

Technology Opportunities from California

- 1. Smart Grid and Demand Response***
- 2. Cool Roofs: from Cool Cities to a Cooler World***

**Arthur H. Rosenfeld, Commissioner
California Energy Commission
(916) 654-4930
ARosenfe@Energy.State.CA.US**

**<http://www.energy.ca.gov/commissioners/rosenfeld.html>
or just Google “Art Rosenfeld”**

Demand Response in CA

Demand Response

In 3 cool seasons CA peak is 40 GW, but a/c adds 20 GW in summer

So we want demand response to price.

So all customers will receive communicating interval meters, 10 million of them

Dynamic pricing: TOU summer afternoon + “critical peak” 10 days/yr

Programmable communicating thermostats and controls.

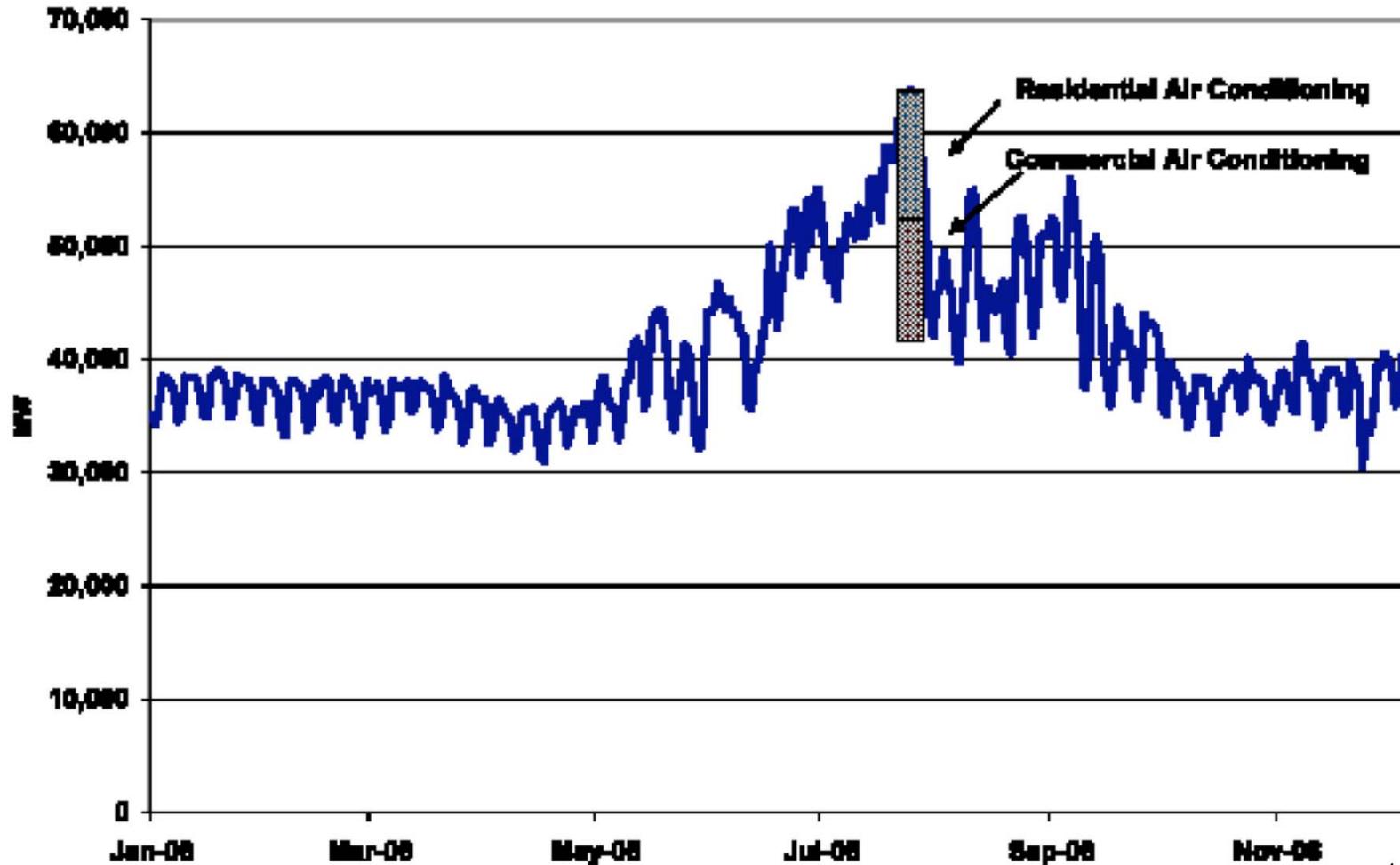
Cost premiums are small: \$20-30 for meters, \$20-30 for thermostats

TOU and dynamic pricing will change the design of buildings – promote thermal storage and the use of thermal mass, white roofs, etc.

