Ten Years at the Calif. Energy Commission & White Roofs to Cool your Building, your City and (this is new !) Cool the World

IEA Annex 53 Meeting
Lawrence Berkeley Lab.

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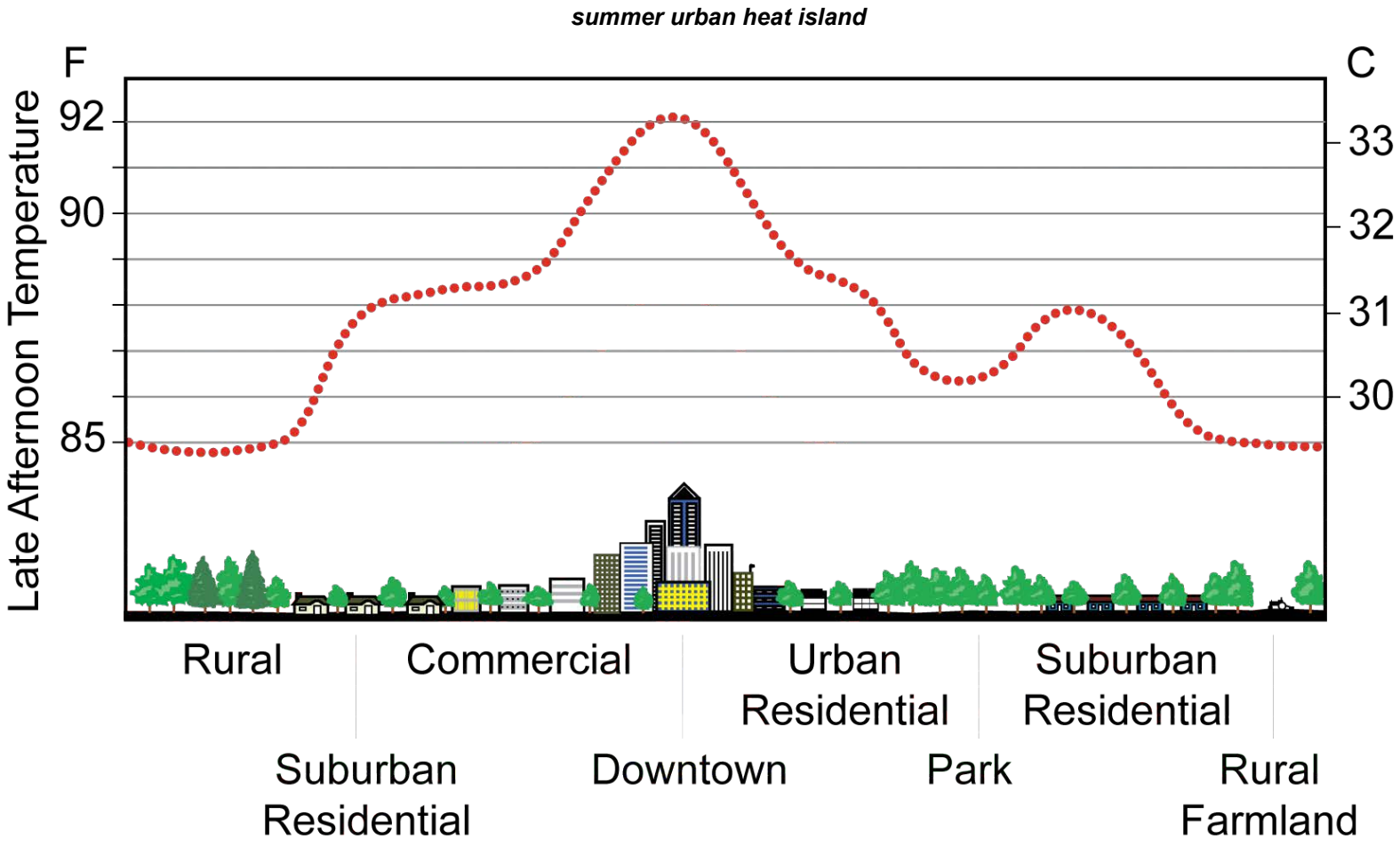
Presentation available at www.ArtRosenfeld.org

Filename Carnegie DC fm Russian Talk 6-5-11 + DR from EE Summit Sacto. Path DinnerTalk Life at CEC. ARPA-E

