



Master Gardener Program

University of California Cooperative Extension 

Conserving Energy in the Landscape

University of California

Mary Bianchi, Horticulture Advisor San Luis Obispo

Pamela Geisel, Statewide Coordinator

Master Gardener Program


Sustainable Energy Practices for Landscapes

- **Goals**
 - Use less energy in gardening practices
 - Use less energy for the home
- Both are attainable with compatible practices





Master Gardener Program

University of California Cooperative Extension 

Advice to Grow by....Ask Us!

Less energy for gardening, Less energy for the home

Compatible practices can achieve both!

What are Sustainable Energy Practices for our Landscapes?

- Gardening practices that we can implement immediately
 - Benefits are gained one household at a time
 - Engage large fraction of households in conserving energy.
- Gardening practices that save us money AND help to improve environmental quality.

The Strategic Initiatives from ANR Into 2025

- Initiative to improve energy security and technologies through innovative science, engineering, agricultural, biological and environmental science.
 - Extend research based information that saves energy
 - tree planting and placement,
 - alternative and recyclable mulches,
 - alternative or electric motors for mowers and other landscape equipment.



Energy Uses in Landscapes

- ?

What is energy?

- Ability to do work
- Moving or lifting
- Warming, cooling, and lighting



Energy used in gardening practices

The obvious ones

- Landscape maintenance
 - Tool Selection
 - **Hand tools vs power tools**
 - **Fuel economy and emissions**
 - 4 cycle engines vs 2 cycle engines
 - **Electric vs gas**
 - Tool maintenance

Changing the world one lawnmower at a time

- In the hour it takes you to mow your lawn, your gas-powered lawn mower produces as much air pollution as driving a car 20 miles!
- Mowers use 580 million gallons gas/year



Help Mow Down Pollution!

City of Charleston



- An estimated 17 million gallons of gasoline are spilled refueling lawn equipment in the U.S. every year, releasing harmful fumes into the air and contaminating our ground water.

Energy used in gardening practices

- **Landscape maintenance**
 - **Tool Selection**
 - **Hand tools vs power tools**
 - **Fuel economy and emissions**
 - **4 cycle engines vs 2 cycle engines**
 - **Electric vs gas**
 - **Gasoline lawn and garden equipment, on average, produces 5% of ozone-forming VOCs in areas with smog problems.**
 - **Tool maintenance**

Practices to reduce energy

- Landscape Inputs
 - Think and buy local –
 - mail order increases transportation costs
 - Plant natives and propagate your own.
 - Buy 3 instead of 40.
 - Use local or recycled building materials
 - Nutrients
 - Grasscycling

Fertilizing with your lawn mower?

1/3 rule applies

- When clippings are returned,
 - small quantity of organic matter and
 - substantial quantities of mineral nutrients are returned
- High fertility - 1,000 square feet of Kentucky bluegrass turf annually yielded
 - 5.7 pounds of nitrogen (N)
 - 0.6 pounds of phosphorus (P), and
 - 3.4 pounds potassium (K).
- Very low fertility -1,000 square feet of Kentucky bluegrass clippings annually yielded
 - 1.0 pound N,
 - 0.1 pound P, and
 - 0.7 pound K

Fertilizing with your lawn mower?

- mineral fertilization can be reduced while still producing turf of high quality.
- clippings were found to release nutrients into soil in as little as 14 days
- saves time and expense.
 - Mowing is not interrupted for emptying grass catchers.
 - 1,000 square feet of highly fertilized Kentucky bluegrass yielded 529 pounds of clippings in one year. If clippings were collected, work stoppage would occur 22 times to empty a basket that accommodated 25 pounds of clippings.

Energy Sustainability by Design

- Design and Construction
 - ?
 - ?
 - ?
 - ?



Energy Sustainability by Design

- Design and Construction
 - Materials
 - Transport
 - Labor
 - Maintenance



What is energy?

