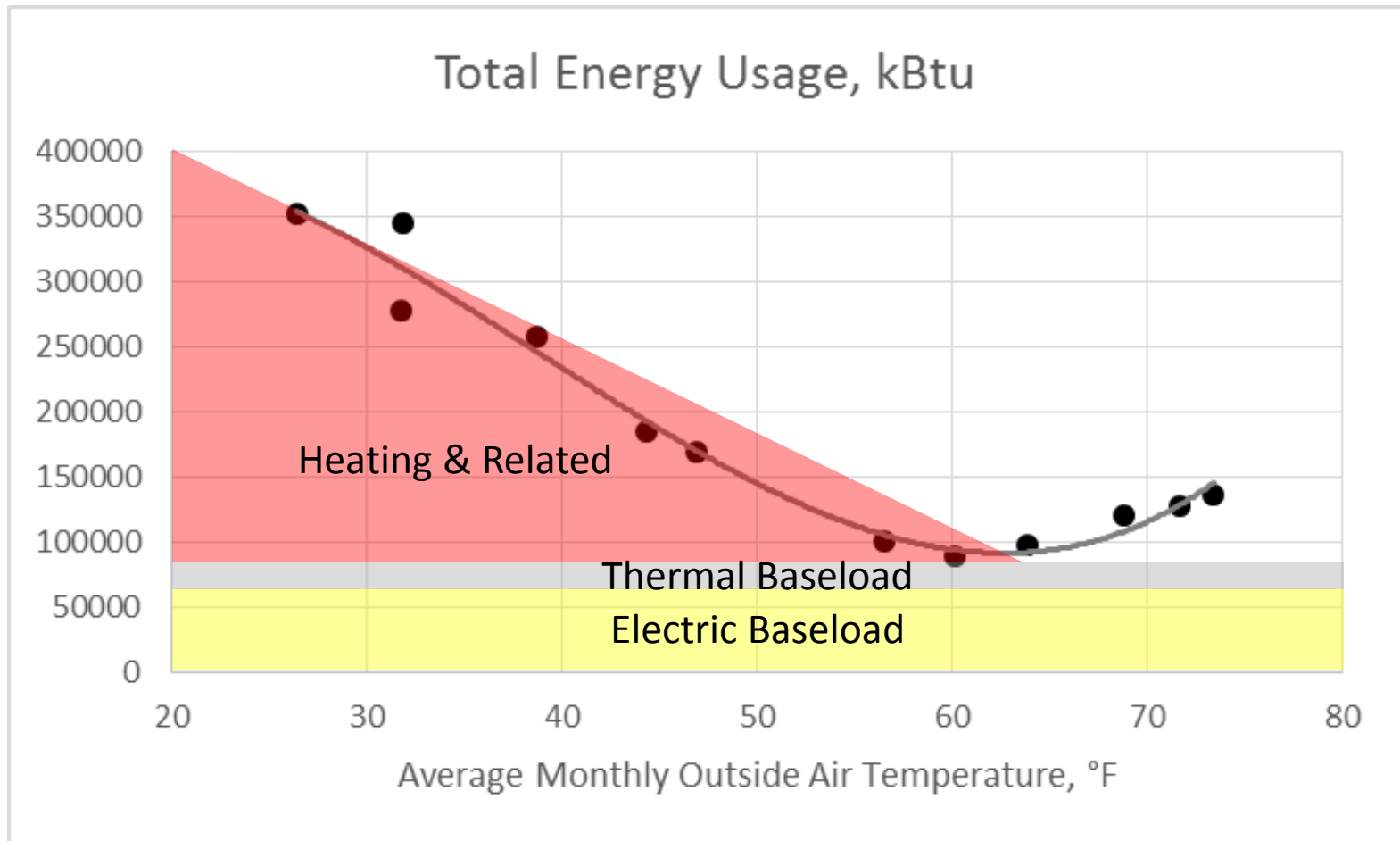
# Energy Signatures - Total



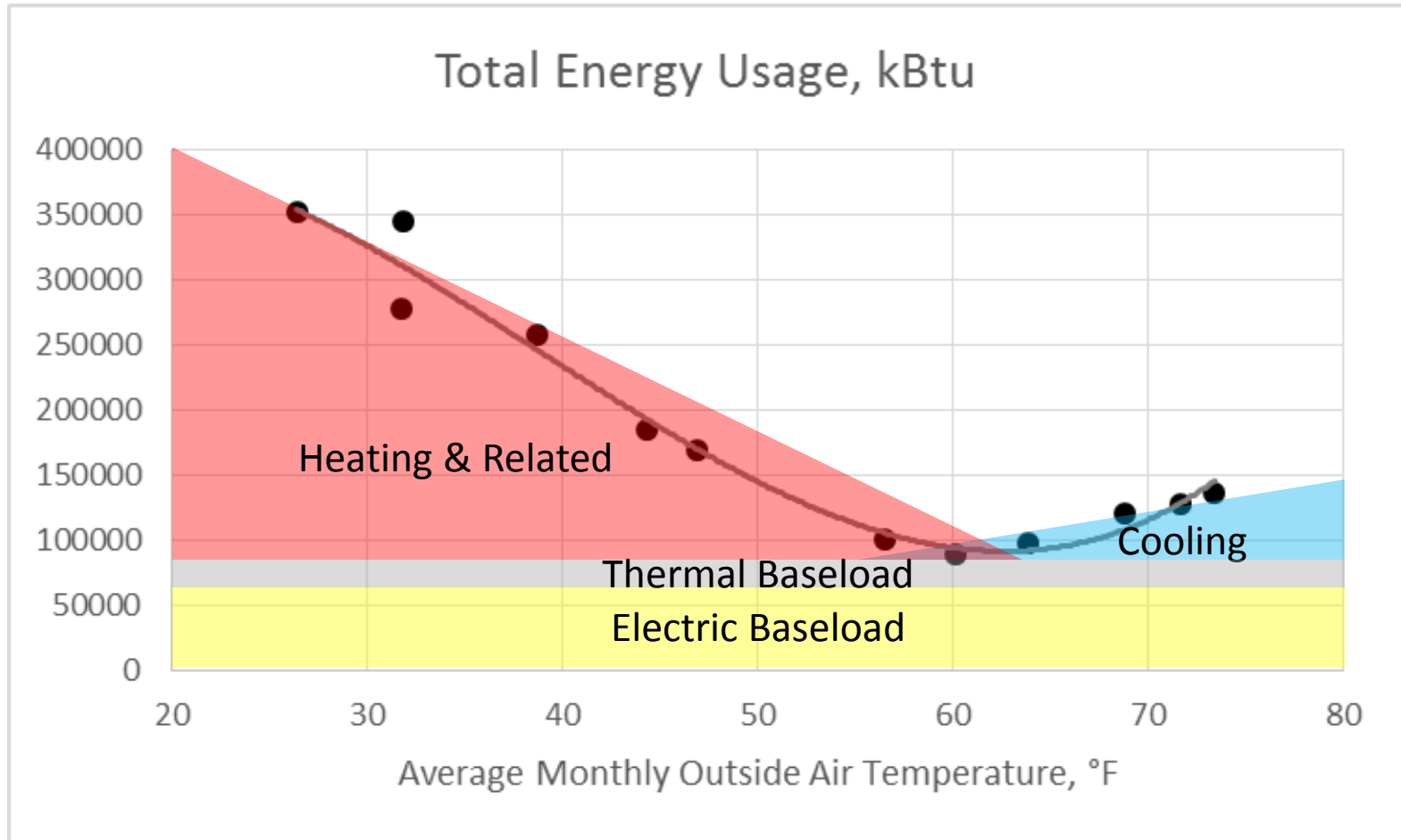
# Energy Signatures - Total



# Energy Signatures - Total



# Energy Signatures - Total



# The Building!



# Identifying Improvements from the Energy Signature

## Controls

- Simultaneous heating and cooling
- HVAC Reheat
- Poor set points
- Inefficient scheduling

## Heating & Cooling

- Poor efficiency
- Excess outside air rates
- High infiltration
- 24-hour fan schedule

## Baseloads

- Poor lighting efficiency
- Plug load management
- Data centers
- Hot Water Recirculation



# Summary

- What can we do now?
  - End use disaggregation
  - Broad-based diagnostics
  - Ongoing performance tracking



# Introduction to Advanced Benchmarking

## End of Part C