

Inclusion of Solar Reflectance and Thermal Emittance Prescriptive Requirements for Low-Sloped Roofs in Residential Title 24

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Cooling roofs by increasing solar reflectance

- A conventional dark roof **absorbs most sunlight**
- Increasing **solar reflectance**
 - reduces solar heat gain
 - lowers roof temperature
- High **thermal emittance**
 - facilitates radiative cooling
 - helps keep roof temperature low
- Lowering roof temperature can reduce
 - building cooling electricity use
 - peak power demand
 - ambient air temperature



Environmental impacts of cooling roofs

- **Benefits**
 - increased human comfort
 - slowed smog formation
 - mitigation of urban heat islands in summer
 - decreased waste from disposal of roofs
- **Penalties**
 - slightly higher wintertime heating energy use
 - degraded wintertime urban air quality

“Cool” products for low-sloped roofs

- Many materials available
 - coating (white)
 - single-ply membrane (white)
 - painted metal (white, cool colored)
- Products are rated by the Cool Roof Rating Council (CRRC)
 - labels solar reflectance, thermal emittance
 - website: www.coolroofs.org

“Cool” roof requirements in T24: a timeline

Roof → Building	Low-Slope	Steep-Slope
Residential	2008	2008
Non-Residential	2005	2008

Scope of current study

- Introduce requirements for **low-sloped roofs** on residential buildings
 - Study proposes minimum aged values of solar reflectance, thermal emittance
 - Based on new building energy analysis

Methodology

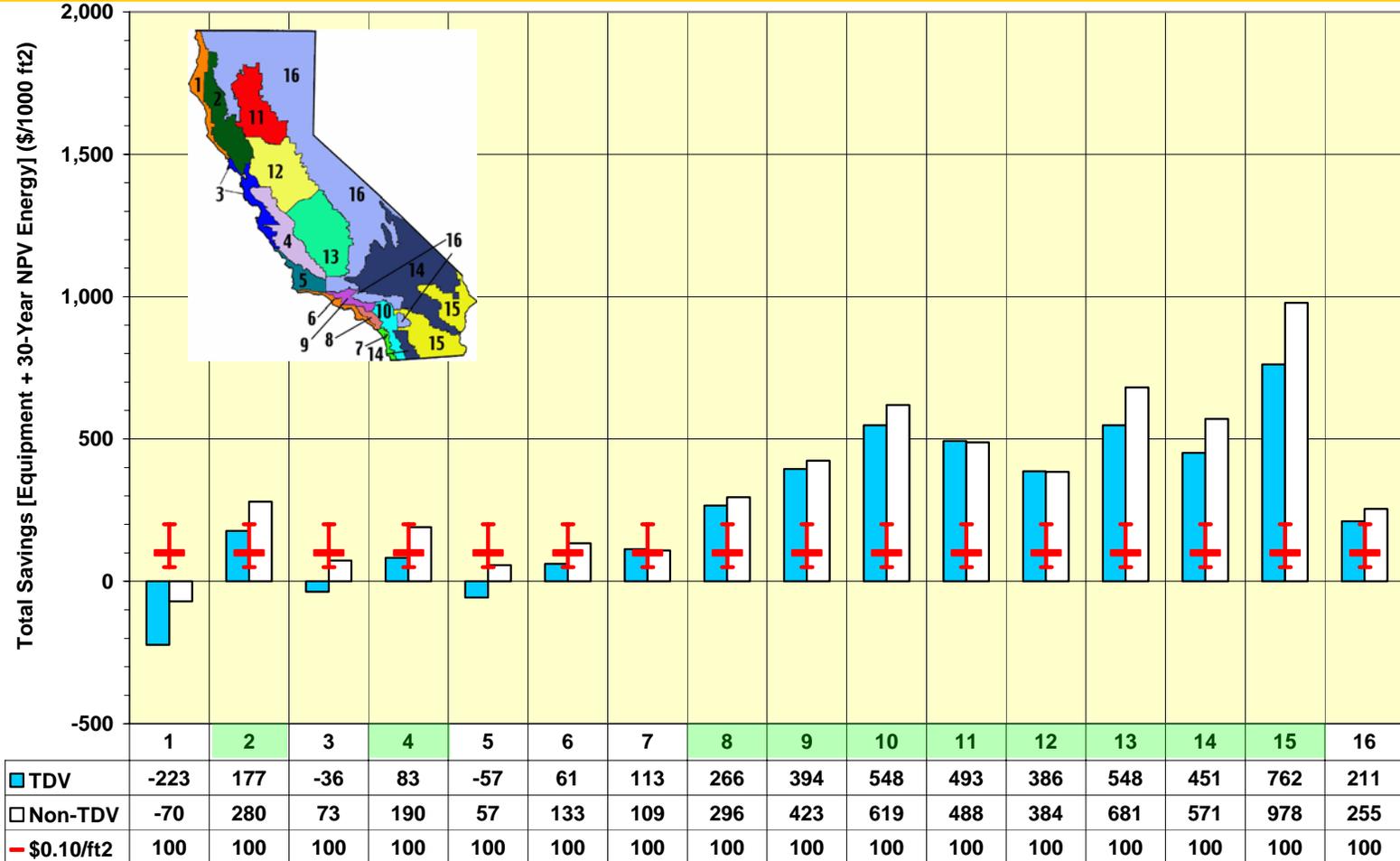
- Review measure availability and cost
 - technologies, market share
 - manufacturers, distribution
 - availability, cost premium
 - useful life
- Perform building cost/benefit analysis
 - evaluate measured energy savings
 - simulate cooling and heating energy uses
 - net savings (\$) = cooling savings (\$) - heating penalty (\$)
- Project state-wide savings