- Ability to do work
- Moving or lifting
- Warming, cooling, and lighting



Landscaping Strategies to reduce home energy use

- **Temperate Region**
 - Maximize warming effects of the sun in the winter.
 - Maximize shade during the summer.
 - Deflect winter winds away from buildings.
 - Funnel summer breezes toward the home.
- **Hot-Arid Region**
 - Provide shade to cool roofs, walls, and windows.
 - Allow summer winds to access naturally cooled homes.
 - Block or deflect winds away from air-conditioned homes.

Effects of Shading and Evapotranspiration



Copyright © 2004 Regents of the University of California

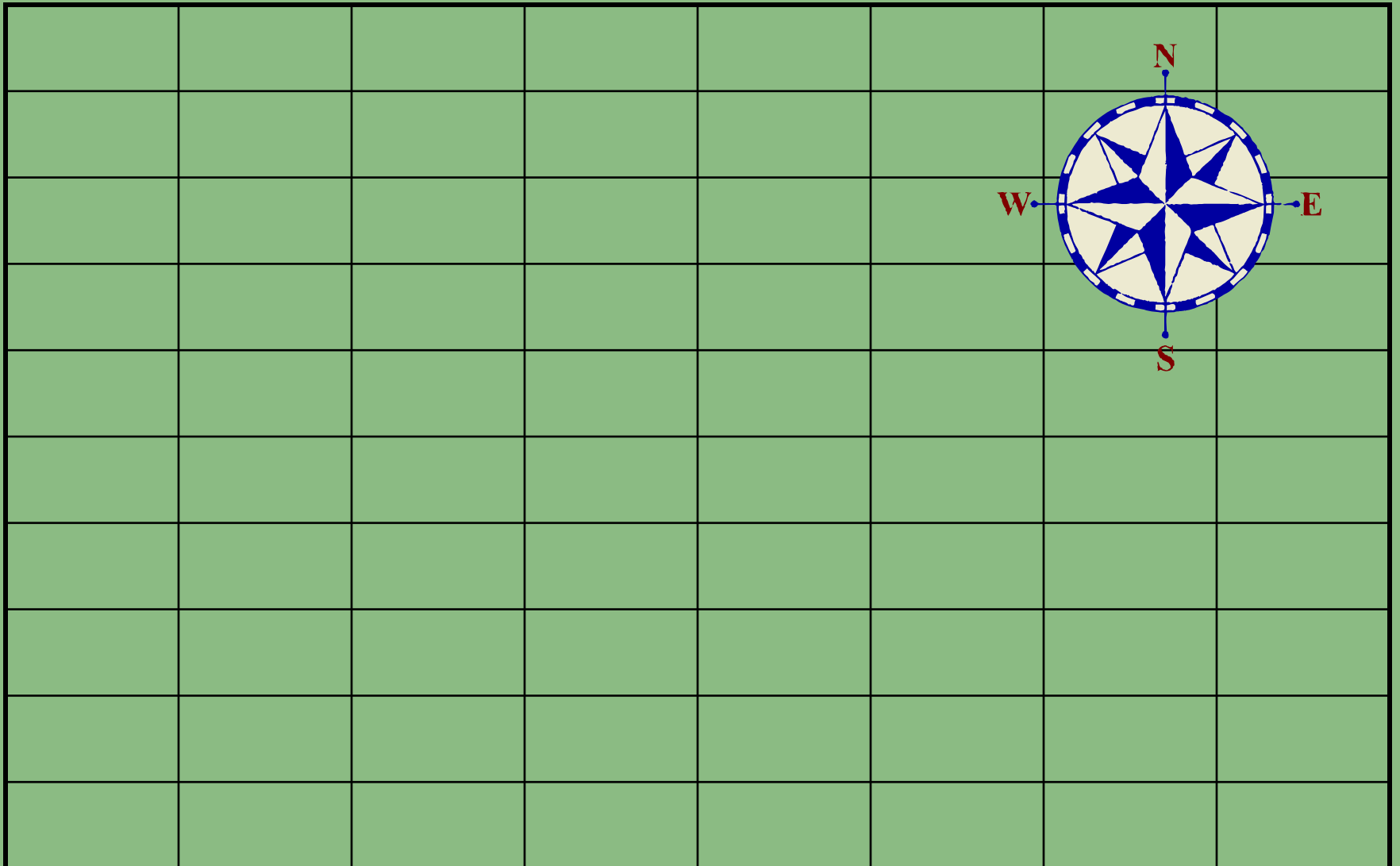
- Trees can reduce surrounding air temperatures as much as 9°F
- Because cool air settles near the ground, air temperatures directly under trees can be as much as 25°F cooler than air temperatures above nearby blacktop.

