Green Zones

- Վերջ “խոռը” Էտուամներին!!!
- Increase green zones
- Better managed green zones
- Green roofs, vertical gardens
- Urban agriculture

Green Zones

Most urban planning standards advocate having at least 25 m^2 of green space per person

Rome = 321 m^2/person green space*
Madrid = 68 m^2/person green space*
Amsterdam = 36 m^2/person green space*
Paris = 14 m^2/person green space*

New York = 18 m^2/ person of park space**
Boston = 31 m^2/ person of park space**

YEREVAN = ?

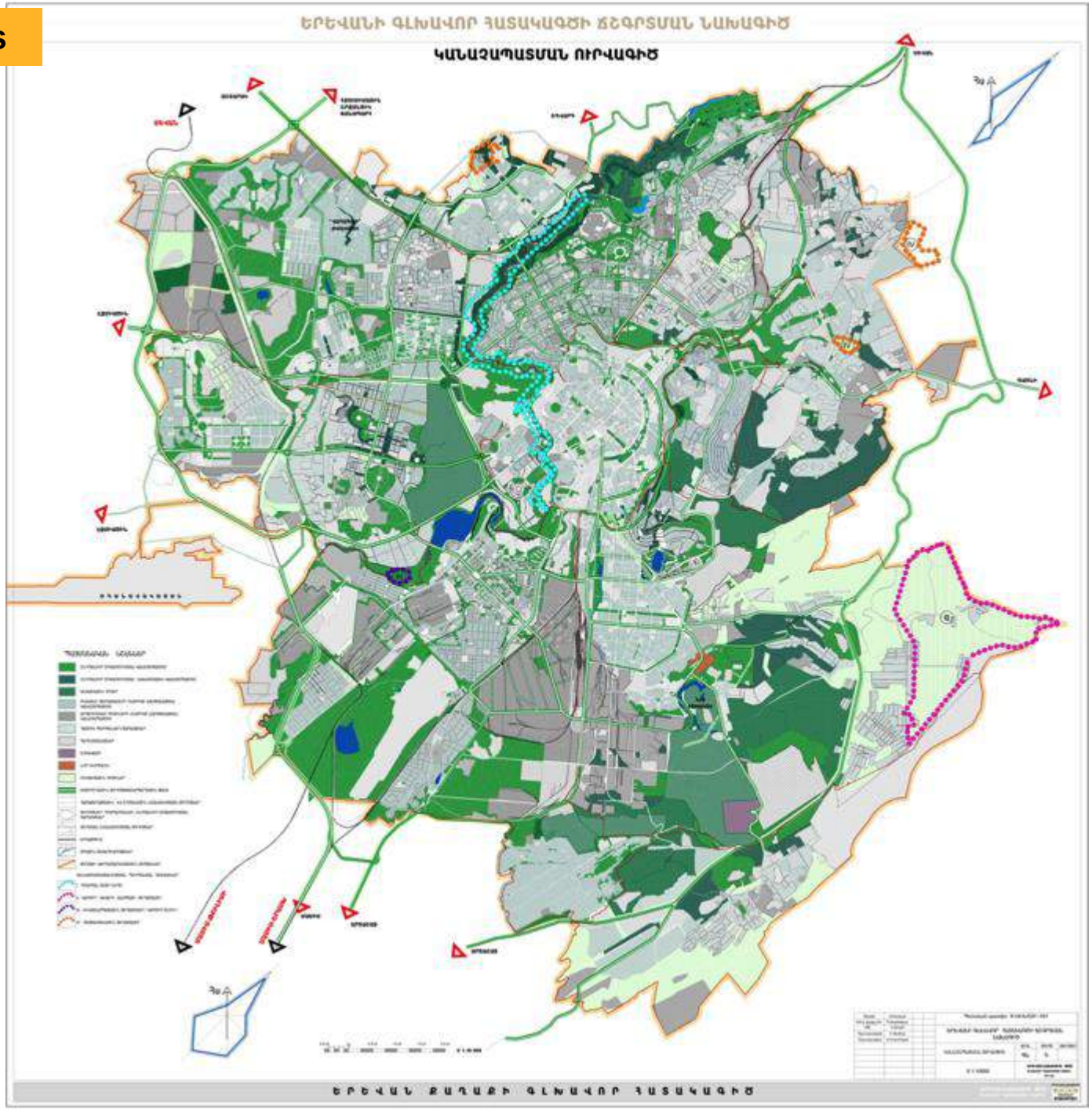
$YEREVAN_{2011}$ = 7.5 m^2/person green space

$YEREVAN_{2020}$ = 19.8 m^2/person green space

How?
Not clear

Sources:
(*) www.cnrs.fr/cw/dossiers/dosbioville_E/contenu/alternative/alter_etape2_3.html
(**) http://persquaremile.com/2011/01/27/parkland-per-person-in-the-united-states/

Green Zones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Better managed green zones:

- Native plants
- Non-invasive plants
- Low water demanding plants
- Good water retention practices (mulching, stone reservoirs, effective ground cover)
- Nutrient management of soil

Low water use landscaping

Landscaping around Los Angeles

Մարտահրավեր բուսավաճառներին և լանդշաֆտ նախագծողներին՝ ՏԵՂԱԿԱՆ ՏԵՍԱԿՆԵՐՈՎ ԴԻԶԱՅՆ

Green Zones

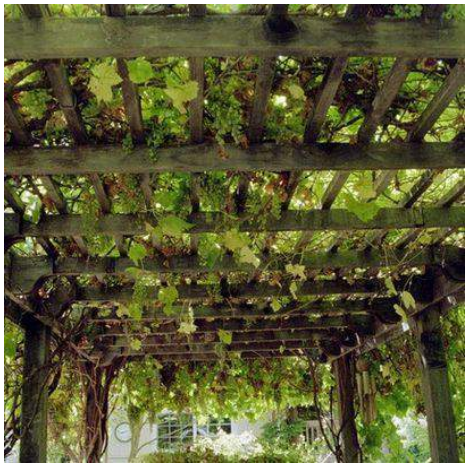


Figure 6. Use of vines for shading is common in the Caucasus including in Yerevan. It is a good practice that can be used to enhance design and building occupant comfort. In the rendering below, the western façade of a US Federal Building in Portland, Oregon has trellises with vine growing on them. For updates see the site for project architect SERA (serarch.com)