Cost effectiveness of increasing solar reflectance

- Simulated increasing three-year-aged solar reflectance ρ_{aged} of low-sloped roofing products
 - increased ρ_{aged} to 0.55 from 0.20
- Cost premium for higher-reflectance roofing
 - about \$0.20 per square foot of roof area
- Simulated increases were cost effective in Climate Zones 10, 11, 13, 15, and 16
 - 30-year net present value of TDV energy savings \geq \$0.20/ft² in California climate zones 10, 11, 13, 15, and 16



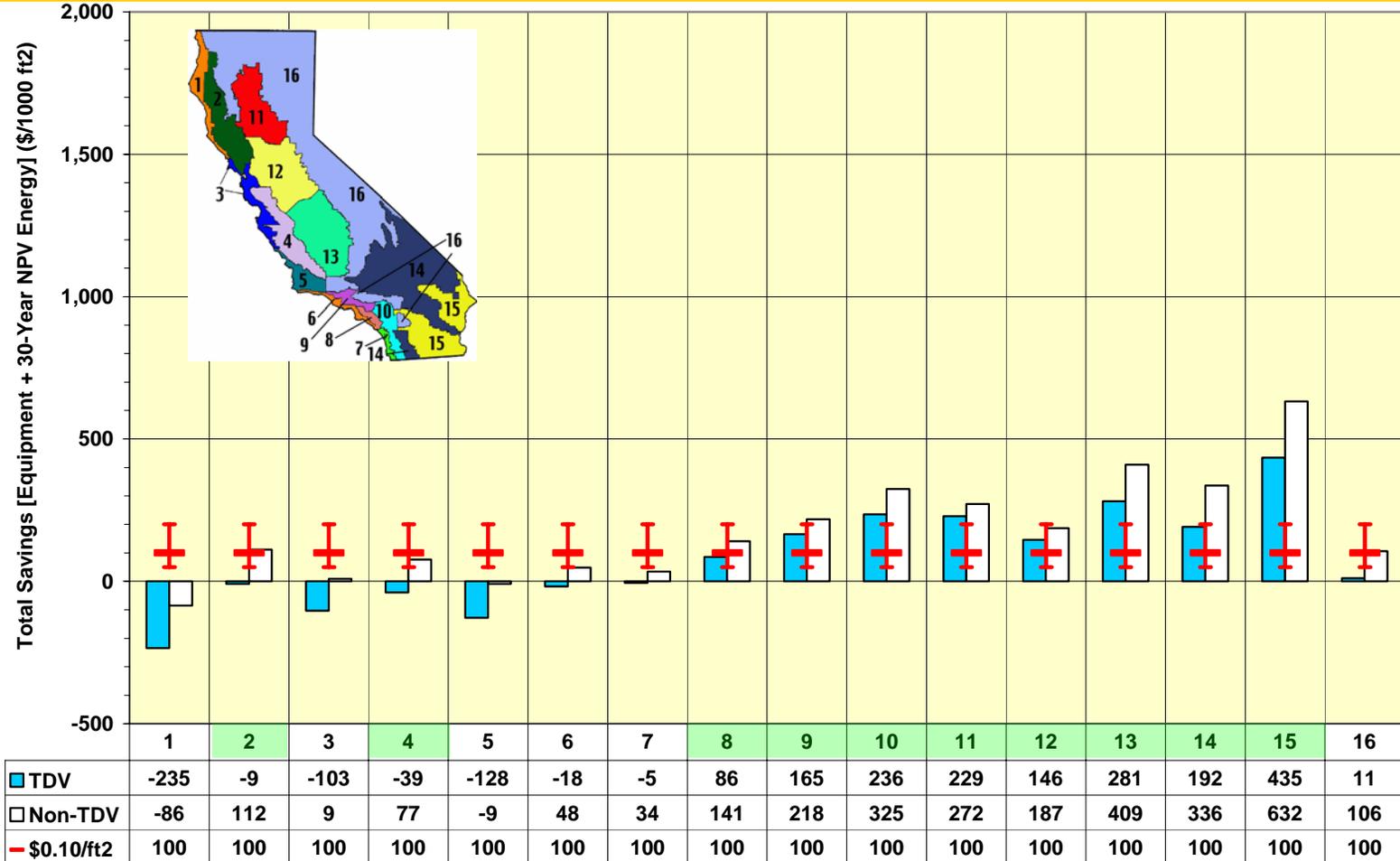
30-Year Net Present Value of Savings (\$/1000 ft²): **built-up roof without radiant barrier**



