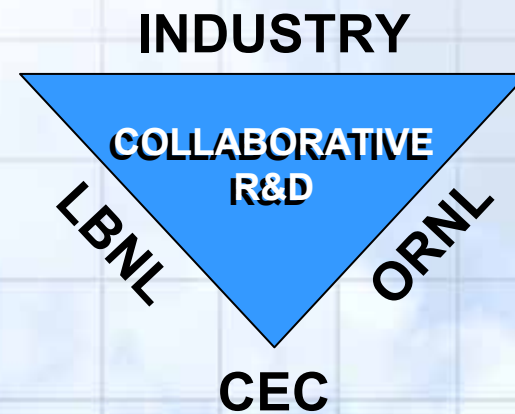


Market Deployment of Cool-Colored Roofing Materials

Project Advisory Committee (PAC) Meeting

Sponsored by the
California Energy Commission
(Project Manager: Chris Scruton)

September 7, 2006; California Energy Commission, Sacramento, CA



Phase 1 Accomplishments

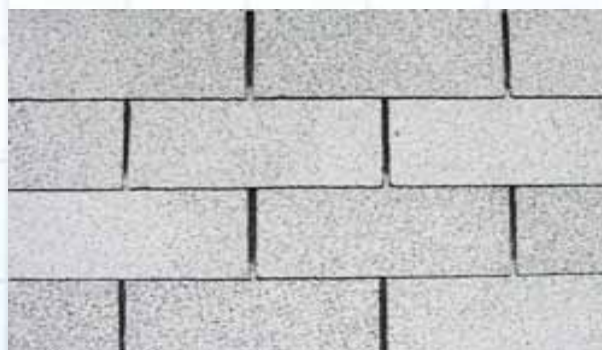
- Our goals were to develop
 - dark shingles with solar reflectance of ≥ 0.25
 - Tiles, tile coatings, and painted metals with solar reflectances ≥ 0.45
- We achieved
 - colored shingles with solar reflectance of ≥ 0.25
 - colored tiles, tile coatings, and metals with solar reflectance of 0.30-0.45 (from 0.05-0.25)
- Thanks to our manufacturing partners

Increasing solar reflectance of fiberglass asphalt shingles: prototypes

cooler: $\rho=0.28$



$\rho=0.36$



$\rho=0.37$



warmer: $\rho=0.23$



$\rho=0.27$



$\rho=0.28$



Increasing solar reflectance of fiberglass asphalt shingles: Elk Prestique® Cool Color Series



3M “cool” granules for fiberglass asphalt shingles

Courtesy
3M



$\rho=0.32$

$\rho=0.25$

$\rho=0.27$

$\rho=0.27$

ρ = solar reflectance

ISP Mineral SolarShield™ reflective granules:

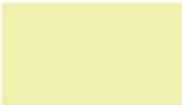
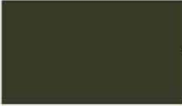
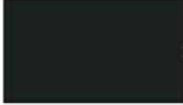
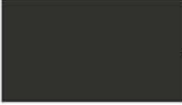
(source:www.hersheyphilbin.com/news/isp/021506.html)



SolarShield™ granules meet and exceed EPA's Energy Star® steep-sloped roofing requirements

Increasing solar reflectance of metal roofing: BASF Ultra-Cool® metal roof coatings

Courtesy
BASF
Industrial
Coatings

	Concord Cream 872T4 67.3 (60.4)		Slate Gray 870D3 39 (19.6)		Evergreen 870G4 29.4 (12.5)
	Rawhide 872T6 57 (47)		Bright Red 872R5 38.5 (38.5)		Hartford Green 872G3 28.3 (10.8)
	Sierra Tan 870T7 53.6 (37.6)		Brick Red 872R6 36.6 (24.7)		Teal 872G4 28.1 (24.8)
	Pearl Gray 872D4 48.7 (31.5)		Medium Bronze 872T10 34.6 (12)		Regal Blue 872B4 27.5 (19.6)
	Marine Green 870G2 41 (31.9)		Slate Blue 872B6 34.4 (21.3)		Charcoal Gray 872D2 27.4 (14.2)
	Patina Green 872G5 41 (29.2)		Slate Bronze 870T5 30.6 (9.6)		Dark Bronze 872T9 26.6 (8)

numbers denote solar reflectances: cooler (warmer)