Green roofs

California Academy of Sciences building in San Francisco; LEED Platinum Building

Traditional Armenian “green” roof next to Sourb Astvatsatsin Church near the city of Ashtarak

Nanyang Tech University, Singapore

Source: neatorama.cachefly.net/images/2008-01

Hunderwasser's village model

Source: thewere42.wordpress.com

Source: greenroofs.wordpress.com

DPI Marine and Freshwater Resource Institute, Queenscliff, Victoria

Source: www.greenopia.com

Source: www.e-roofing.com

Source: www.architecturelist.com

Green Zones

Figure 19. Green roofs are generally categorized into 3 types: extensive, semi-intensive, and intensive

Extensive green roof

Semi-intensive green roof

Intensive green roof

	Extensive	**Semi-intensive**	**Intensive**
Maintenance	Low	Periodically	High
Irrigation	No	Periodically	Regularly
Plant communities	Moss-sedum-herbs and grasses	Grass-herbs and shrubs	Lawn or perennials, shrubs and trees
System build-up height	60-200 mm	120-250 mm	150-400 mm; on underground garages > 1m
Weight	60-150 kg/m^2	120-200 kg/m^2	180-500 kg/m^2
Costs	Low	Middle	High
Use	Ecological protection layer	Designed Green Roof	Park like garden

Source: International Green Roof Association (www.igra-world.com/types_of_green_roofs/); photos from various sources.

Urban Agriculture

Photo: www.greenroofs.wordpress.com

Washington State, United States

Photo: Wikipedia, "Urban Agriculture"

Kstovo, Russia

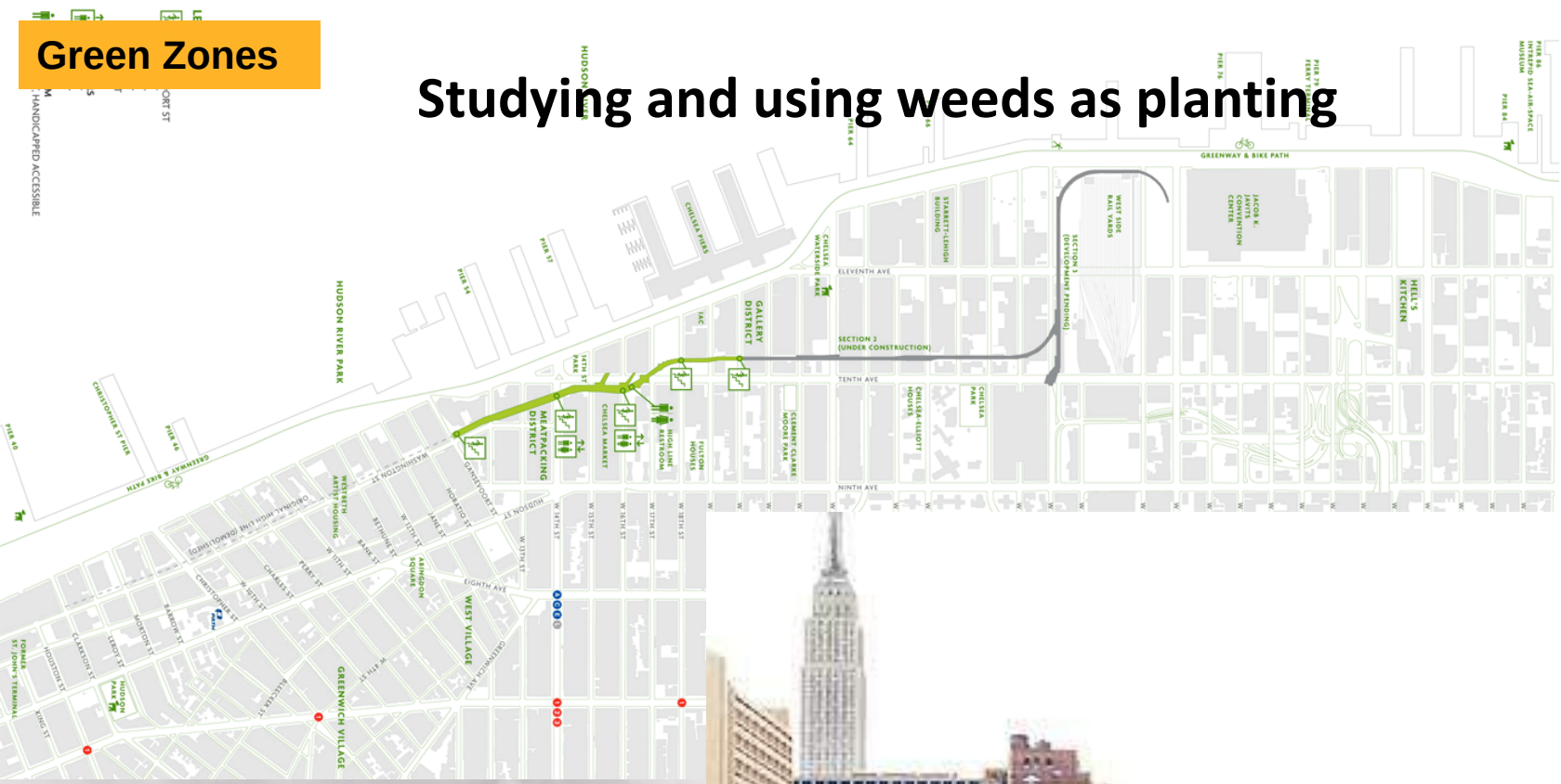
- It creates or sustains green space in a city.
- It reduces the transport cost of food and reduces CO2 emissions associated with transport of food. (For instance, Bill McKibben in his *Deep Economy* claims that land within and around Manhattan can provide all the food needs of the city).
- It also has an important educational impact; urban residents can be very detached from the basic cycles and inputs of life. Growing one's own food can sensitize one to the intimate connection between "Land, air, water and life."