California Climate Zone



30-Year Net Present Value of Savings (\$/1000 ft²): **built-up roof with radiant barrier**



California Climate Zone



Projected annual statewide savings: **new construction**

- Increase in residential roof area.....180 Mft²
- Increase in AC low-sloped Res roof area.....13 Mft²
- Electricity TDV savings.....3.2 GWh
- Natural gas TDV **deficit**.....4.1 GBTU
- Net source energy TDV savings..... 6.9 GBTU
- Peak power demand savings.....0.6 MW
- Equipment savings.....\$0.2M
- TDV NPV savings.....\$1.8M



Projected annual statewide savings: **new construction + reroofing**

- Increase in AC low-sloped Res roof area.....62 Mft²
- Electricity TDV savings.....16 GWh
- Natural gas TDV **deficit**.....20 GBTU
- Net source energy TDV savings..... 33 GBTU
- Peak power demand savings.....2.8 MW
- Equipment savings.....\$0.8M
- TDV NPV savings.....\$8.8M



Proposed requirements for three-year-aged values of solar reflectance (ρ_{aged}), thermal emittance (ϵ_{aged})

- All products with $\epsilon_{\text{aged}} \geq 0.75$:
$$\rho_{\text{aged}} \geq 0.55$$
- All products with $\epsilon_{\text{aged}} < 0.75$:
$$\rho_{\text{aged}} \geq 0.55 + 0.24 * (0.75 - \epsilon_{\text{aged}})$$



Determining three-year-aged values of solar reflectance, thermal emittance

- Use CRRC aged values ρ_{aged} , ϵ_{aged} if labeled
- If CRRC labels only initial values ρ_{initial} , $\epsilon_{\text{initial}}$, we estimate ρ_{aged} and ϵ_{aged} :
 - $\rho_{\text{aged}} = 0.20 + 0.70 \times (\rho_{\text{initial}} - 0.20)$
 - $\epsilon_{\text{aged}} = \epsilon_{\text{initial}}$
- If the product does not have a CRRC label, default values are
 - $\rho_{\text{aged}} = 0.10$
 - $\epsilon_{\text{aged}} = 0.75$



Sections of T24 standards to be modified

- Section 101 - Definitions And Rules Of Construction
- Section 118(f) - Mandatory Requirements for Insulation and Cool Roofs
- Section 150 – Mandatory Features and Devices
- Section 151 – Performance and Prescriptive Compliance Approaches
- Section 152 –Addition and Alteration to Existing Buildings
- Alternative Calculation Manual (ACM)



Proposed requirements for 3-year-aged values of Solar Reflectance Index (SRI)

- Prescriptive requirements can be simpler
- All products: $SRI_{\text{aged}} \geq 64$