Summer in the city



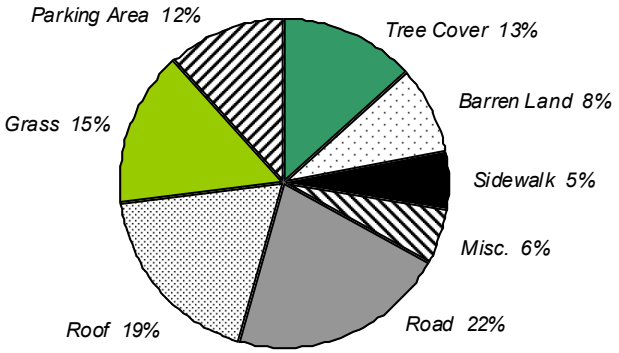
Bird's eye view of urban land use

3

~ 1 km^2

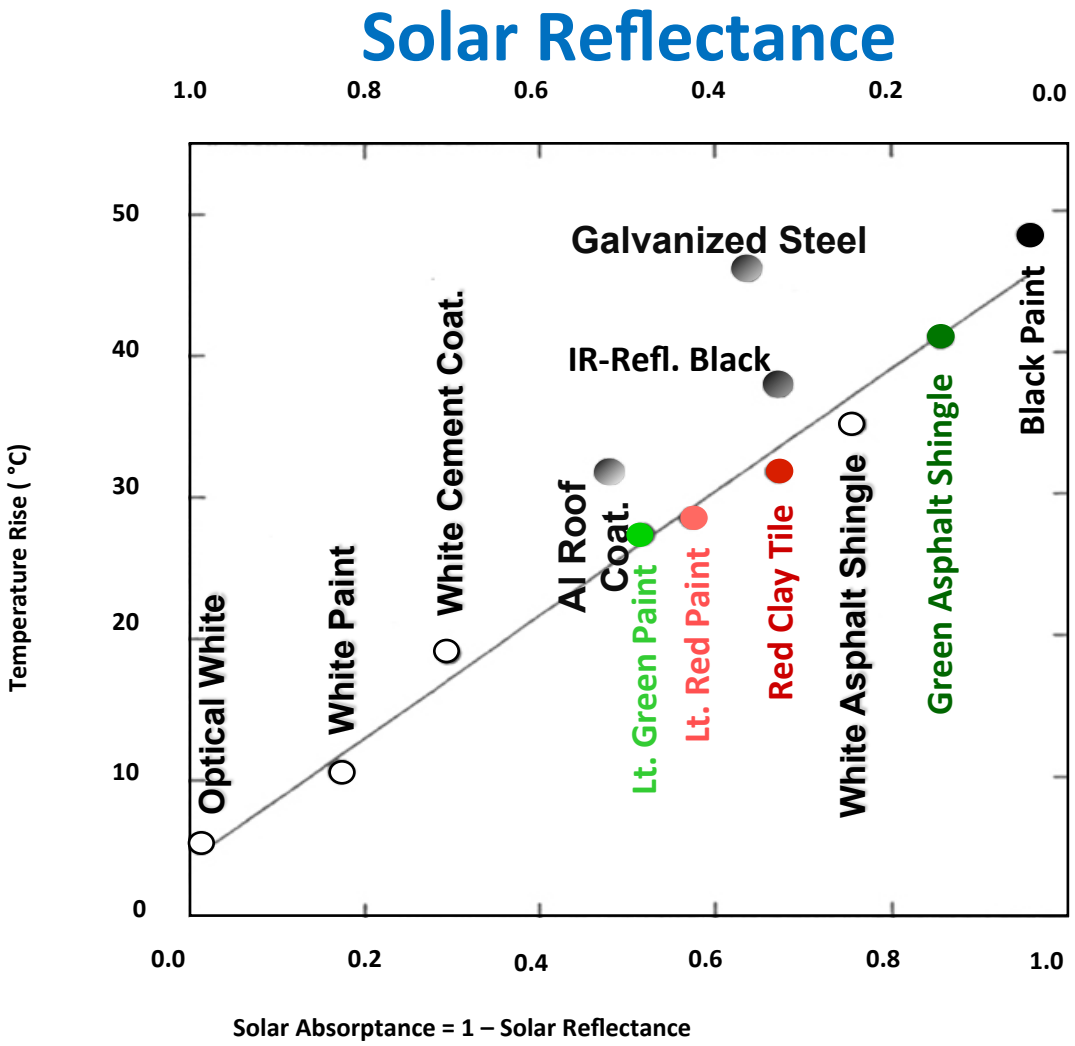
The surface of Sacramento, CA is about

- **20% roofs**
- **30% vegetation**
- **40% pavement**



Area by Land-Cover Category Above the Canopy

Reflective roofs stay cooler in the sun



White roofs, cool-colored roofs save money