Green Zones

Green Zones

Green Zones

Studying and using weeds as planting

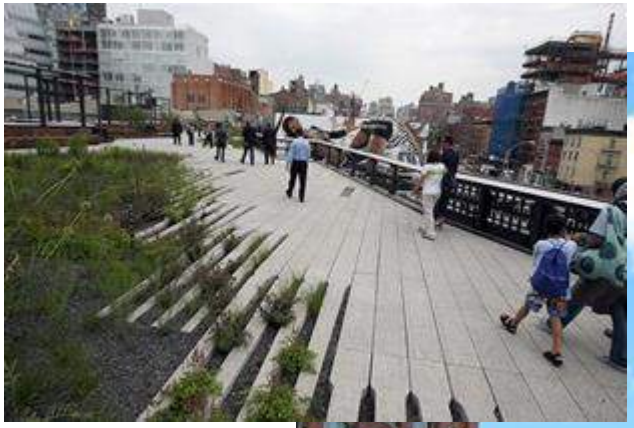


Green Zones

Zero-emission commuting

Green Zones

A place to rest



Energy

- Reduce use while maintaining comfort
- Emphasize passive solutions
- Use renewables

Կան ճիշտ լուծումներ որ արդեն իսկ կիրառում ենք
Zero-emission solutions

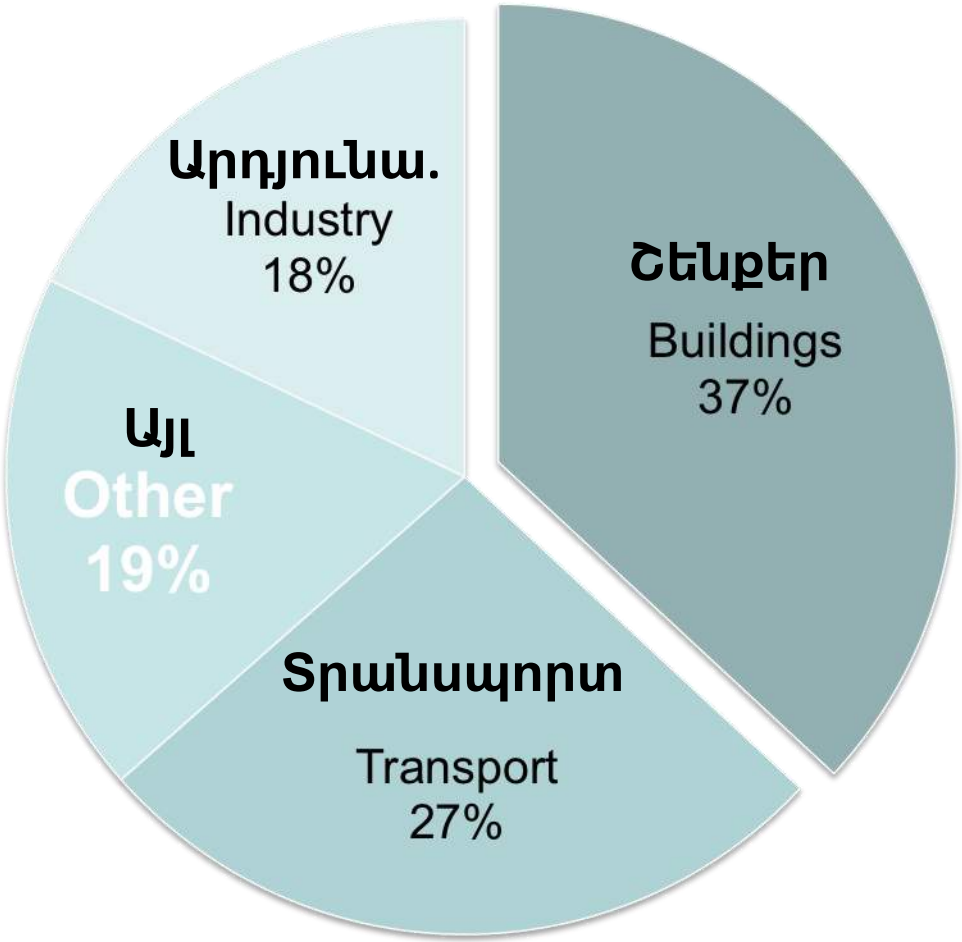
Singapore public housing; using the sun to dry clothes

Stepanakert “hayat”; using the sun to dry clothes

Solar clothes dryers by Aytec Avnim

Էներգիայի վերջնական սպառողները Հայաստանում
Final Consumers of Energy in Armenia
(2011)

Total Final Energy Consumption
1961 ktoe's
(thousand tons of oil equivalent)