Shade and energy conservation

- About 40 percent of the unwanted heat that builds up in your house comes in through windows.
- Block sunlight before it enters the windows.

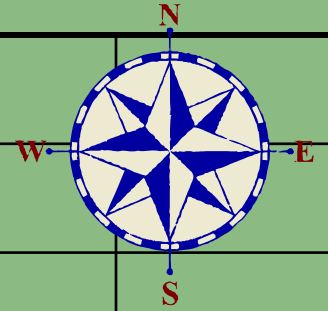


Sketch in your house on the grid



Sketch in your house on the grid

Mark the windows and doors



Sketch in your house on the grid


Add the prevailing winds




STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
LOMPOC AP, CA (KLPC). WIND	E	E	W	W	W	W	W	W	W	W	E	E	W
LONG BEACH AP, CA (KLGB). W	WNW	W	S	W	S	S	S	WNW	WNW	WNW	WNW	WNW	WNW
LOS ANGELES INT'L AP, CA (KL	E	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	E	WSW
LOS ANGELES-DOWNTOWN, CA (KC	W	WSW	WSW	WSW	WSW	WSW	WSW	WSW	W	W	W	W	WSW
MADERA MUNI AP, CA (KMAE).	ESE	E	NW	NW	WNW	WNW	WNW	WNW	WNW	WNW	E	E	WNW

Sketch in your house on the grid

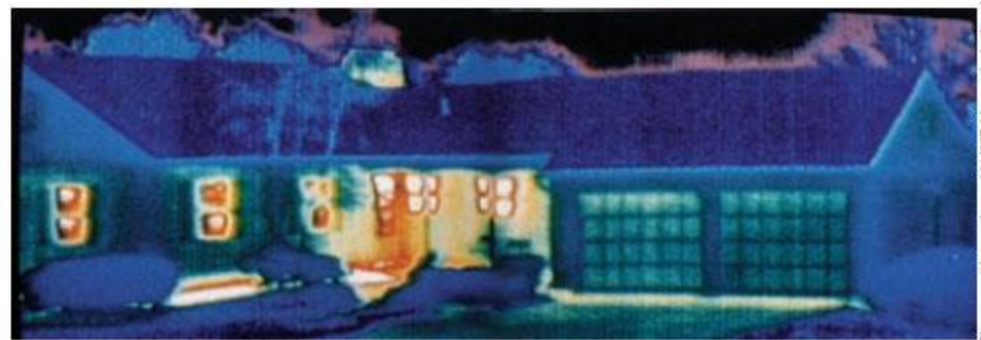
Add direction and prevailing winds

March - Oct							

**Nov-
Feb**

Year Around Energy Savers?

- Deciduous Trees
 - Trees that drop their leaves each winter
 - Can help to cut home cooling costs
 - Help warm the house in cold weather



Cool Hot

Thermograph photograph copyright 1997, Airpaction Industries, Inc., Shelburne, VT

