

# 2016 STANDARDS PROJECT

## High Performance Attics and Alternatives for Cooling Climates

April 4, 2014

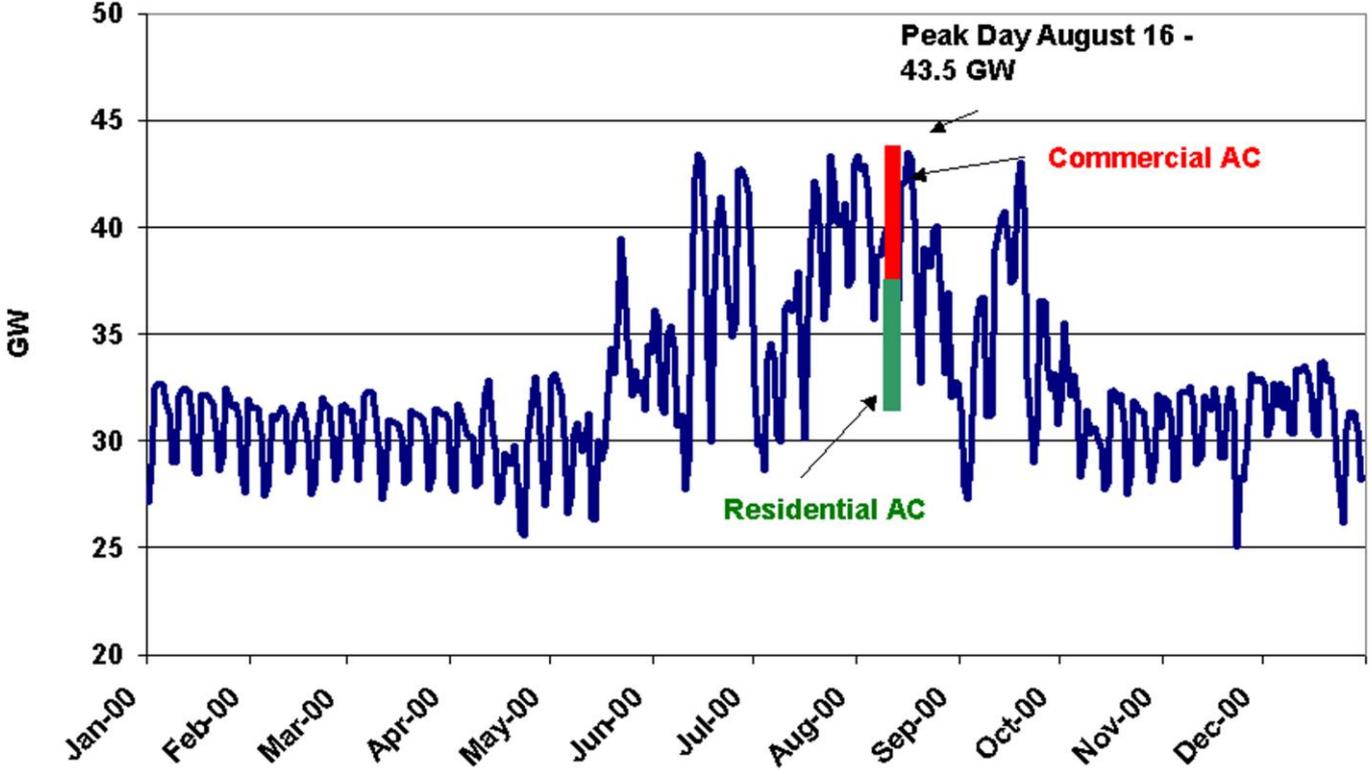
Bruce Wilcox, P. E.  
Berkeley, CA  
[bwilcox@lmi.net](mailto:bwilcox@lmi.net)

# Agenda

- Goal
- Conditions in Typical California Attics
- Hot Attic Impacts
- Hot Attic Remedies
- Roof Deck Insulation Examples
- Alternate Approaches
- Successful Examples