Source: International Energy Agency, 2011 Armenia Energy Balance

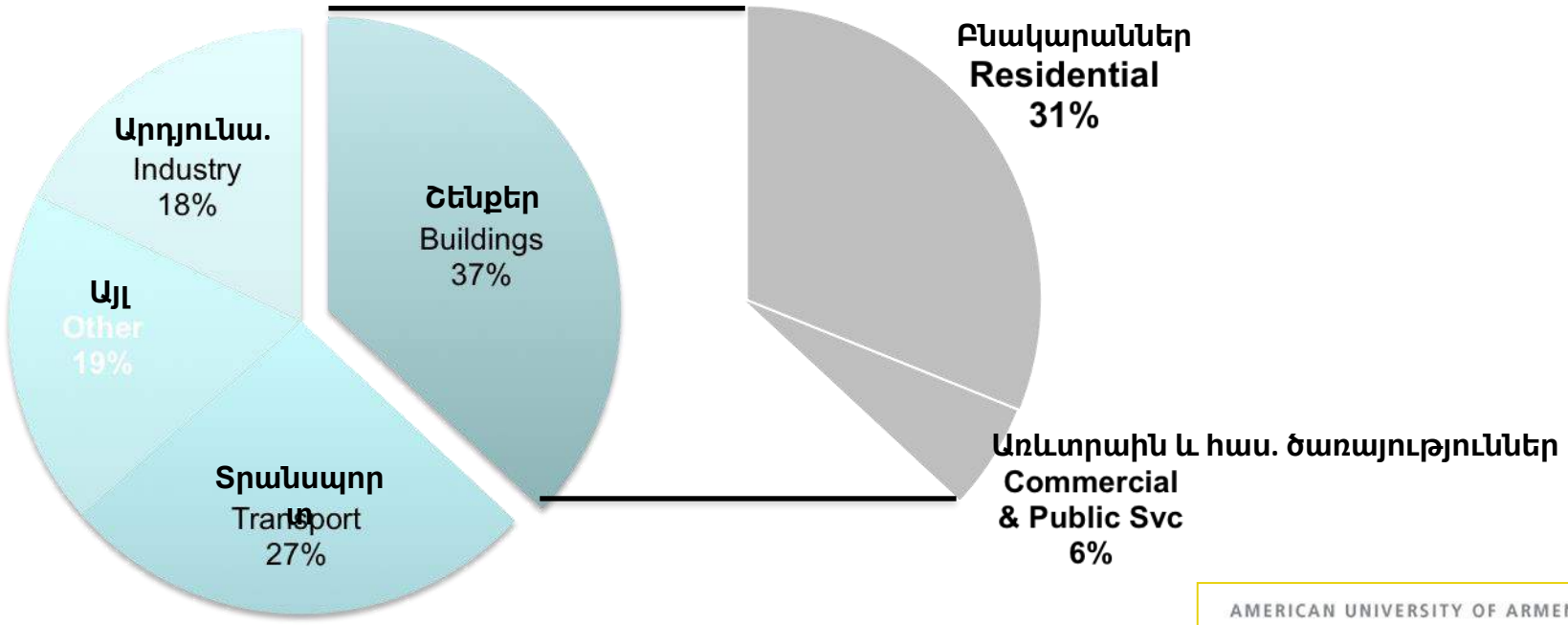
Հայաստանում շենքերը էներգիայի ամենից խոշոր սպառողներն են!

Buildings are the largest users of energy in Armenia!

AMERICAN UNIVERSITY OF ARMENIA
Acopian Center *for the Environment*

Էներգիայի վերջնական սպառողները Հայաստանում
Final Consumers of Energy in Armenia
(2011)

Բնակարանները էներգիայի ամենից խոշոր սպառողներն են:
Residential buildings are the dominant users of energy.