Deciduous Trees

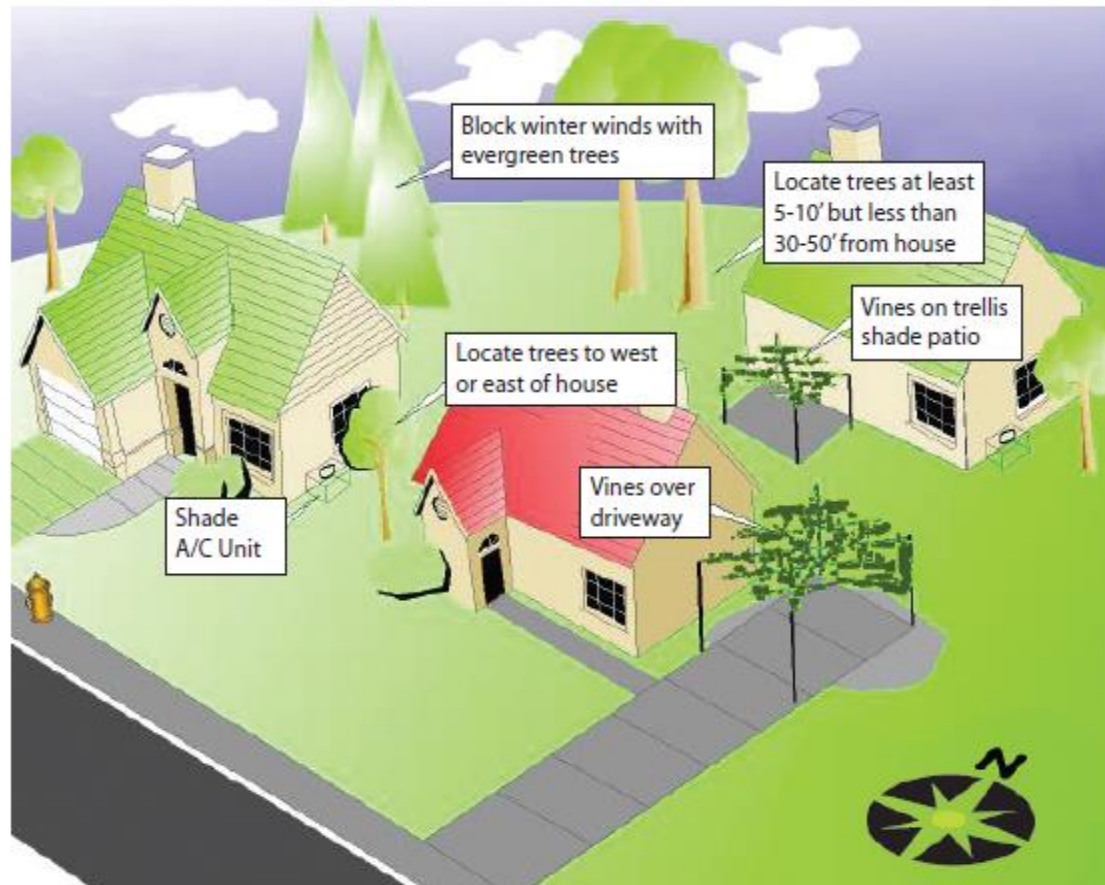
- Trees with high spreading branches
 - Planting to the south provides maximum summer roof shading – does this provide maximum energy savings?