OLD

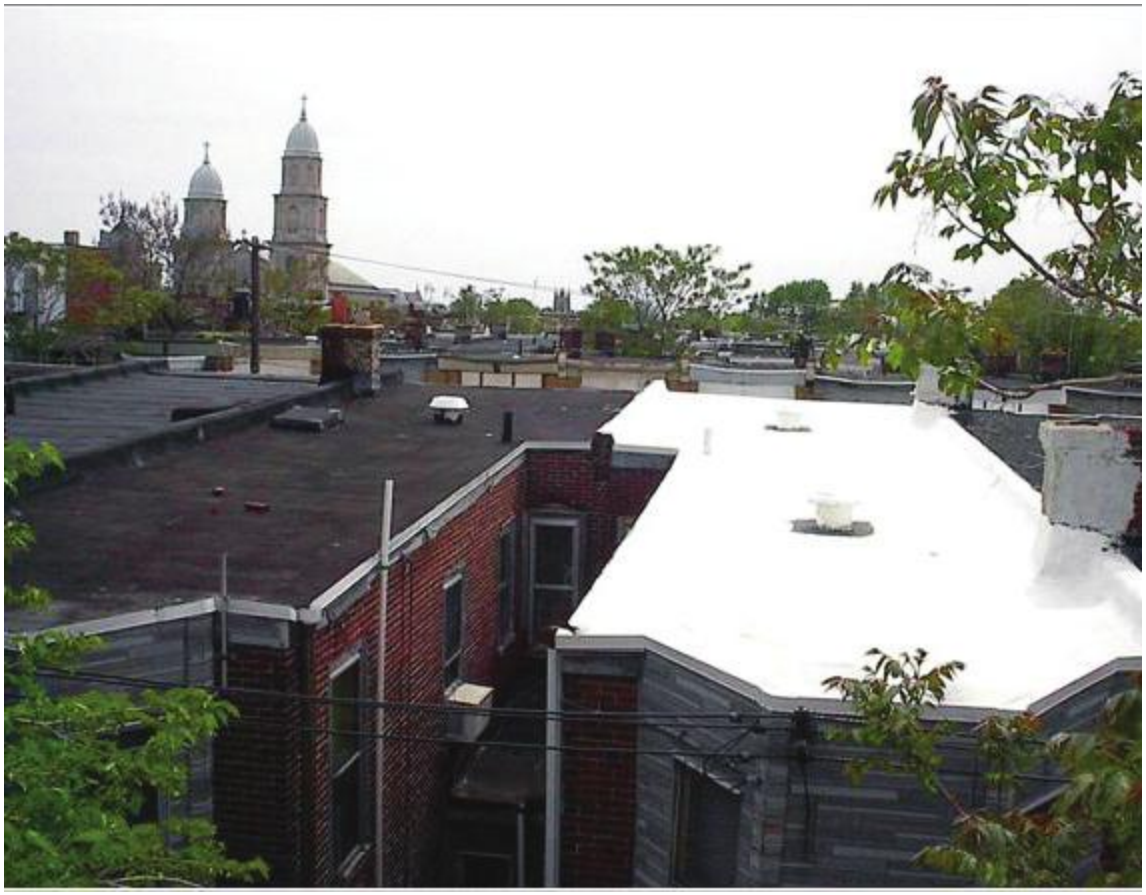
flat, white

pitched, white

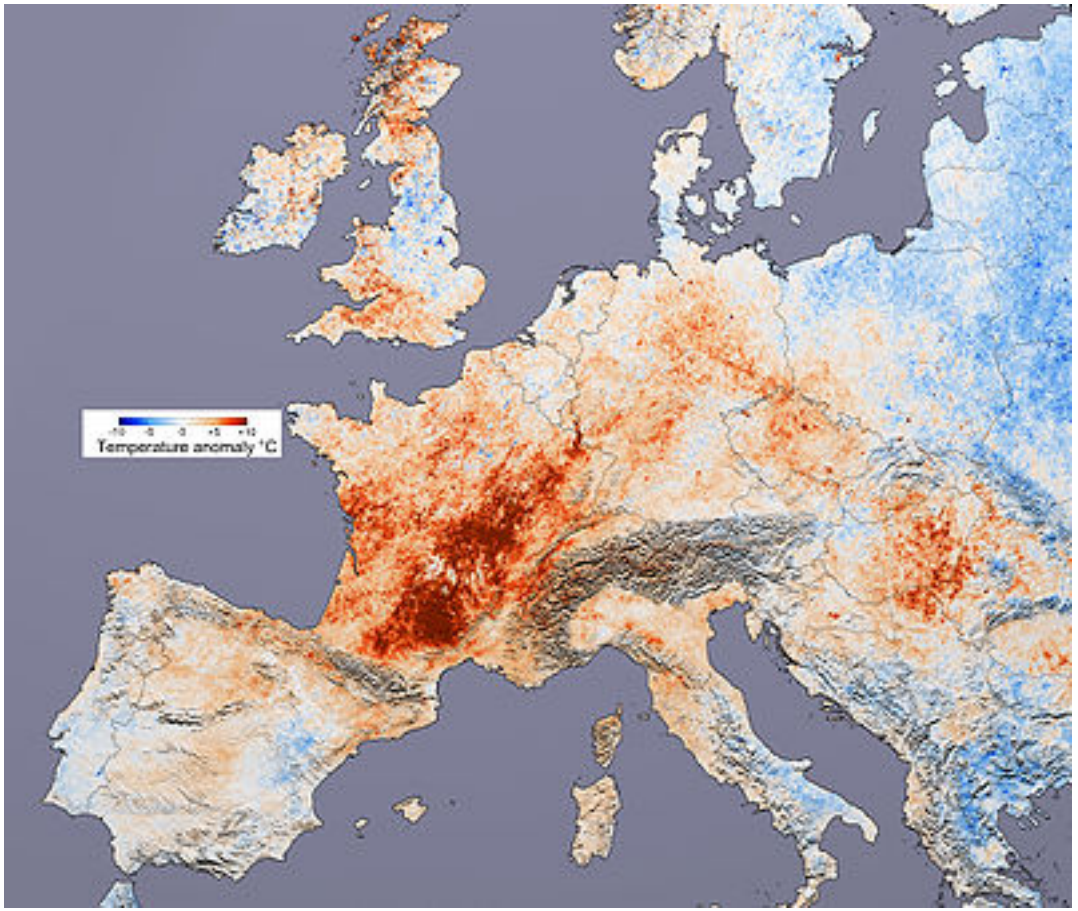
NEW

pitched, cool & colored

Chicago Heat Wave 1995, 739 Deaths
The most lethal floor was the top floor of a building with a black roof



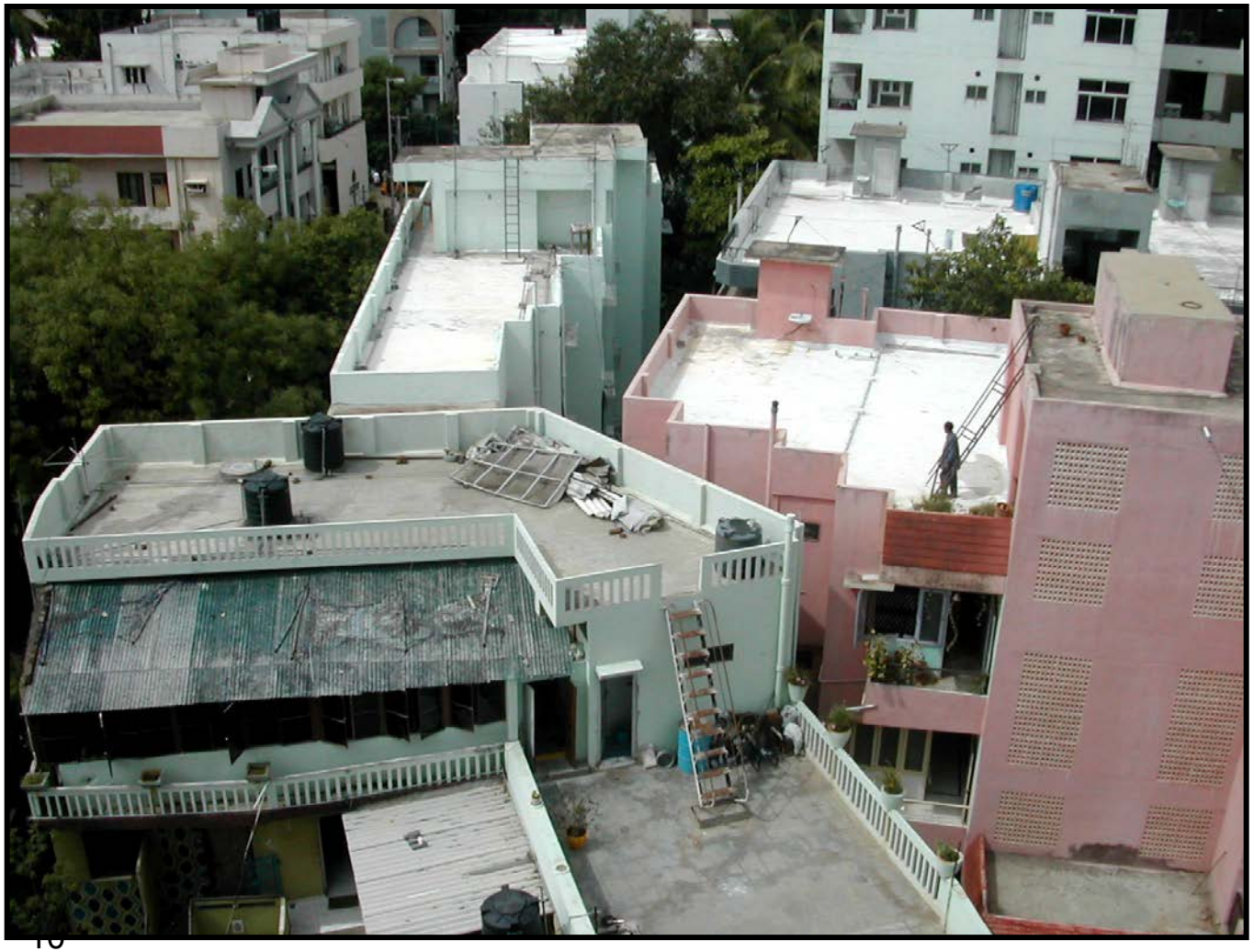
European Heat Wave 2003, 30,000 Deaths
Moscow-Centered Heat Wave 2010,~10,000 Deaths