Source: International Energy Agency, 2011 Armenia Energy Balance

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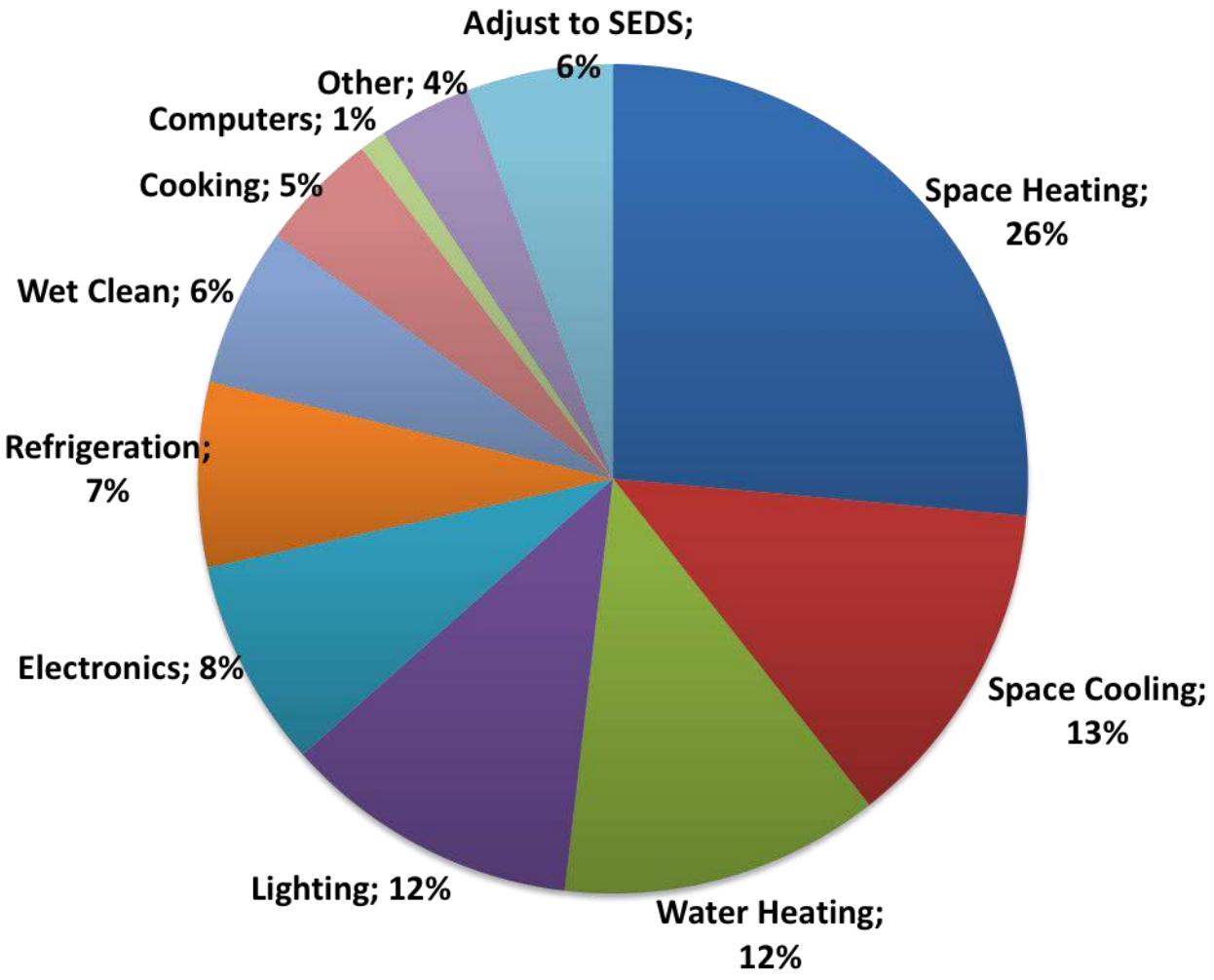
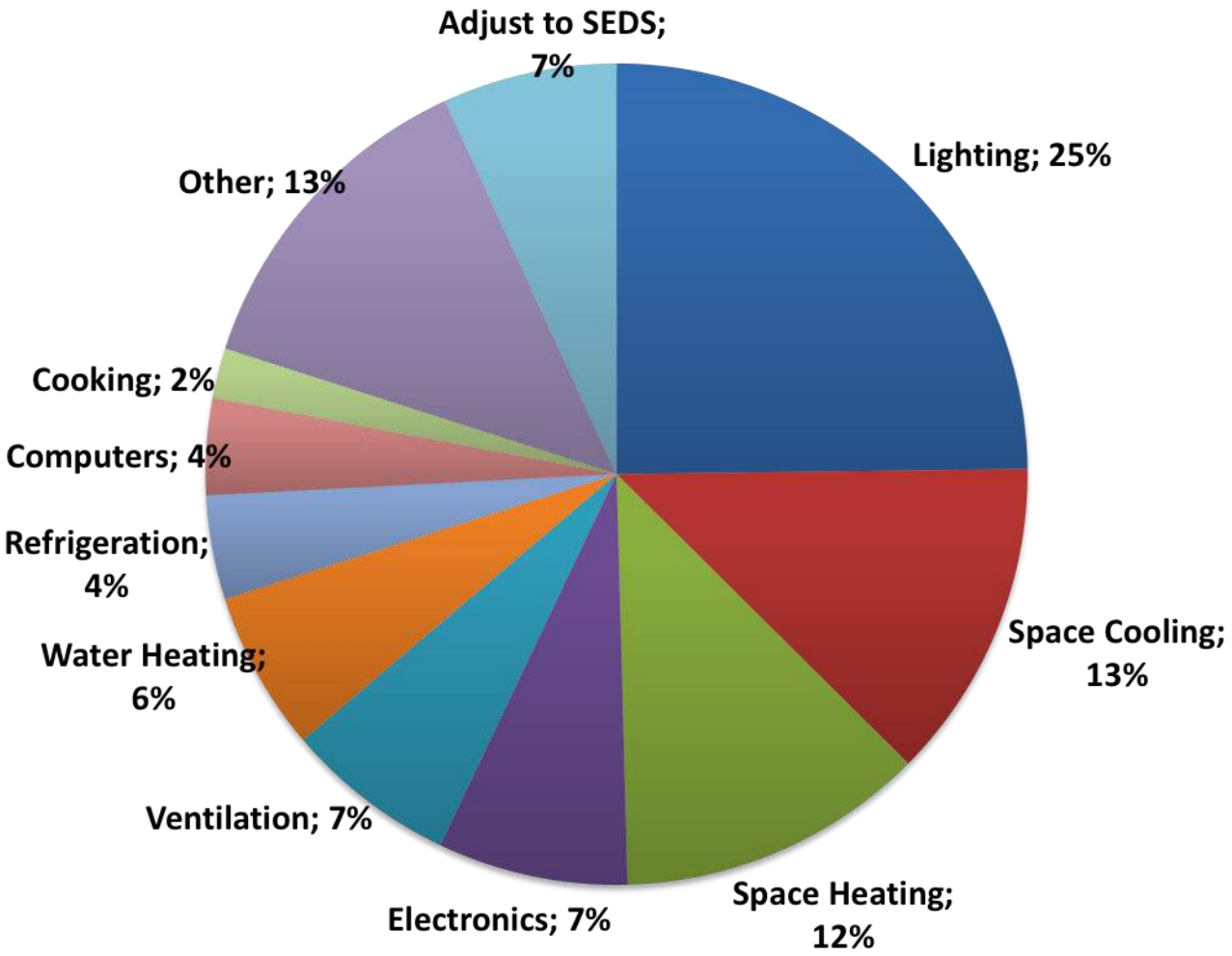
for the Environment

2006 Residential Energy End Use in the US



Source:buildingsdatabook.eren.doe.gov

2006 Commercial Energy End Use in the US



Source:buildingsdatabook.eren.doe.gov

Էներգիախնայողության սահմանը?
How much could a household save?

There are examples of energy efficiency that we should aspire to -- 15 kWh/m^2 per year in thermal consumption (Gold Standard)

In Armenia its about 160 kWh/m^2 per year

Lodenareal – New housing in Innsbruck, Austria (built in 2009) built to the gold standard

Annual heating cost for typical 86m^2 flat:

Electricity:	**AMD 30,400 / US$ 76**
Gas:	**AMD 14,800 / US$ 37**
TOTAL:	**AMD 45,200 / US$ 113**

for the entire year

Source: UNDP Workshop on Integrated Building Design Approach held at the Yerevan State University of Architecture and Construction. Workshop led by Kirsty McGuire, UNDP expert.