- Solar-heated homes in cold climates

Energy savings greatest - west and southwest plantings

Figure 5: Tree Placement to Maximize Energy Savings



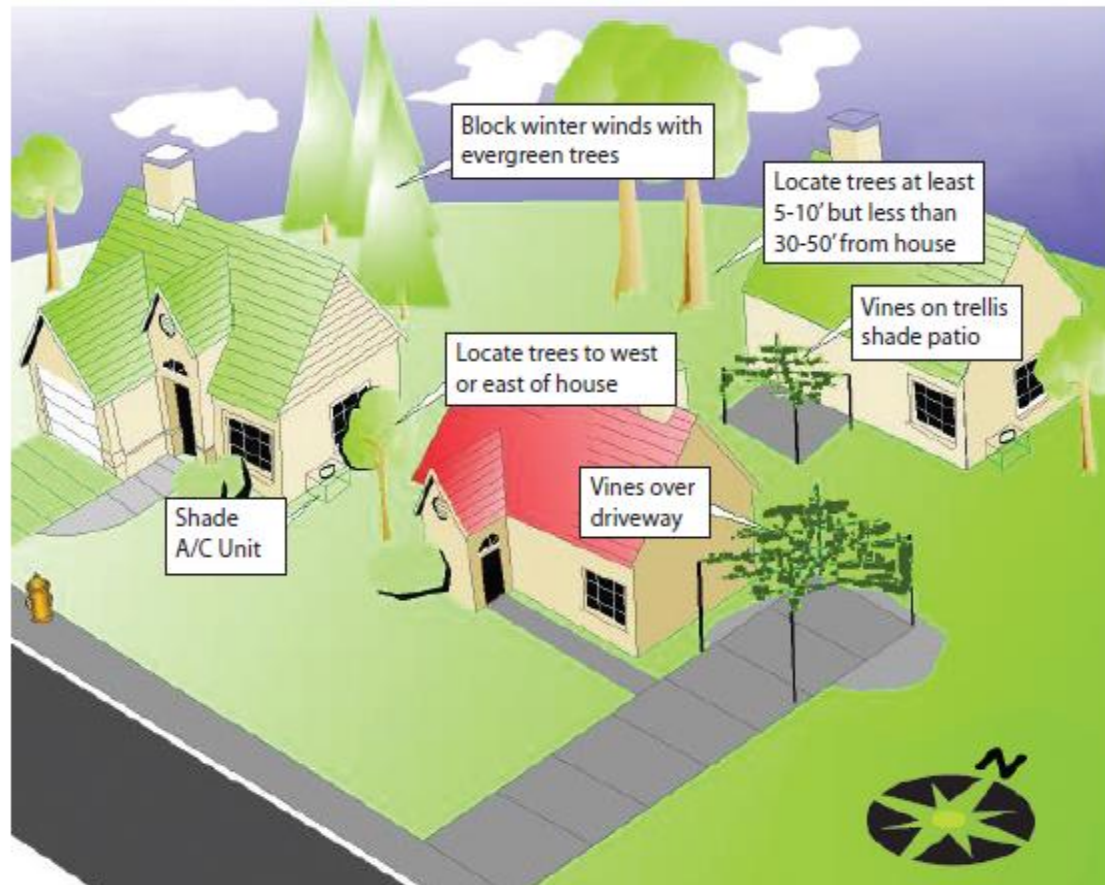
Picking the right trees and putting them in the right location will maximize their ability to shade buildings and block winds throughout the year.

- Cooling energy savings ranged between 7 and 47 percent – highest with west and southwest plantings