If you announce dynamic prices today, architects will design better buildings tomorrow.

California is VERY MUCH a Summer Peaking Area

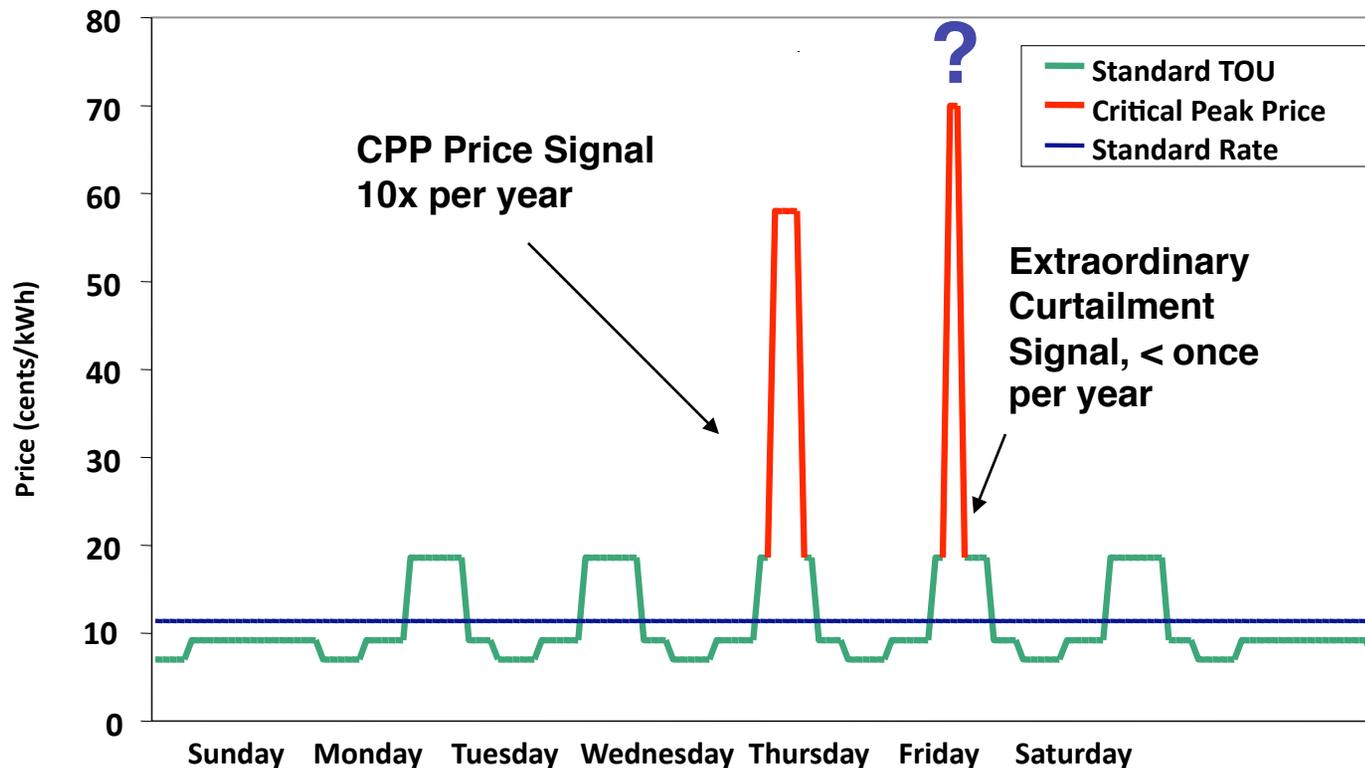
California Daily Peak Loads – 2006

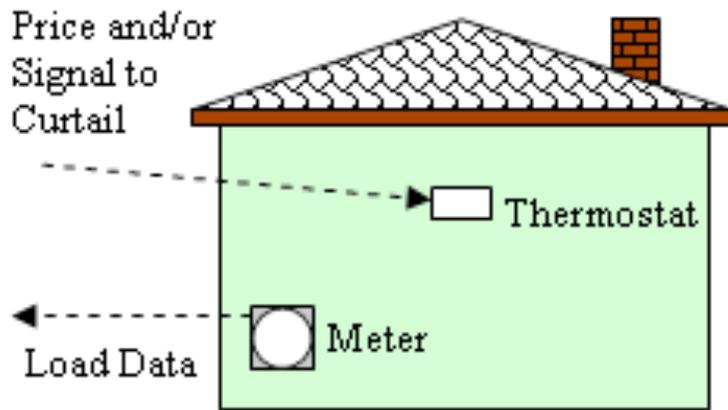


Critical Peak Pricing (CPP) with additional curtailment option

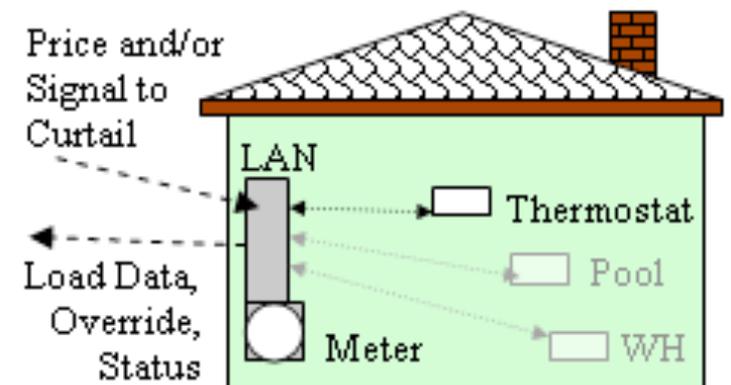
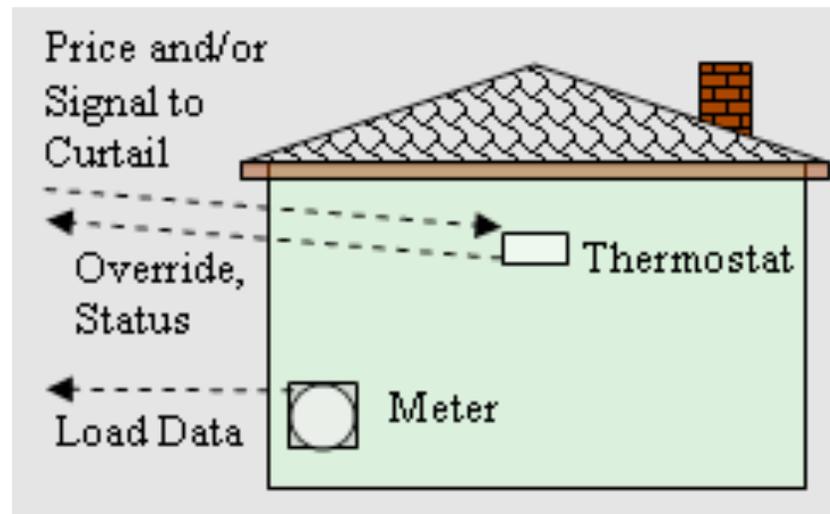
Potential Annual Customer Savings:

10 afternoons x 4 hours x 1kw = 40 kWh at 70 cents/kWh = ~\$30/year





Just some of the proposed systems for PCTs and demand response in the residential and small commercial/ industrial sectors.



Santorini, Greece



White is 'cool' in Bermuda



and in Hyderabad, India



...and widely in the State of Gujarat, India

- *To be published in Climatic Change 2009*
- **Global Cooling: Increasing World-wide Urban Albedos to Offset CO2**