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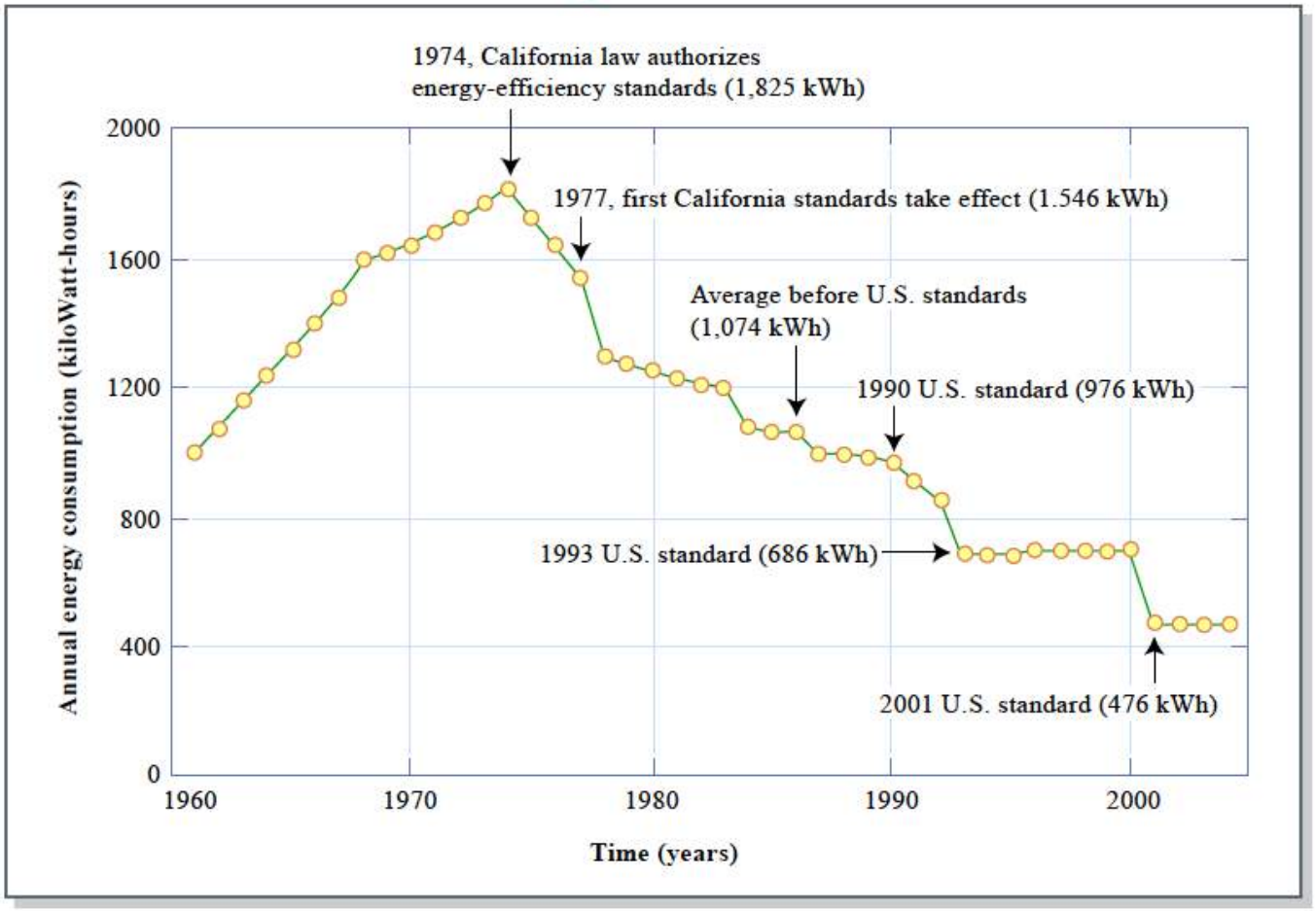
In energy efficiency gains, while markets seem to have produced benefits, regulation has had the highest, quantum gains



Source: MIT OCW (Les Norford,, Building Technology Program, Dept of Arch, MIT: "Buildings and Energy"); Collaborative Labeling and Appliance Standards Program

PASSIVE SOLUTIONS TO SAVING ENERGY

1. Building orientation

2. Tree shading

3. Building Envelope

- **Walls, Roofs, and Foundations**
- **Super insulation**
- **Cool roofs (green roofs, white roofs, …)**
- **Light colored pavements**
- **Double skin**
- **Windows and Doors**
  - **Triple glaze**