White roofs around the world

…in Santorini, Greece

…in Hyderabad, India



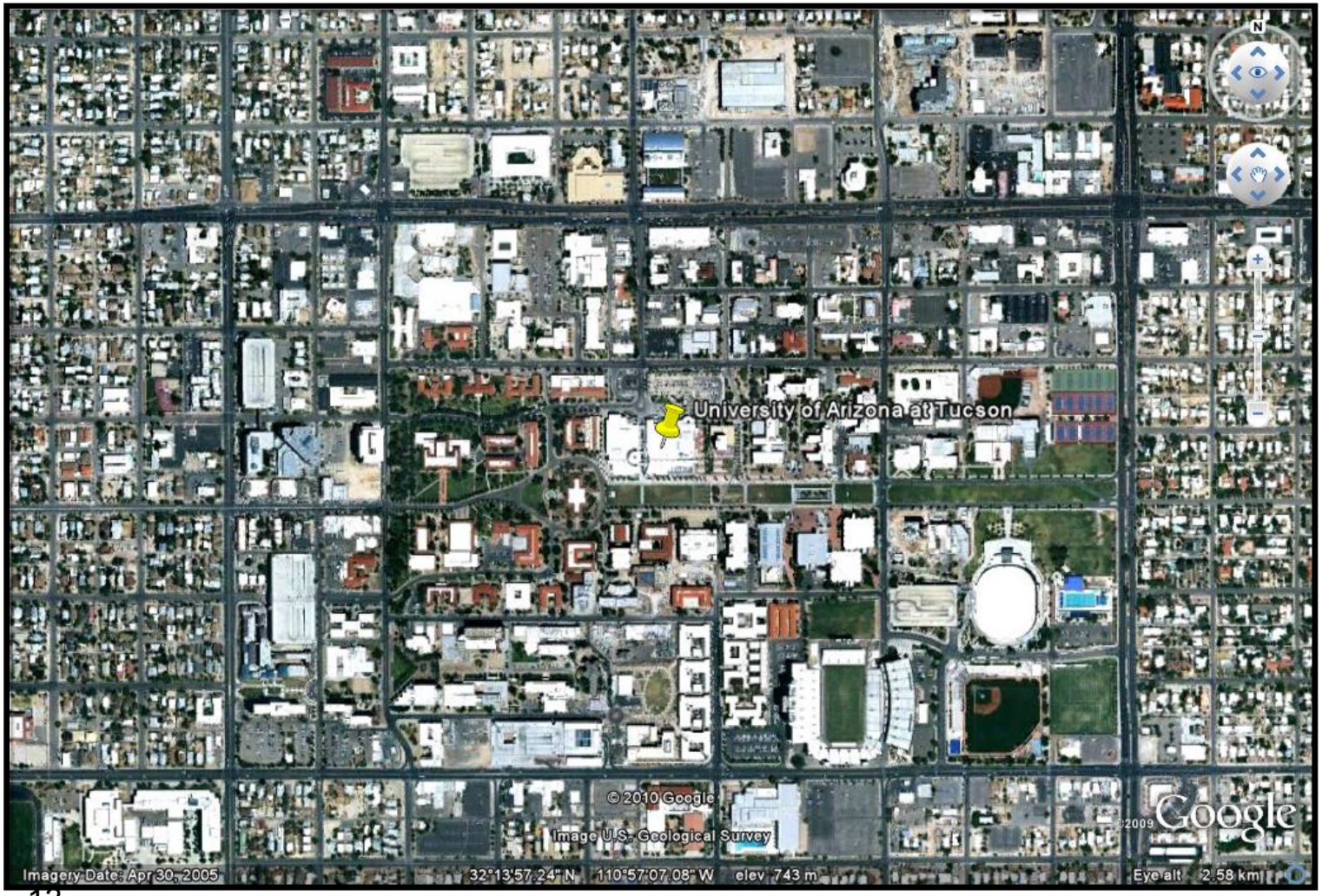
…and widely in the state of Gujarat, India.