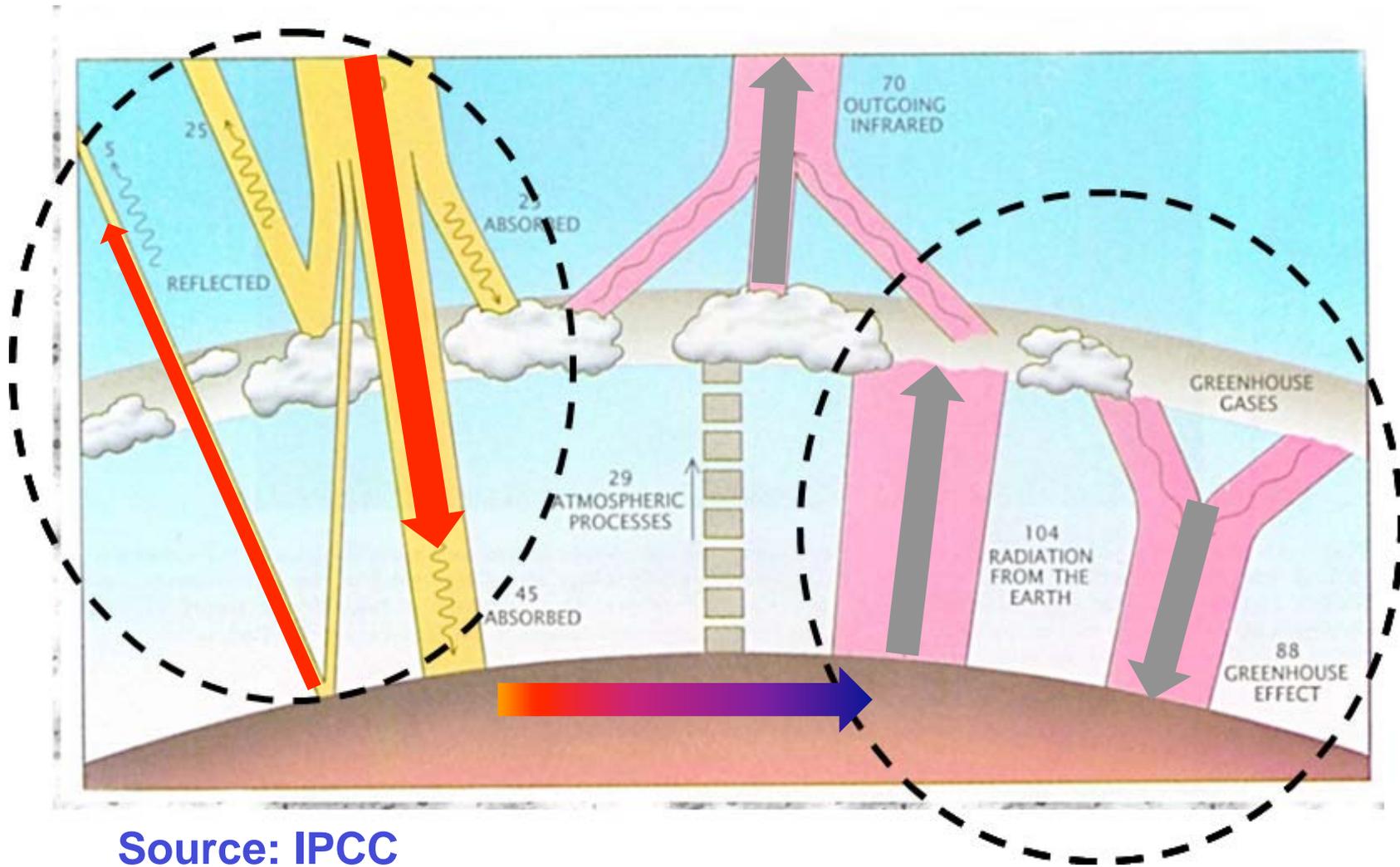
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Hashem Akbari and Surabi Menon
*Lawrence Berkeley National
Laboratory, USA*
H_Akbari@lbl.gov
Tel: 510-486-4287

Arthur Rosenfeld
*California Energy Commission,
USA*
Arosenfe@energy.state.ca.us
Tel: 916-654 4930

- **A First Step In Geo-Engineering Which Saves Money and Has Known Positive Environmental Consequences**

Solar Reflective Surfaces Also Cool the Globe



Source: IPCC

100m²(~1000 ft²) of a white roof, replacing a dark roof, offset the emission of 10 tonnes of CO₂



How to Relate to 10 Tons of CO2

- First – This is 10 tons ONCE, not 10 tons/year;
- But familiar measures are usually in terms of tons/**year**;
- So we will look at how many years of emissions 10 tons will offset

	Tons CO2/Yr	Years Equivalent to 10 Tons
Average US House Emits	10	1
Average US Car Emits	5	2
Average Global Car Emits	4	2.5
Average CFL Saves	.05=1/20	200

CO₂ Equivalency of Cool Roofs World-wide (Tropics+Temperate)

- Cool Roofs alone could offset a total of 24 Billion Tons (Gt) CO₂, = world emissions this year !!!!
- Worth > €240 Billion (Pre-recession was €600B)
- To Convert 24 Gt CO₂ one-time into a rate
- Assume 20 Year Program, thus 1.2 Gt CO₂/year
- Average World Car emits 4 tCO₂/year,

equivalent to 300 Million Cars

off the Road for 20 years.