5. Natural ventilation

6 Daylighting and Lighting

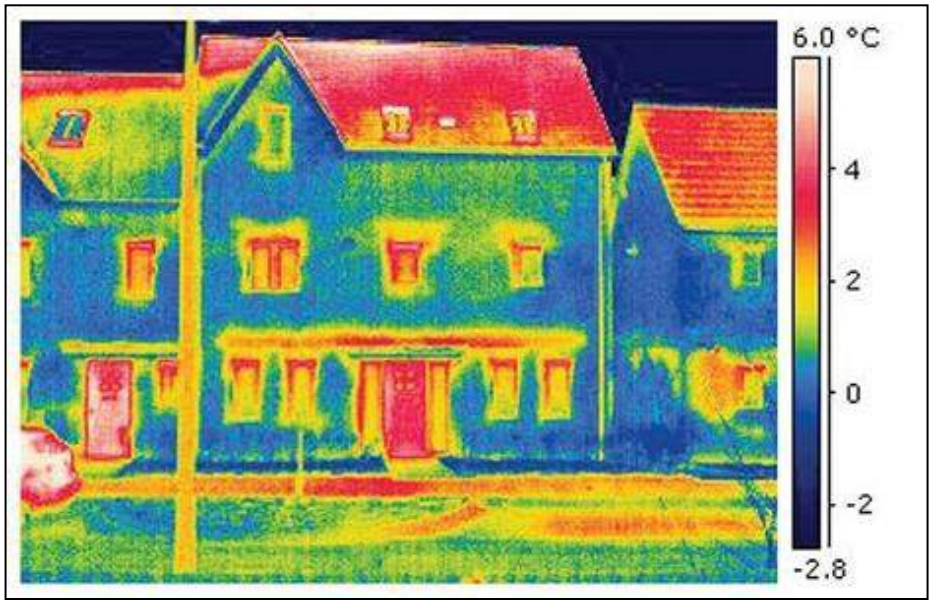
7. Passive Solar air and water heating

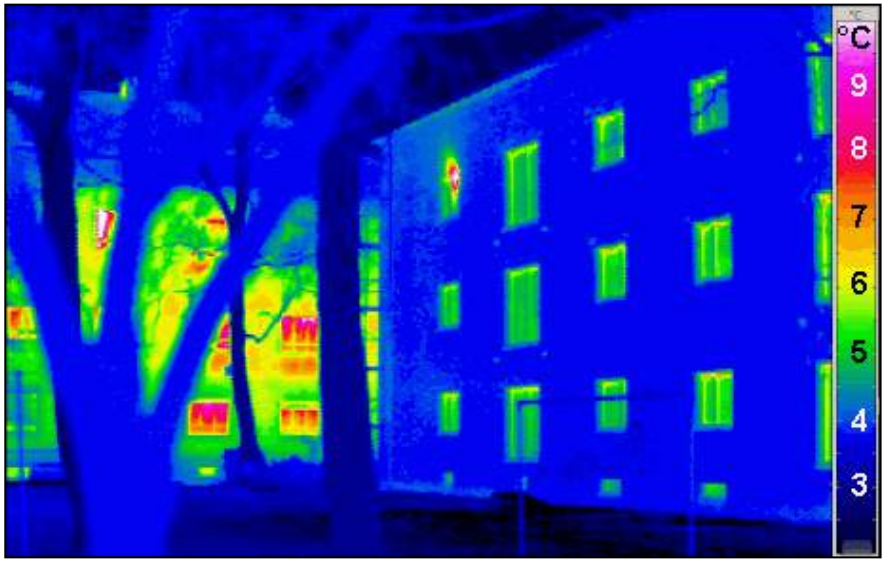
Building Envelope

- When poorly constructed, the building envelope can be a source of:

  — Increased energy costs
  — Thermal discomfort
  — Poor air-quality indoors, (excessive moisture, mold, etc.)

- With the use thermography we can see how well the building envelope is constructed





Daylighting and Lighting

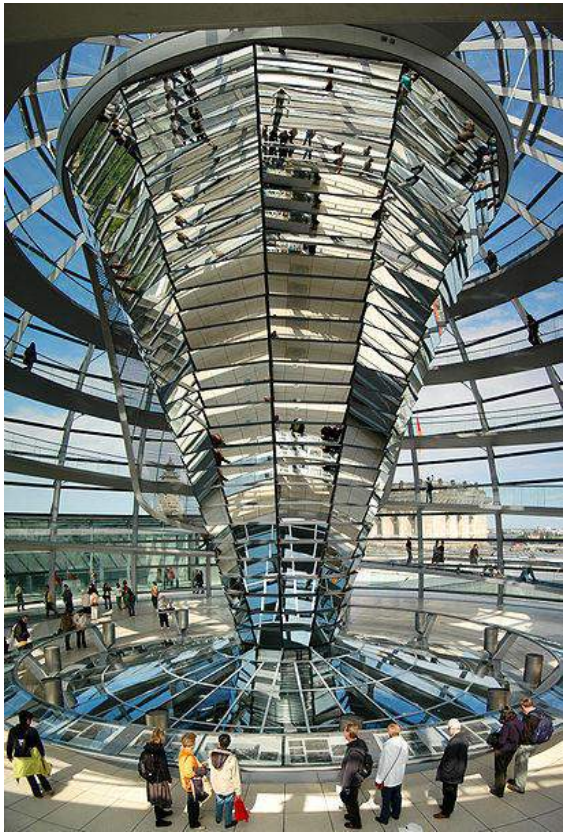


Figure 8. Interior view of the glass dome of the Reichstag in Berlin, Germany by architect Norman Foster. Another iconic masterpiece of daylighting. The dome also allows for natural ventilation from the top of the dome, similar to the Pantheon in Rome.

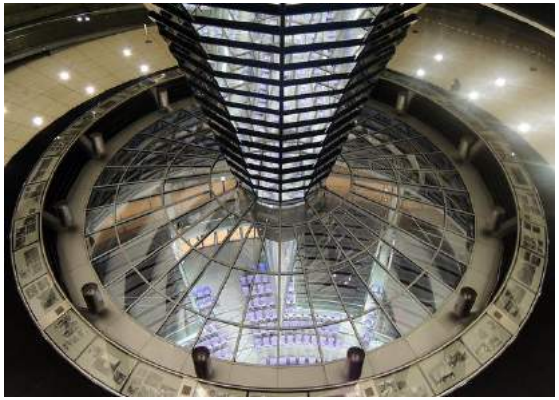


Figure 7. Yerevan's Enclosed Market built in the 1950s and designed by architect Grigor Aghababyan was a masterpiece of daylighting

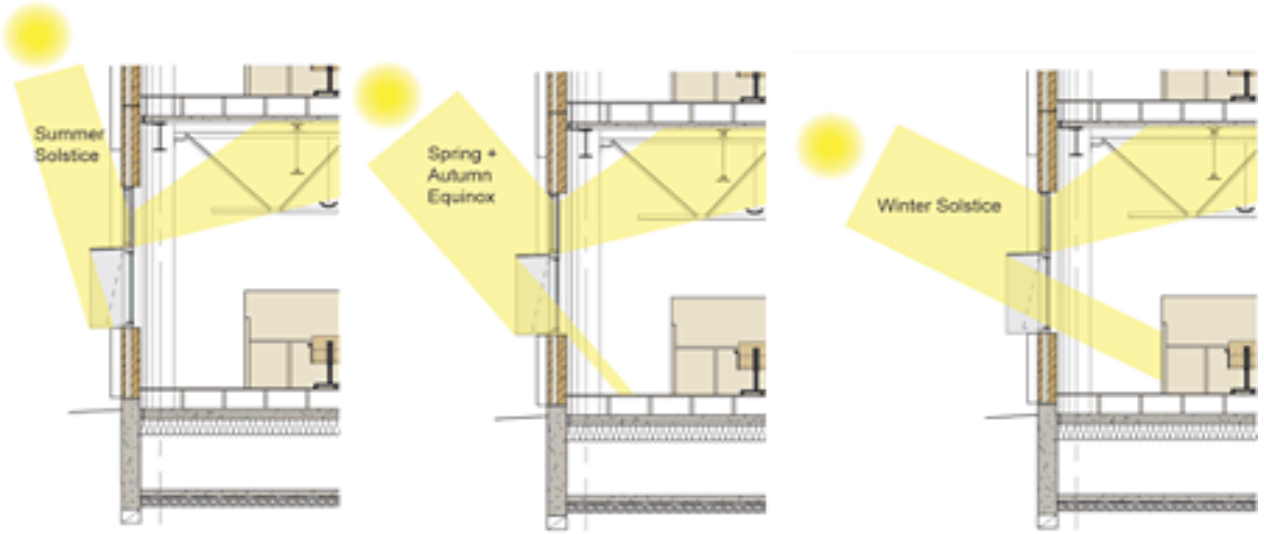


Figure 9. Use of light shelves allows for shading against direct light but reflection of indirect light deeper into the interior space.