Energy savings summer and winter

USDA Forest Service Study SMUD

Figure 5: Tree Placement to Maximize Energy Savings

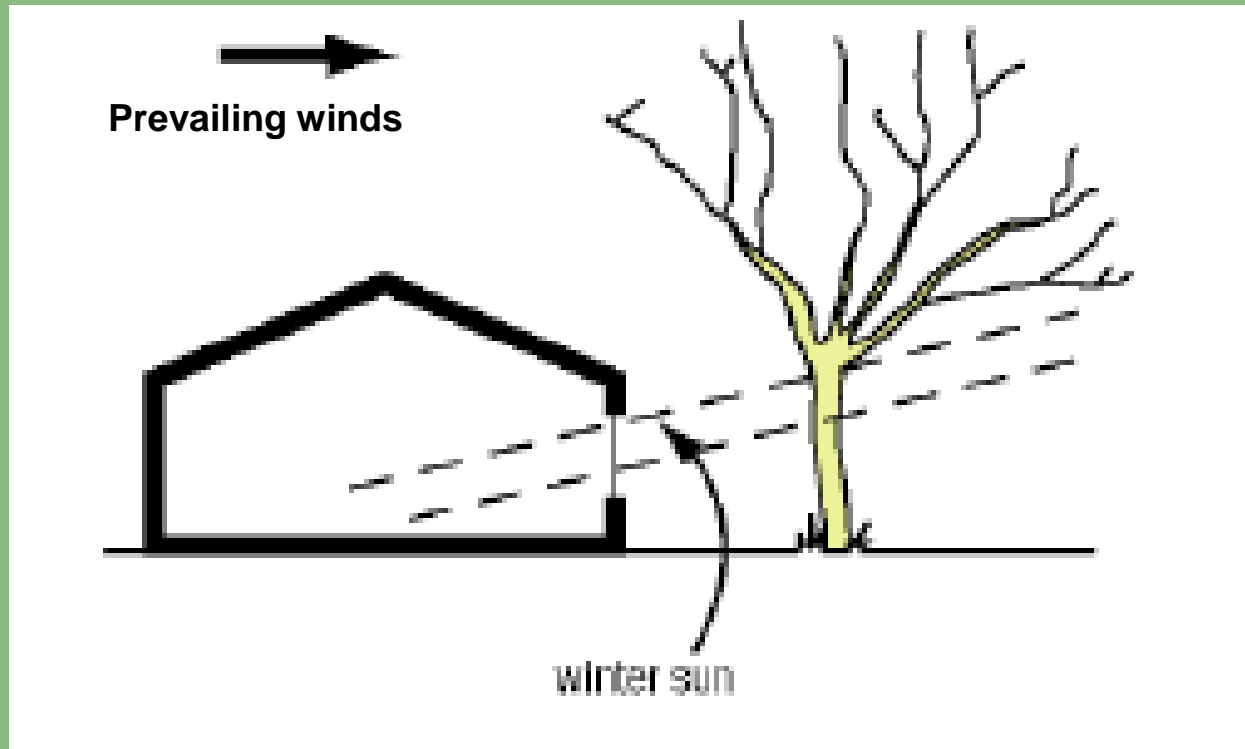


Picking the right trees and putting them in the right location will maximize their ability to shade buildings and block winds throughout the year.

- 3 new trees planted within 10 feet
- 250 homes
- Annual cooling savings 1% per tree
- Annual heating savings 2% per tree

Deciduous Trees

- Trees with high spreading branches
 - Provide access to the winter sun



Shrubs can help with shade



UC Statewide IPM Program
© 2000 Regents, University of California



- Shrubs planted close to home fill in rapidly and shade walls and windows
- Avoid in wetter climates where wind flow around the home is needed to reduce moisture

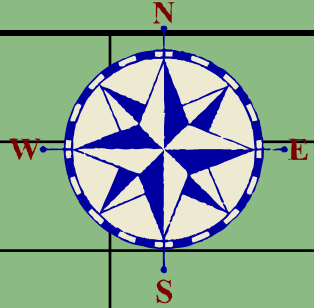


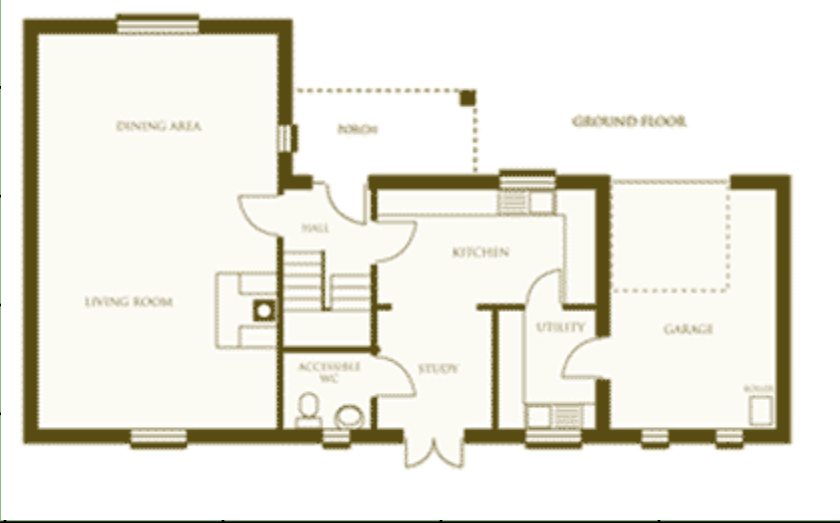
Figure 10.14: Planting to promote ventilation