Cool metal roofs



Cool colored clay tiles

Model	Color	Initial solar reflectance	Solar reflectance after 3 years
Weathered Green Blend		0.43	0.49
Natural Red		0.43	0.38
Brick Red		0.42	0.40
White Buff		0.68	0.56
Tobacco		0.43	0.41



Increasing solar reflectance of concrete tiles: American Rooftile Coatings

Courtesy
American
Rooftile
Coatings

$\rho=0.41$ <i>black</i>	$\rho=0.44$ <i>blue</i>	$\rho=0.44$ <i>gray</i>	$\rho=0.48$ <i>terracotta</i>	$\rho=0.46$ <i>green</i>	$\rho=0.41$ <i>chocolate</i>
$\rho=0.04$	$\rho=0.18$	$\rho=0.21$	$\rho=0.33$	$\rho=0.17$	$\rho=0.12$
$\Delta\rho=0.37$	$\Delta\rho=0.26$	$\Delta\rho=0.23$	$\Delta\rho=0.15$	$\Delta\rho=0.29$	$\Delta\rho=0.29$

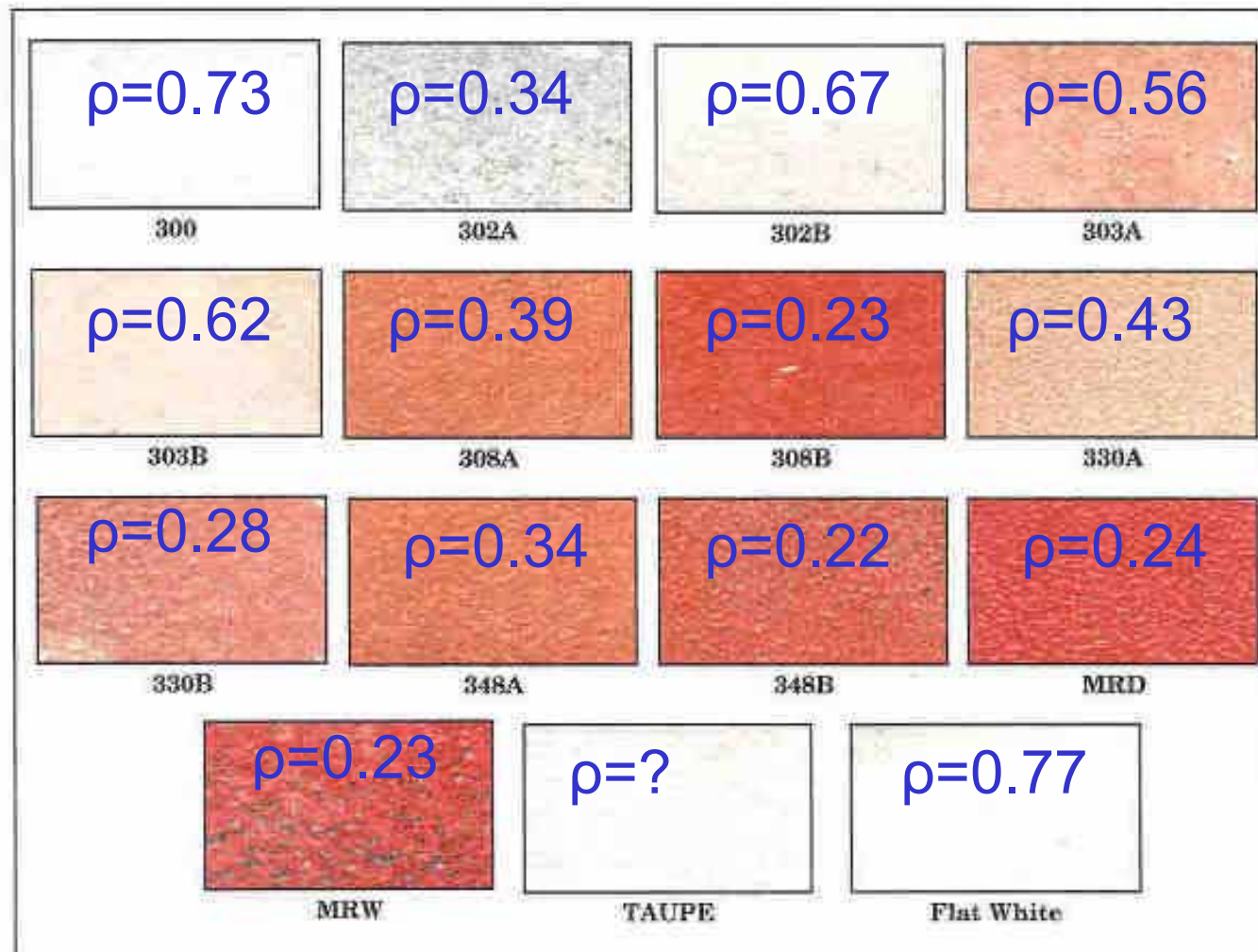
cooler

warmer

- Can potentially increase solar reflectance ρ by up to 0.50
- Gain greatest for dark colors

MonierLifetile concrete tiles

(Source: <http://www.fsec.ucf.edu/bldg/pubs/cr670/index.htm#Figure%204>)



From cool color roofs to cool color cars



- Toyota experiment
- Ford is also working on the technology

And cool colored jackets

(Source: www.ips-innovations.com/solar_reflective_clothing.htm)



What needs to be done next? (Phase 2 Project)

- Credit and prescribe cool roofs for steep-sloped-roof buildings in the state's Title 24 energy efficiency standards for residential and nonresidential buildings
- Encourage the production and purchase of cool roofs via utility-sponsored innovative incentive programs