Figure 12. A number of factors impact the movement of light inside a building.

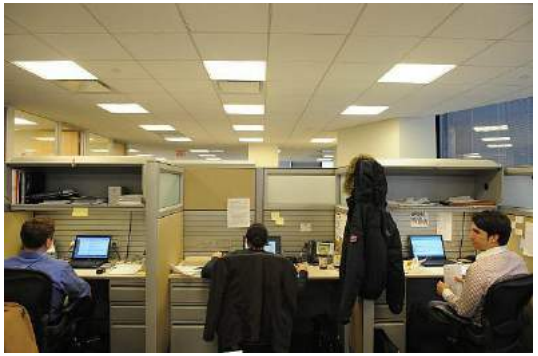
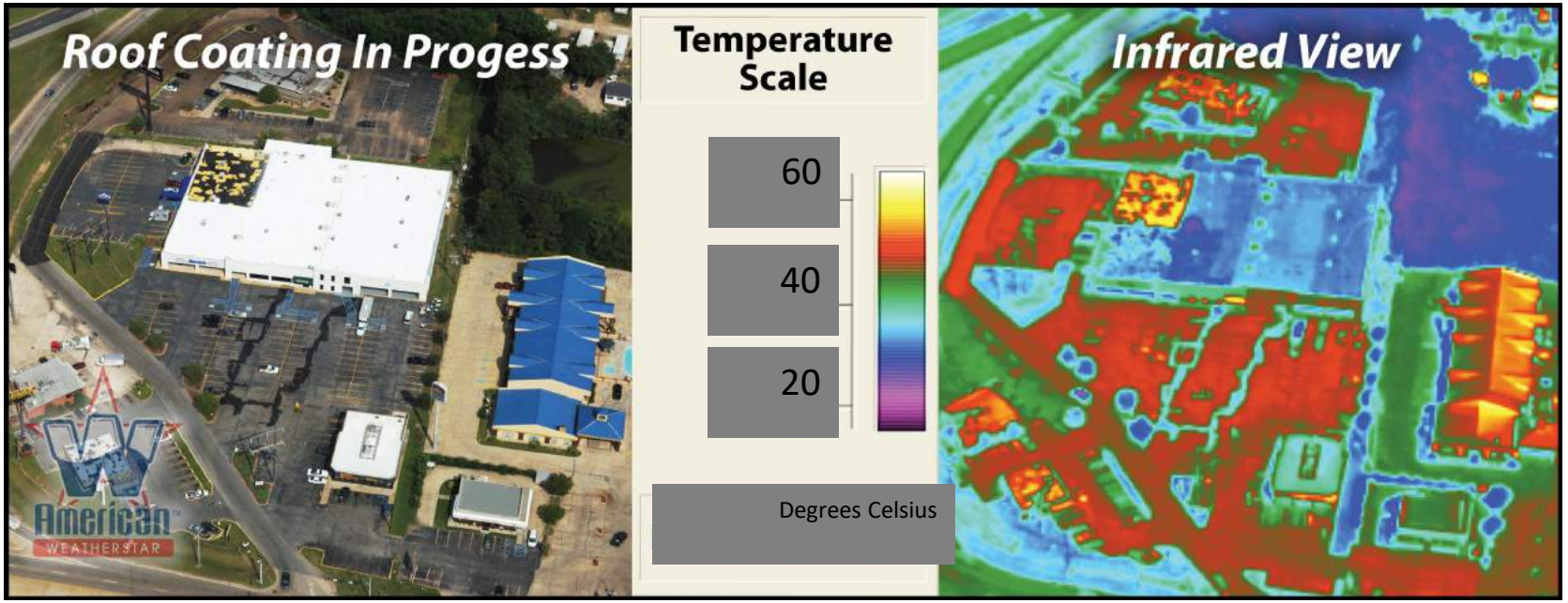
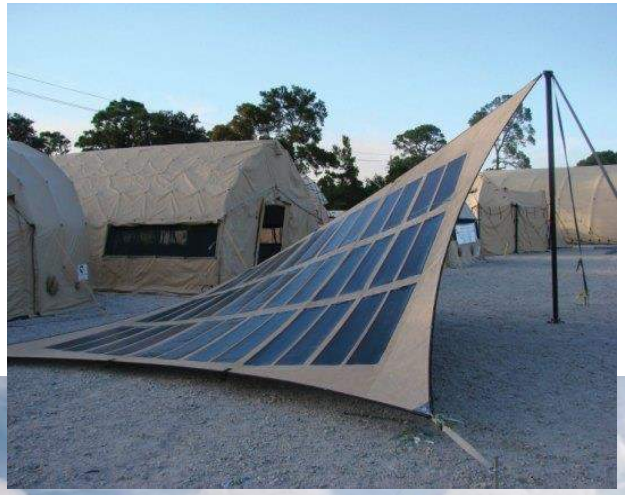


Figure 10. The iconic double skin of Morphosis architectural firm. Pictured is the Cooper Union Building in New York City.

Figure 11. Commonly used structure and architectural elements to provide shade

Figure 13. Thermographic view of roof being transformed into a cool roof. Note the top left corner that is not yet fully converted is substantially hotter.






WOOD CUBE

Figure 12: Horizontal axis wind turbine (HAWT)