# Goal: Reduce Energy Use & California's Peak Electricity Problem

Cal ISO Daily Peak Loads  
January 1, 2000 - December 31, 2000



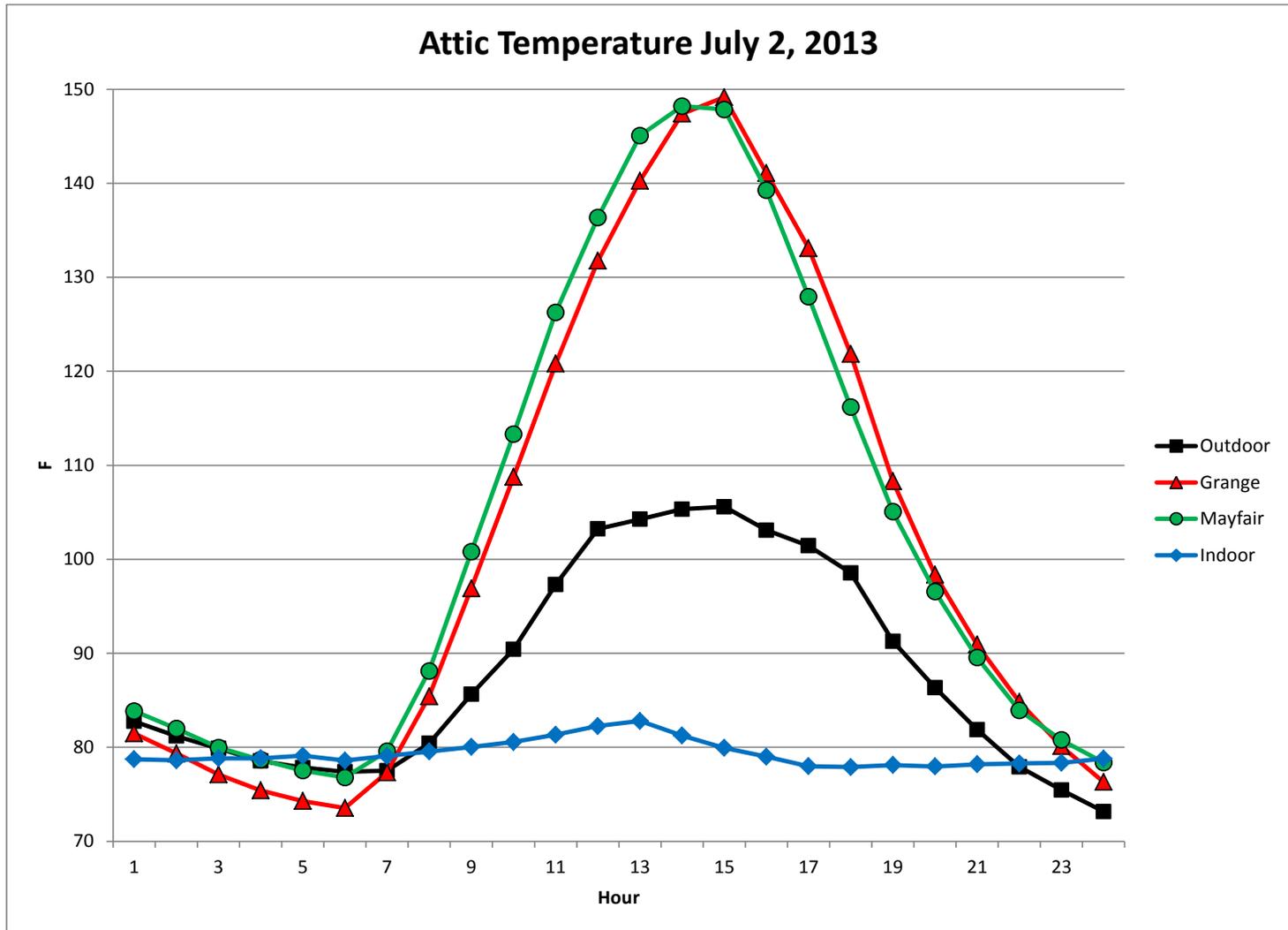
# Conditions in the Grange Attic



# Conditions in the Mayfair Attic



# Solar Heating of the Roof Drives Typical Older Attics 45 deg F above Outdoor Temp



# Hot Attic Impacts

- Reduced efficiency of AC systems and ducts located in the attic
  - Heat conduction through ducts and poorly insulated furnaces. CA default area: 32 to 37% of house floor area
  - Return duct leakage is attic air coming in
- Increased cooling loads
  - Summer infiltration is super hot air from the attic
    - 50% of house envelope leakage is in the ceiling
    - Worse with continuous Indoor Air Quality exhaust ventilation
  - Ceiling and knee wall insulation defects let the heat in