(600 million cars in the world)

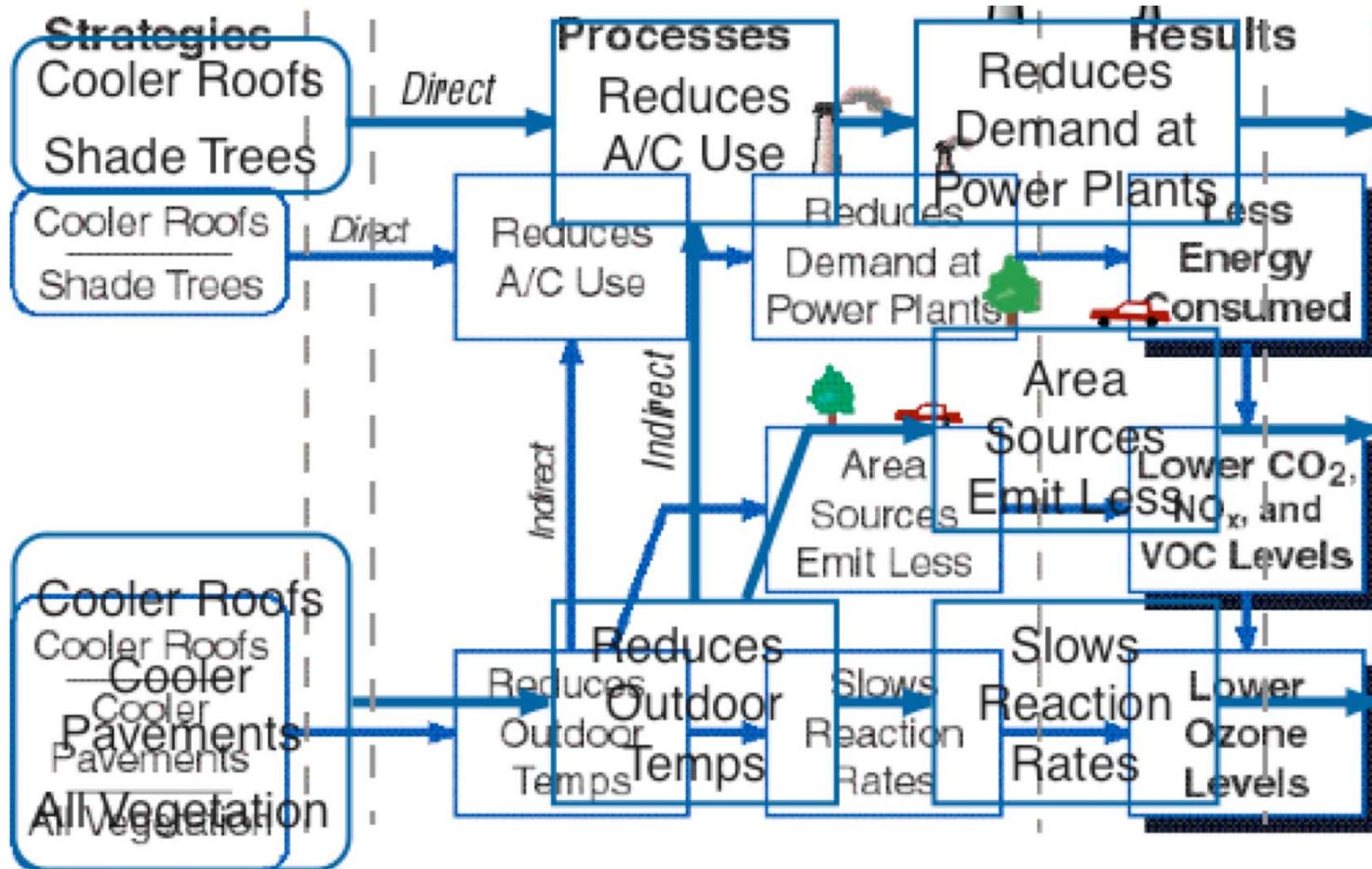
The End

For More Information:

http://www.energy.ca.gov/commissioners/rosenfeld_docs/index.html

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Methodology: Energy and Air-Quality Analysis