Sketch in your house on the grid

Add your plants that shade

March - Oct							
							Nov- Feb





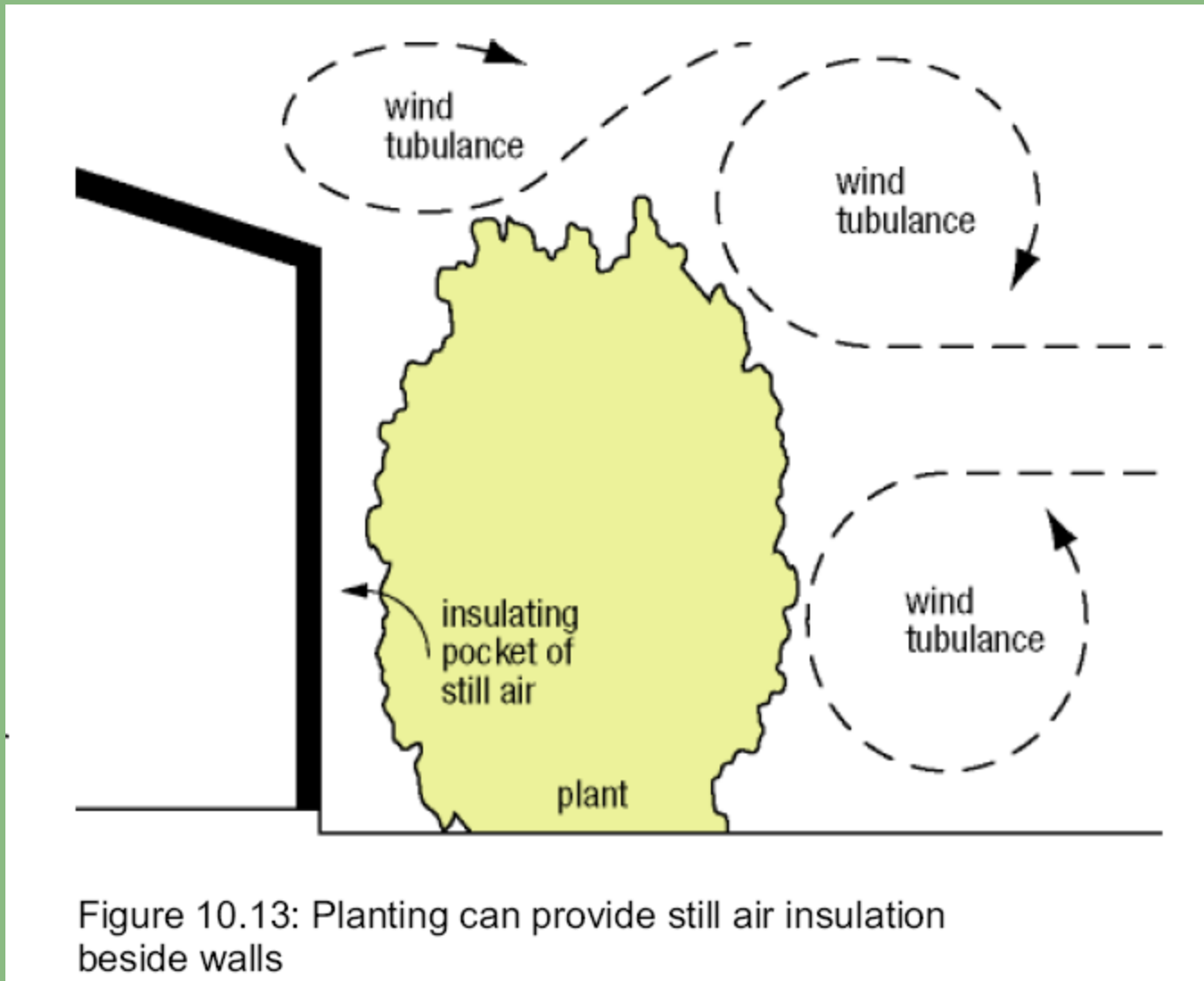
Windbreaks

- For best results
 - Plant dense evergreen trees and shrubs to break prevailing winter winds
 - Plant windbreak at a distance two to five times mature height of trees
 - Block wind close to the ground with low growing trees and shrubs

Windbreaks

- For best results
 - Plant 90 degrees to direction of wind.
 - Density of 50-60% creates less turbulence