- Widen the availability of cool roofing materials for all sloped-roof buildings
- Quantify the direct and indirect benefits of cool roofing materials to homeowners and communities
- Educate consumers, contractors, engineers and architects by publicizing the results of the research

Project goals

- Provide technical assistance to California utilities and public interest organizations in developing incentive programs for residential cool roofs
- Help manufacturers of cool-colored materials to deploy their products
- Measure the energy savings yielded by cool-colored roofing materials, and use this data to validate an energy savings calculator
- Educate consumers, contractors, engineers and architects by publicizing the results of the research

Project Advisory Committee (PAC) members

1. Asphalt Roofing Manufacturers Association (ARMA)
2. Cedar Shake and Shingle Bureau
3. Cool Roof Rating Council (CRRC)
4. Construction Engineering Research Lab (CERL/DOD)
5. Department of Energy (DOE)
6. Environmental Protection Agency (Energy Star/EPA)
7. EPA San Francisco Office
8. Florida Solar Energy Center (FSEC)
9. Pacific Gas and Electric Company (PG&E)
10. Roof Coating Manufacturers Association (RCMA)
11. Tile Roofing Institute
12. Southern California Edison Company (SCE)

Industrial partners

- 3M
- Akzo Nobel
- American RoofTile Coatings
- BASF
- CertainTeed
- Custom-Bilt Metals
- Elk Corporation
- Ferro
- GAF
- Hanson Roof Tile
- ISP Minerals
- MCA
- MonierLifetile
- Owens Corning
- Steelscape
- Shepherd Color