Walmart store in northern California

Congratulations to UC Davis

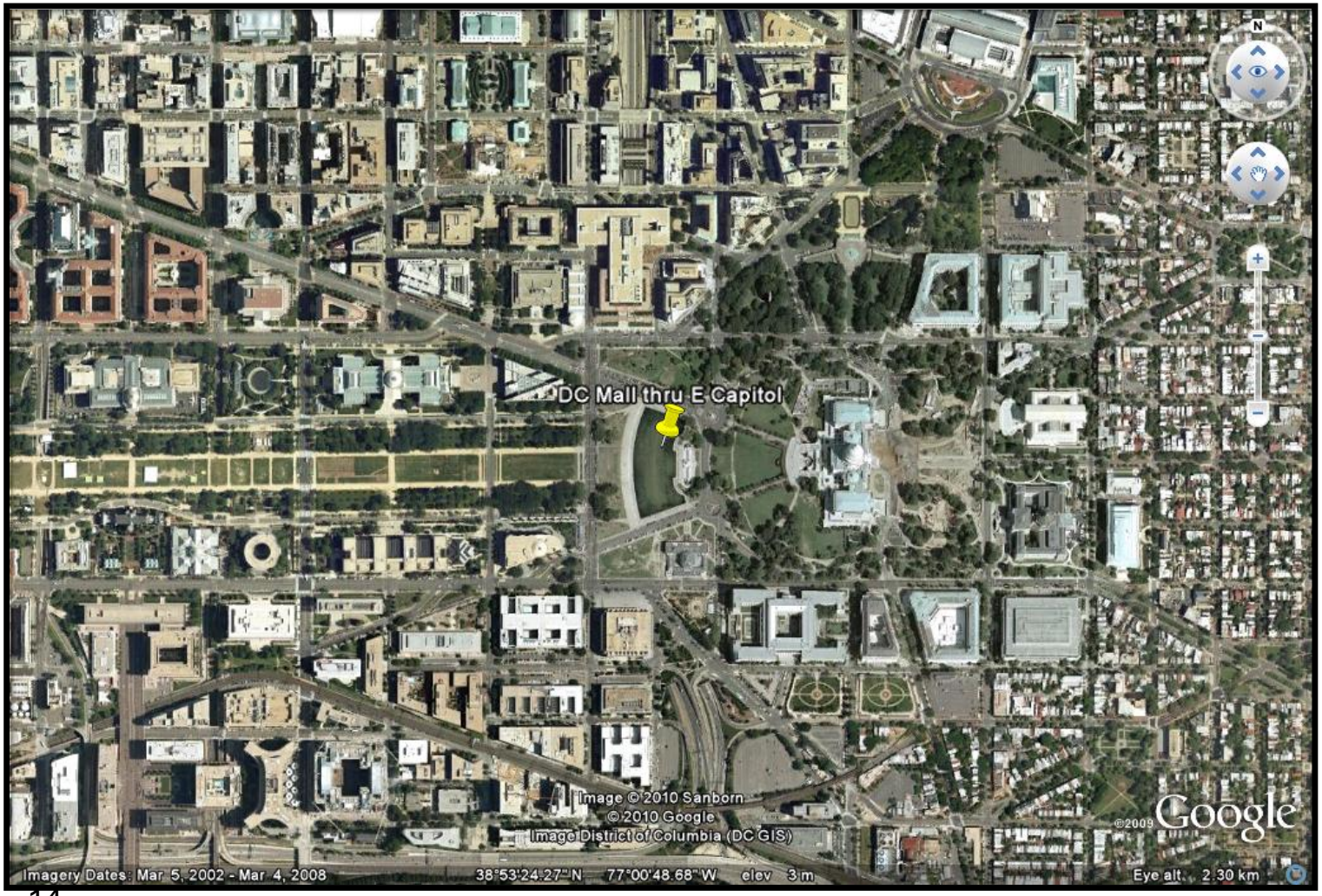
12

White roofs are popular in Tucson, AZ



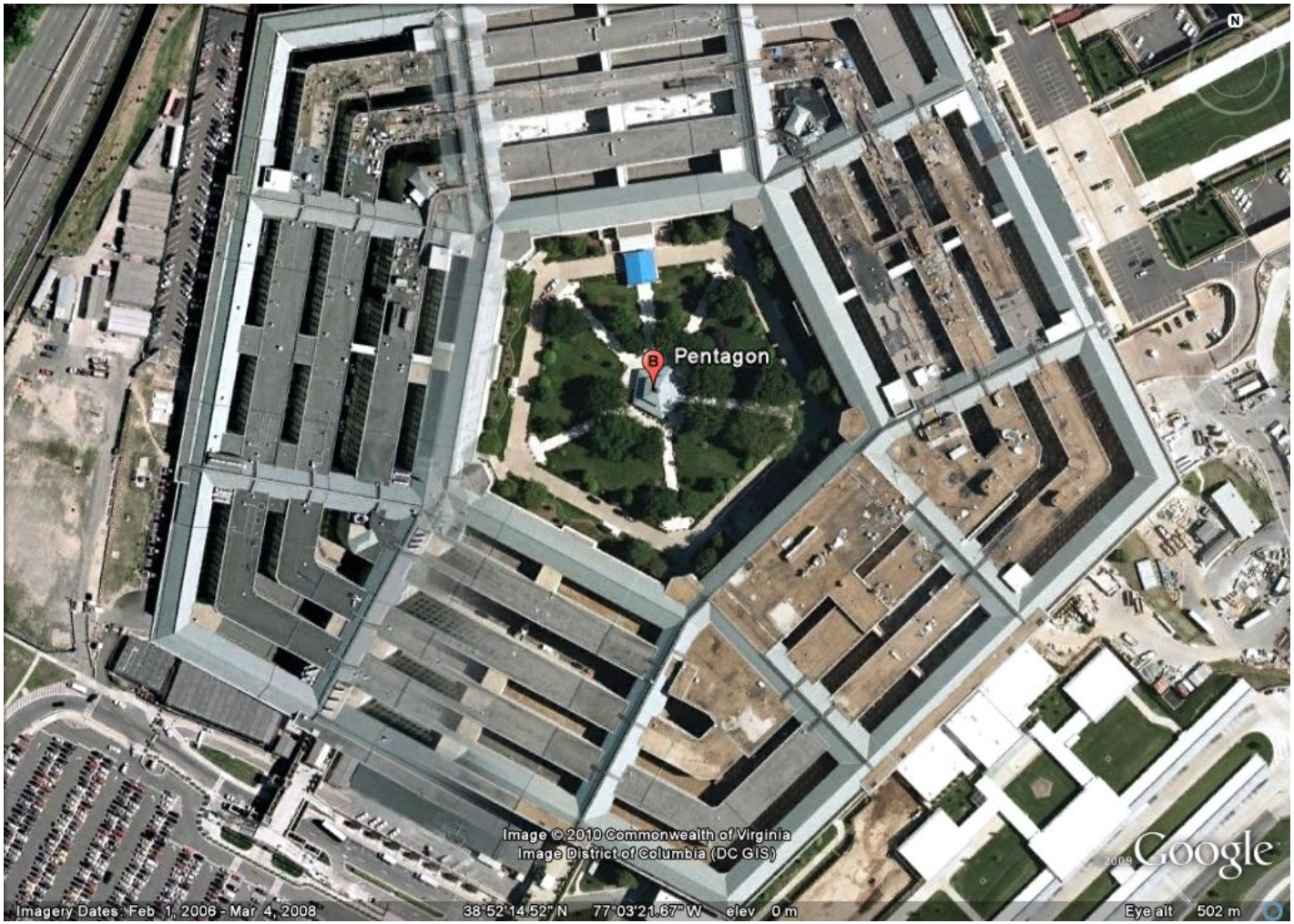
13

Washington, DC (Federal) has problems



14

Pentagon


Pentagon
Image © 2010 Commonwealth of Virginia
Image District of Columbia (DC GIS)
Google
Imagery Dates: Feb 1, 2006 - Mar 4, 2008
38°52'14.52" N 77°03'21.67" W elev 0 m
Eye alt 502 m