# Large, Leaky, Poorly Insulated in the Attic



# Hot Attic Remedies

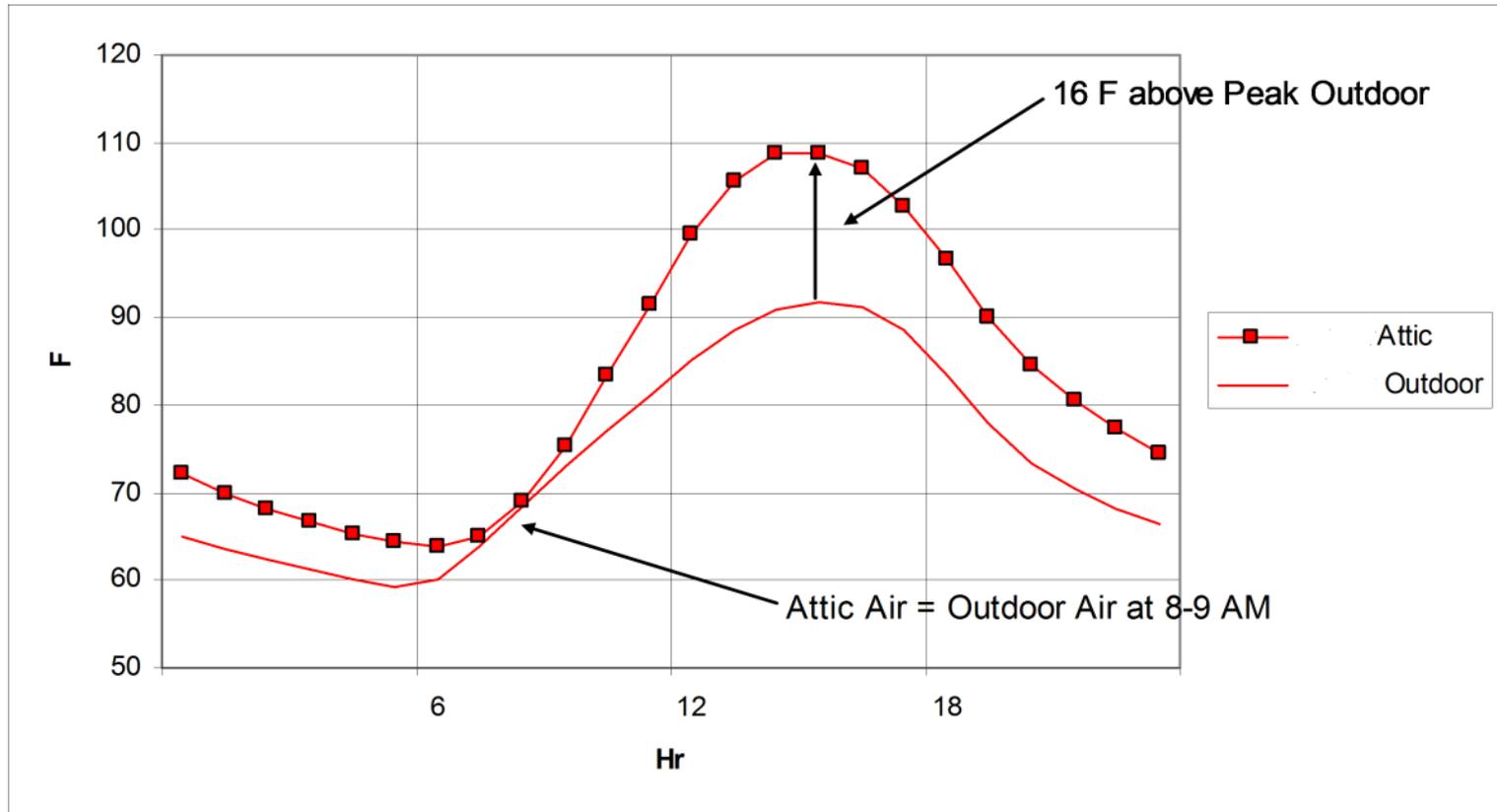
- Keep solar heat out to reduce attic temperatures
  - High reflectance cool roof reduces absorbed solar heat
  - Insulated roof deck keeps absorbed solar heat out
- Move AC system and ducts out of the attic
- Make the attic part of the conditioned space
  - Larger envelope to insulate
  - No ventilation to remove moisture
- Small, well insulated, well sealed attic AC systems