Project team

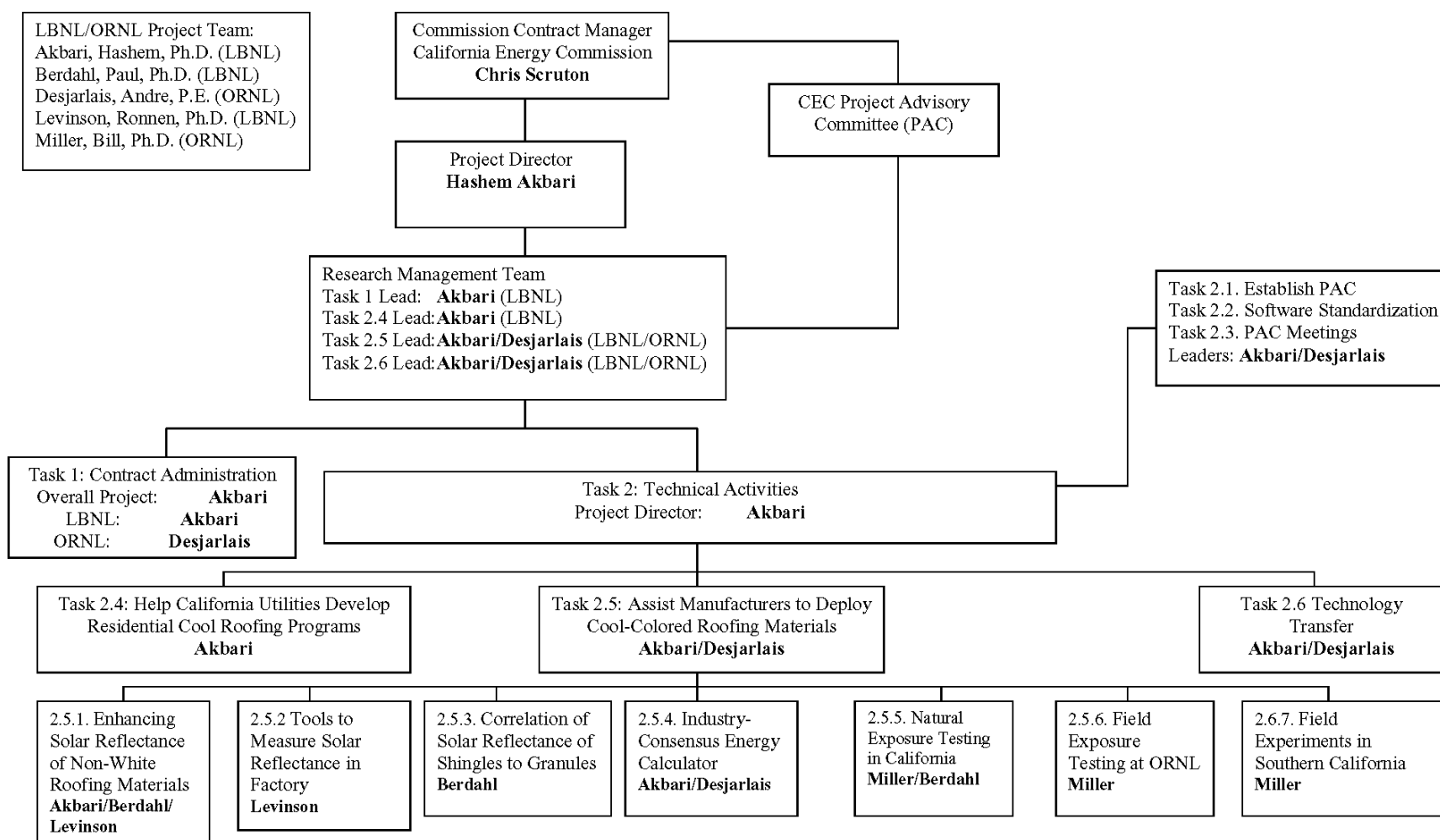
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- Ronnen Levinson
RMLevinson@LBL.gov

- **ORNL**

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- Bill Miller
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Project management



Technical tasks

2.4 Help California utilities develop cool roofing programs for their residential customers

2.5 Assist manufacturers of cool-colored materials to deploy their products

2.6 Technology transfer activities

2.4 Help California utilities develop cool roofing programs for their residential customers

- Objectives
 - The purpose of this task is to help California utilities develop cool roofing programs for their residential customers
- Deliverables:
 - Work with California utilities and assist them to develop incentive programs (Quarterly Progress Reports)
- Schedule: 08/20/2006 – 06/20/2008
- Funds Expended 0%