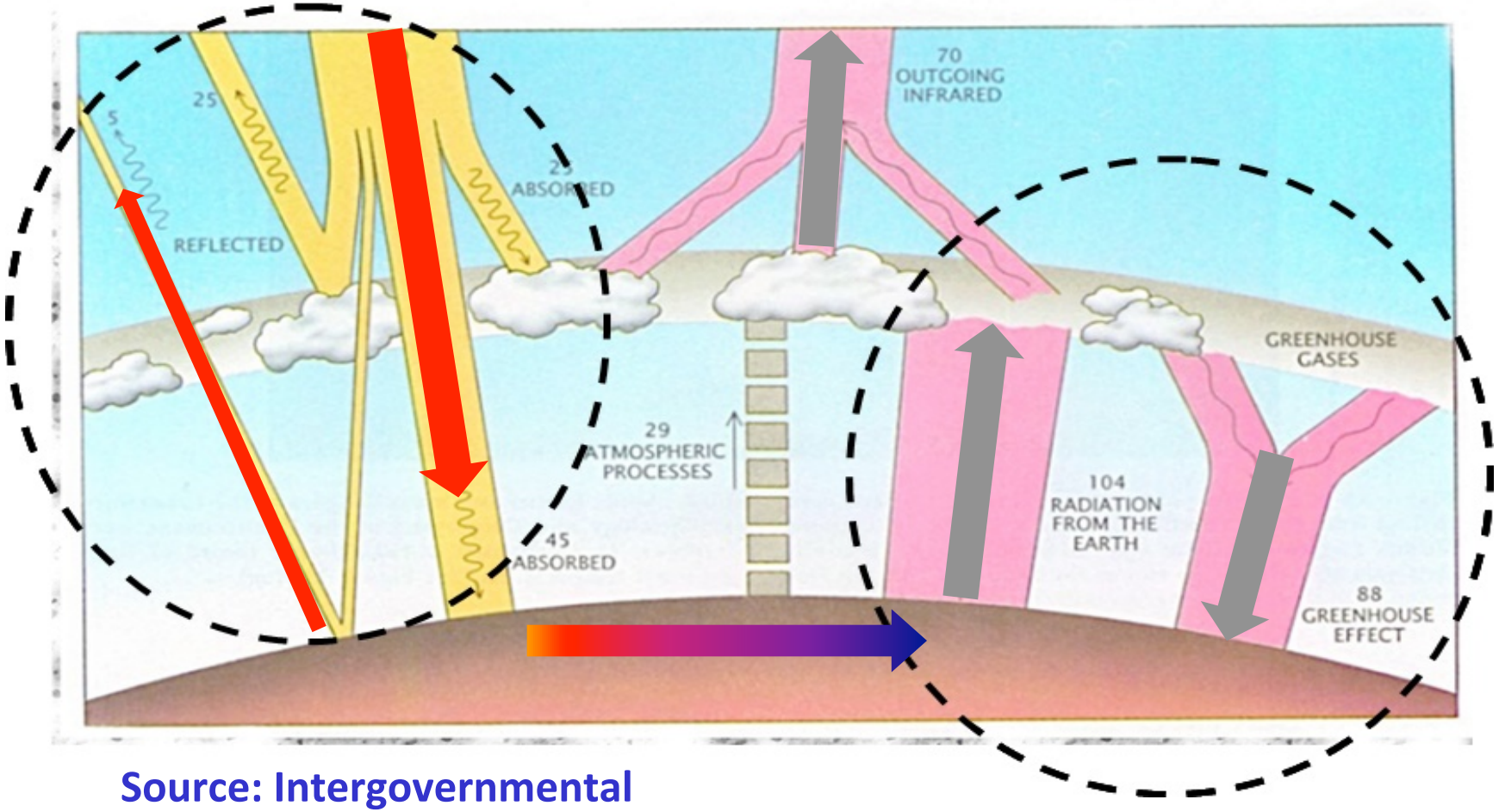
15

Rostov on Don, white roofs

Baku, dark roofs

Cooling our planet

Solar-reflective surfaces cool the globe via “negative radiative forcing”



Source: Intergovernmental Panel on Climate Change (IPCC)

19

GLOBAL COOLING: making 100 m^2 (1000 ft^2) of gray roofing white offsets the **emission** of 10 t of CO_2

20

How much CO_2 equivalent is offset if we whiten all eligible urban flat roofs world-wide? (i/ii)

- Answer: **24 Gigatonnes (Gt)**
  - 2/3 of a year's worldwide emission
  - Gigatonne = billion metric tons

- If implemented over 20 years (the life of a roof or a program) this is ≈ 1.2 Gt/year.

How much CO_2 equivalent is offset if we whiten all eligible urban flat roofs world-wide? (ii/ii)

- Offset is equivalent to **taking 300 million cars off the road for 20 years**.
  - There are about 600 million passenger cars world wide, and they each emit ≈ 4 t CO_2/ year.

In terms of avoided power plants

Full white roof potential can ***offset*** **the emissions from 500 medium-sized coal fired power plants or 1,000 medium-sized gas fired power plants**.

That is just the albedo effect – if the building is air conditioned, it will avoid comparable *real* CO2 back at the power plant.