# Insulated Roof Deck Experiment

## Elk Grove, CA



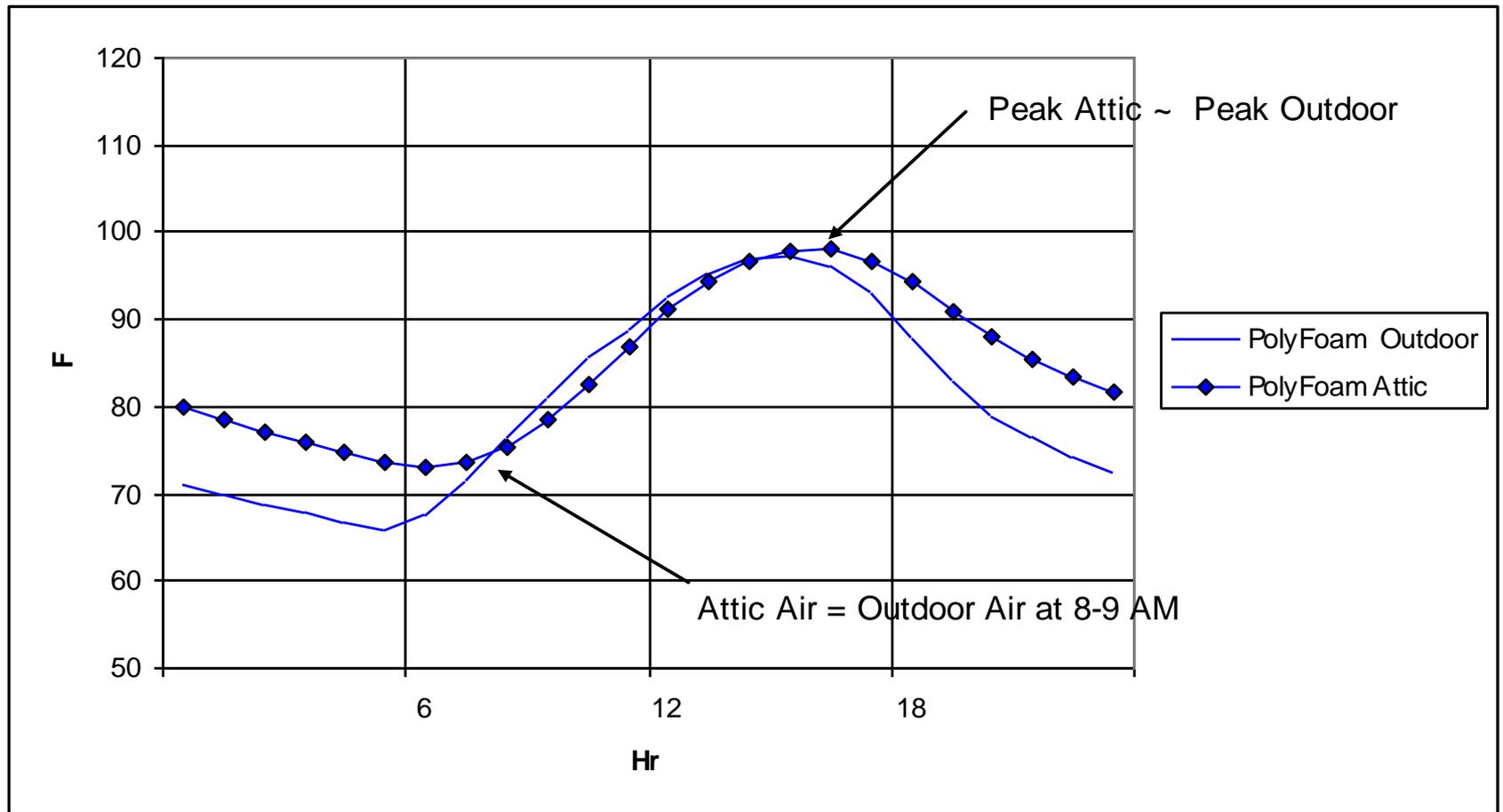
# 2006 Average Attic Temperature



# 2007 Same Tile over New Insulation



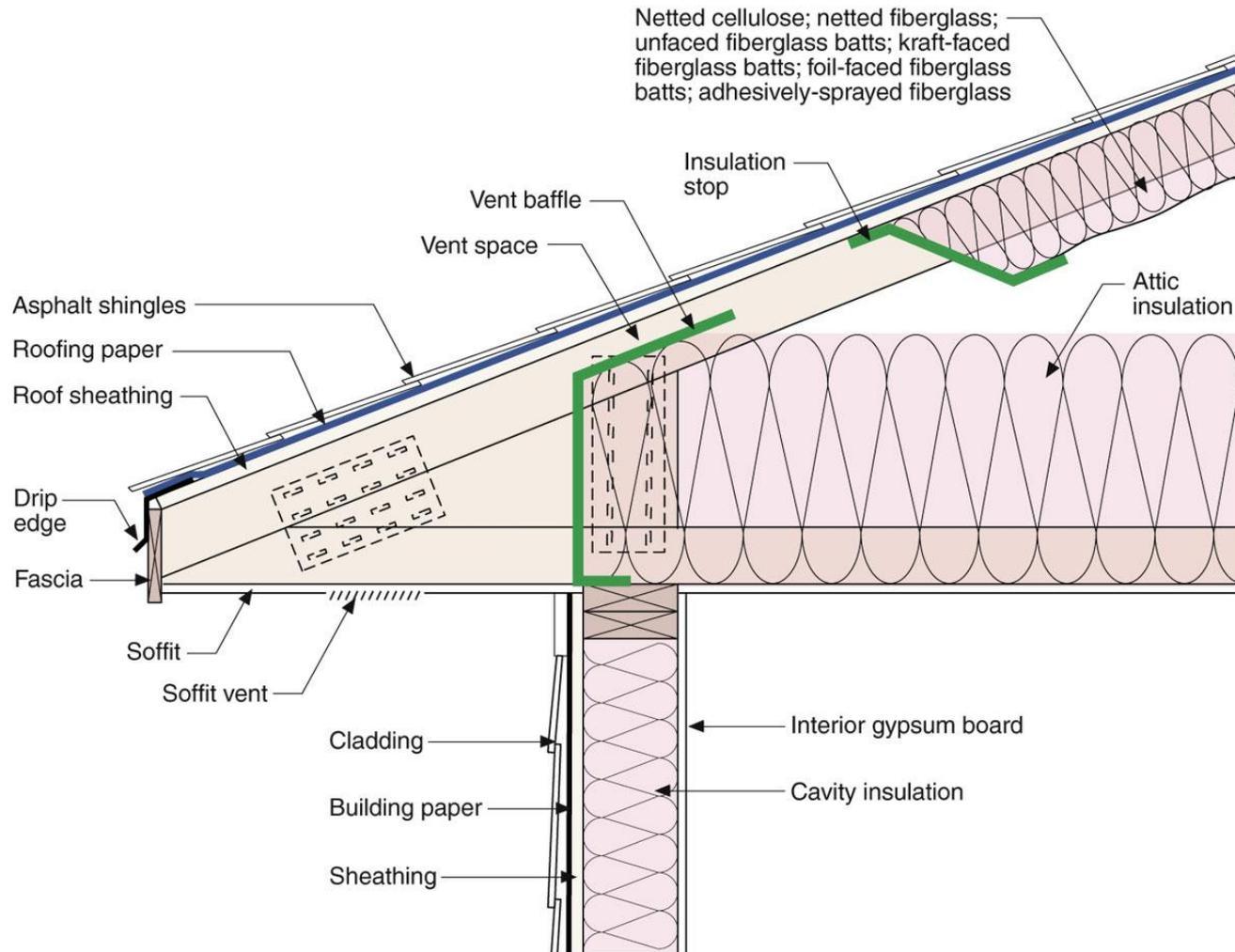
# 2007 Average Attic Temperature with Insulated Roof Deck



# Lower R Spray Foam Only Option Combined with High Reflectance Tiles



# 2011 Building Science Corp Moisture Study: *Vented attic with insulated roof deck “OK in all CEC Zones except 16”*



# Ducts and Systems in Conditioned Space

## No Free Basements in California



# Ductless Systems Performance unclear



# Attic Alternate Examples

CVRH project - Grange house



# Attic Alternate Examples

CVRH project - Fidelia house



# Attic Example Successes

Measured Air Conditioning System Excess Cooling kWh Compared to 2013 Prescriptive AC Verified in Conditioned Space

House	As Found	Upgrade Strategy	Improved
Fidelia	58%	Move ducts from attic completely to conditioned space with new high airflow, low fan watts, high EER AC	-3%
Grange	38%	New attic ducts with no leakage, small surface area, buried under insulation, and new high airflow, low fan watts, high EER AC	7%
This is in the typical +45F attic			