Cool Roof Technologies

Old



flat, white



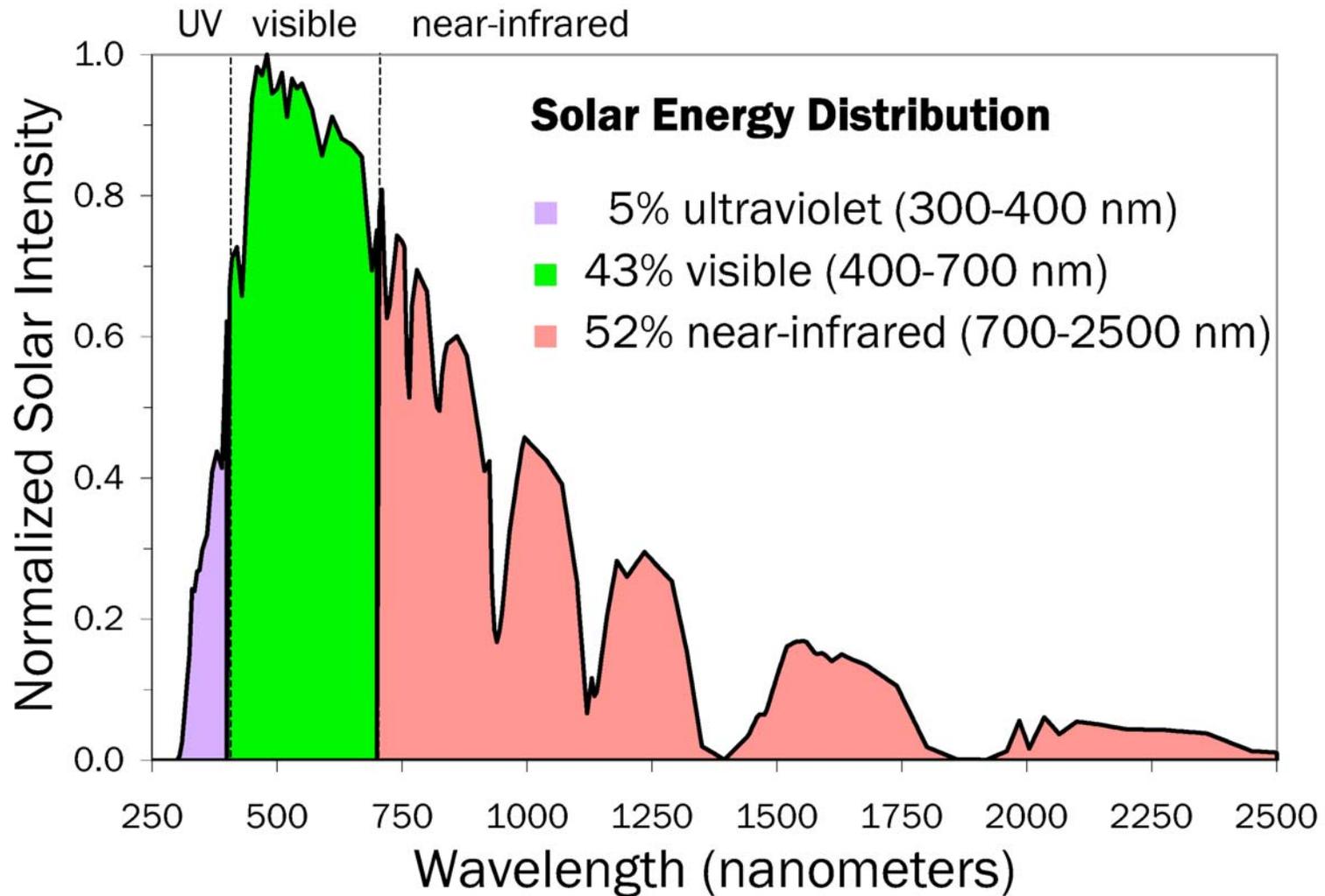
pitched, white

New



pitched, cool & colored

Cool Colors Reflect Invisible Near-Infrared Sunlight



Cool and Standard Brown Metal Roofing Panels

- Solar reflectance ~ 0.2 higher
- Afternoon surface temperature ~ 10°C lower

Courtesy
BASF
Coatings