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COOL CITIES, COOL PLANET

What to do now

Progress in energy efficiency standards

- In 2005, California's "Title 24" energy efficiency standards prescribed white surfaces for low-sloped roofs on commercial buildings. Several hot states are following.
- In 2008, California prescribed "cool colored" surfaces for steep residential roofs in its 5 hottest climate zones.
- **Other U.S. states & all countries with hot summers should follow.**

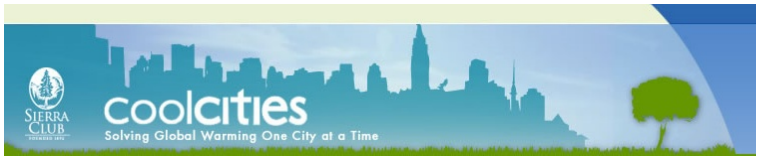
Recent cool roof progress (2005 – 2011)

- 2005
  - California Title 24 – “Flat roofs shall be white” (15 out of 16 climate zones). Walmart adopts white roofs for ALL stores.
  - EPA ENERGY STAR lists Cool Roof Materials
- 2010
  - June 1st, 2010 – Memo from U.S. Energy Secretary Steven Chu calls for all DOE Buildings to have white roofs, if cost-effective
  - June 16th, 2010 – Marine Corp follows suit, Pentagon following slowly
  - June 19th, 2010 – *RetroFIT Philly* announces winner of “coolest block” contest to white-coat black roofs of row houses.
- 2011
  - 100 Cool Cities launched – see www.WhiteRoofsAlliance.org
  - Spring 2011 – US launched, at G20 Energy Ministers meeting, a voluntary Cool Roofs & Pavements initiative and offered technical assistance to developing countries who join early. Joined so far: India, Japan, Mexico, US.

To come 2012…

- Model codes will be modified to prescribe “flat roofs shall be white”
  - ASHRAE for commercial buildings
  - EECC for residential buildings
- But states and cities have to **adopt** model codes

Global Cool Cities Alliance could unite many initiatives and trade associations



American Council for an Energy-Efficient Economy

THE CLIMATE GROUP

Resources on the web

- **Art Rosenfeld's website**
  - ArtRosenfeld.org
- **Cool Colors Project**
  - CoolColors.LBL.gov
- **Heat Island Group**
  - HeatIsland.LBL.gov
- **Cool Communities Project**
  - CoolCommunities.LBL.gov
- **Roof Savings Calculator**
  - RoofCalc.com
- **Global Cool Cities Alliance**
  - GlobalCoolCitiesAlliance.org
- **Cool Roof Rating Council**
  - CoolRoofs.org
- **Cool California**
  - CoolCalifornia.org
- **EPA Heat Islands**
  - epa.gov/heatisland
- **Energy Star Cool Roofs**
  - EnergyStar.gov

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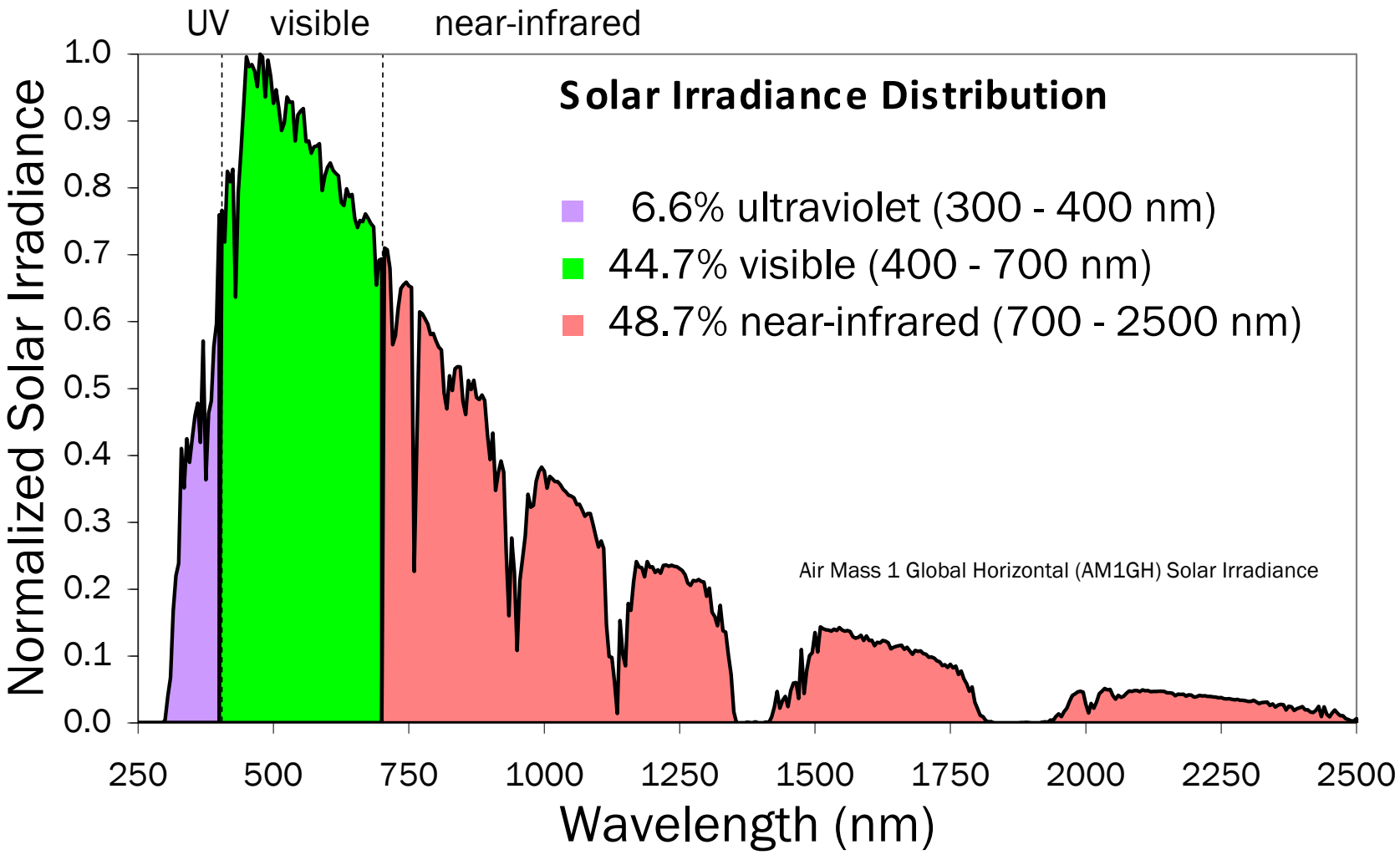
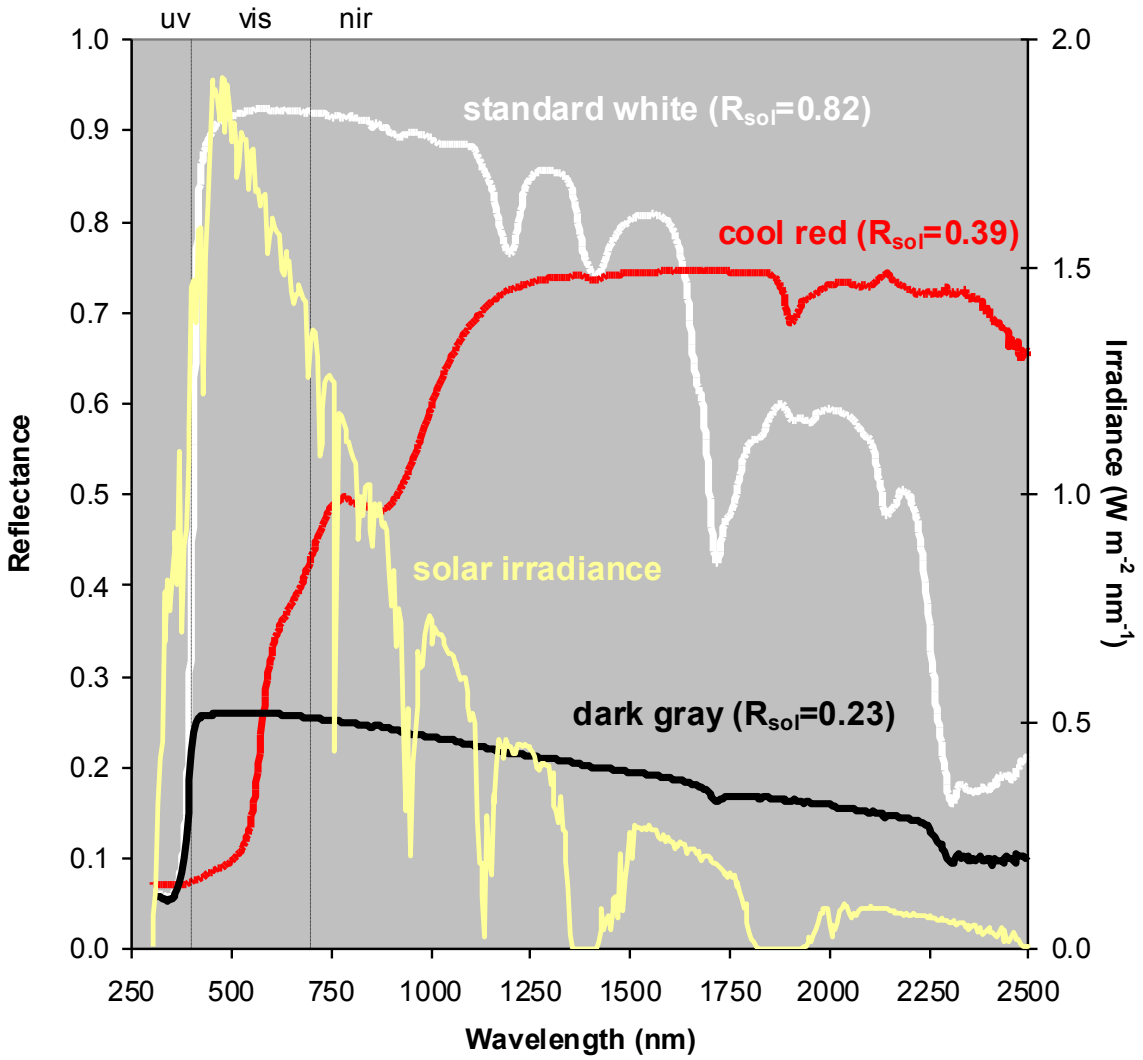
Cool Colors