2.5 Assist manufacturers of cool-colored materials to deploy their products

- Objective: Continue to work with the roofing materials manufacturers to deploy and market their cool products
- Subtasks:
 - Enhance the solar reflectance of non-white roofing materials
 - Develop tools to measure solar reflectance for factory quality control
 - Correlate the solar reflectance of a shingle to that of its constituent granules
 - Develop industry-consensus energy-savings calculator
 - Conduct natural exposure testing in California
 - Conduct field exposure testing at ORNL
 - Carry out field experiments to evaluate new cool-colored roofing materials in Southern California for validation of the industry-consensus energy savings calculator

2.5.1 Enhance the solar reflectance of non-white roofing materials

- Objective: Continue working with ISP Minerals, 3M, and CertainTeed to improve the reflectance of their granules using the bi-layer technique
- Deliverables:
 - Prototype cool-colored roofing shingles and tiles with increased solar reflectance
- Schedule: 07/20/2006 – 07/20/2008
- Funds Expended 0%

2.5.2 Develop tools to measure solar reflectance for factory quality control

- Objective: Develop instruments to measure solar reflectance for factory quality control practices
- Deliverables:
 - A prototype measurement apparatus and protocol for measuring solar reflectance of variegated products in the factory
- Schedule: 07/20/2006 – 07/20/2008
- Funds Expended 0%

2.5.3 Correlate the solar reflectance of a shingle to that of its constituent granules

- Objective: Relate the solar reflectance of a roofing shingle to that of its granules
- Deliverables:
 - A technique for correlating the reflectance of a cool-colored shingle to that of its surface granules
- Schedule: 07/20/2006 – 07/20/2008
- Funds Expended 0%

2.5.4 Develop industry-consensus energy-savings calculator

- Objective: Develop a web-based calculator (and a PC-based version) with which roofing contractors and distributors can estimate the cooling energy savings and peak demand reduction achieved by installing cool roofing on specific buildings
- Deliverables:
 - Industry-consensus energy calculator
- Schedule: 07/20/2006 – 07/20/2008
- Funds Expended 0%

2.5.5 Conduct natural exposure testing in California

- Objective: Conduct natural exposure testing of currently tested roofing samples and new roofing materials
- Deliverables:
 - A technical report summarizing the results of the exposure testing
- Schedule: 07/20/2006 – 07/20/2009
- Funds Expended 0%

2.5.6 Conduct field exposure testing at ORNL

- Objective: conduct field exposure testing of new cool roofing materials at ORNL
- Deliverables:
 - Use data to validate industry-consensus energy savings calculator
 - A technical report summarizing the results of field exposure testing at ORNL
- Schedule: 07/20/2006 – 07/20/2009
- Funds Expended 0%

2.5.7 Carry out field experiments in Southern California for validation of the energy savings calculator

- Objective: Carry out field experiments to evaluate new cool-colored roofing materials in Southern California for validation of the industry-consensus energy savings calculator
- Deliverables:
 - Comparison of validated steep-slope roof calculator to demonstration data
 - A technical report summarizing the results of the field experiments and comparison of the energy-savings calculator
- Schedule: 07/20/2006 – 07/20/2009
- Funds Expended 0%

2.6 Technology transfer activities

- Objective: Make the knowledge gained, experimental results and lessons learned available to key decision-makers
- Deliverables:
 - Publish results in industry magazines and refereed journals
 - Participate in building products exhibitions
 - Develop a brochure summarizing the research results and characterizing the benefits of cool colored roofing materials
- Schedule: 07/20/2006 – 07/20/2008
- Funds Expended 0%

Schedule of PAC meetings

	Date	Location
PAC-1	Sep. 7, 2006	CEC
PAC-2	Mar. 8, 2007	LBNL
PAC-3	Sep. 6, 2007	?
PAC-4	Mar. 6, 2008	ORNL
PAC-5	Sep. 4, 2008	?
PAC-6	Mar. 5, 2009	?

Cool colors project website

- Project information (including copies of this presentation) available online at

<http://CoolColors.LBL.gov>