Sunlight — more than meets the eye



White, cool color, warm color



white roof

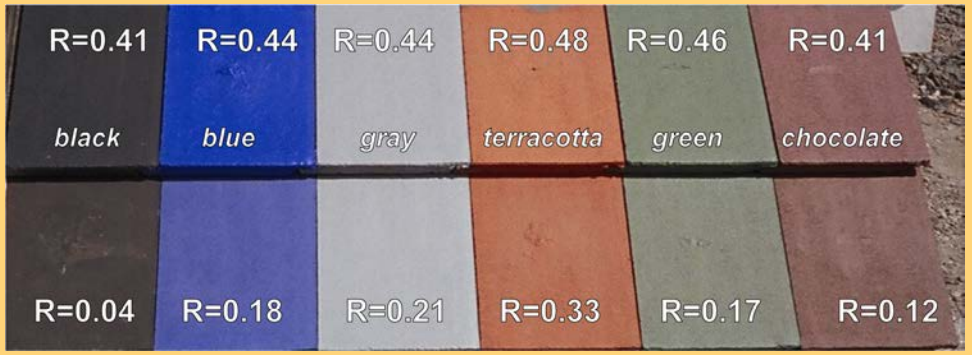
cool red roof

gray roof

Cool colored roofs available today

cool concrete tile
R ≥0.40

standard concrete tile
(same color)

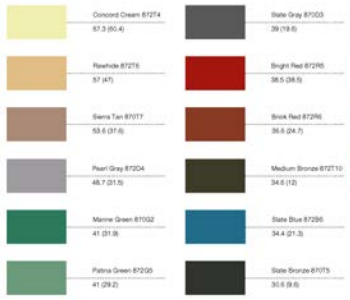


Courtesy
American
Rooftile
Coatings

solar reflectance gain =	+0.37	+0.26	+0.23	+0.15	+0.29	+0.29

cool clay tile
R ≥0.40

Courtesy
MCA Clay Tile



cool metal
R ≥0.30

Courtesy
BASF Industrial
Coatings

cool fiberglass asphalt shingle
R ≥0.25
Courtesy
Elk Corporation

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- **Art Rosenfeld's website**
  - ArtRosenfeld.org
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  - CoolColors.LBL.gov
- **Heat Island Group**
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- **EPA Heat Islands**
  - epa.gov/heatisland
- **Energy Star Cool Roofs**
  - EnergyStar.gov