Create an insulating layer



Counter winter winds – channel summer breezes

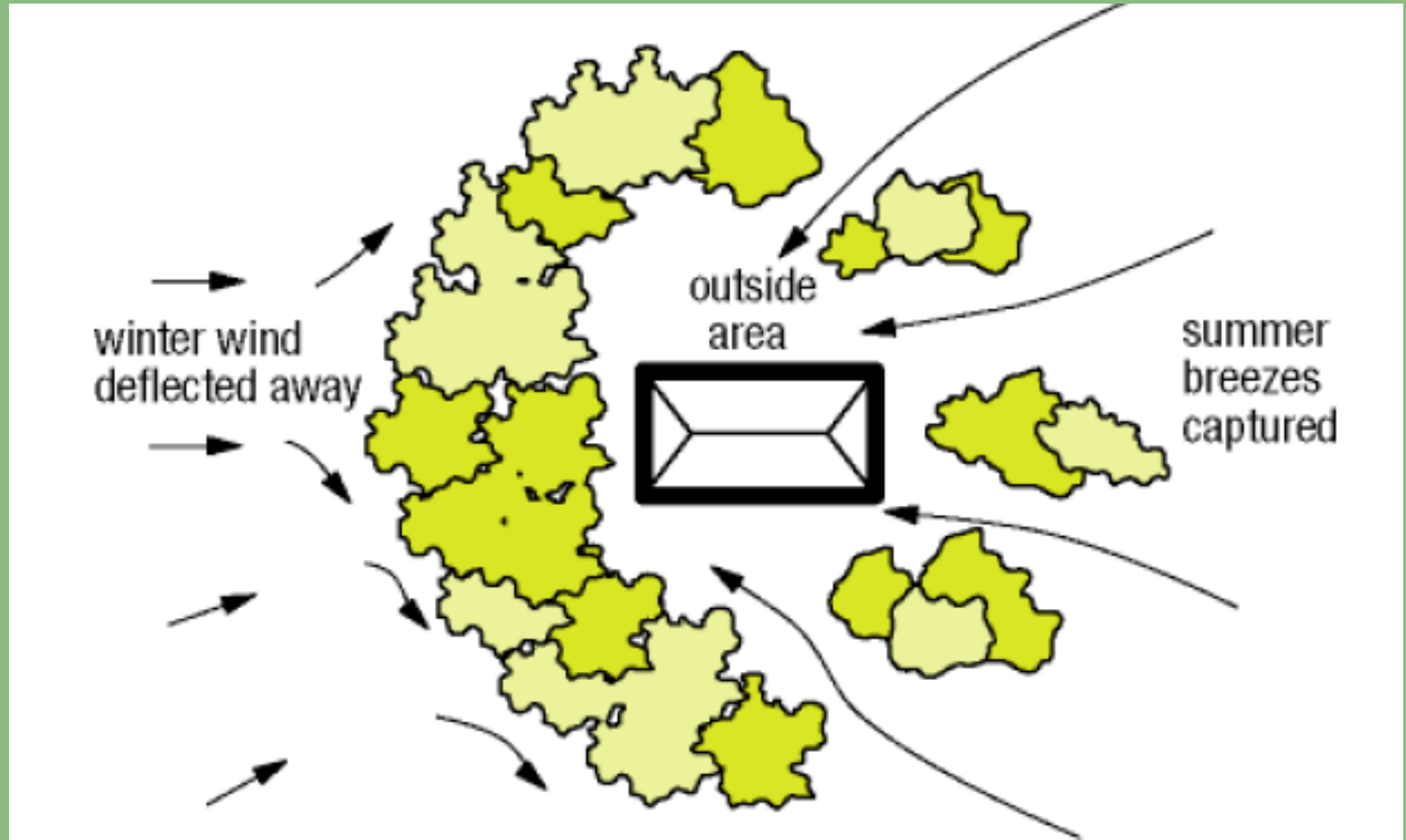


Figure 10.12: Use shrubs to deflect cold winds and channel summer breezes Image Courtesy of ESHousingManualCh10.pdf

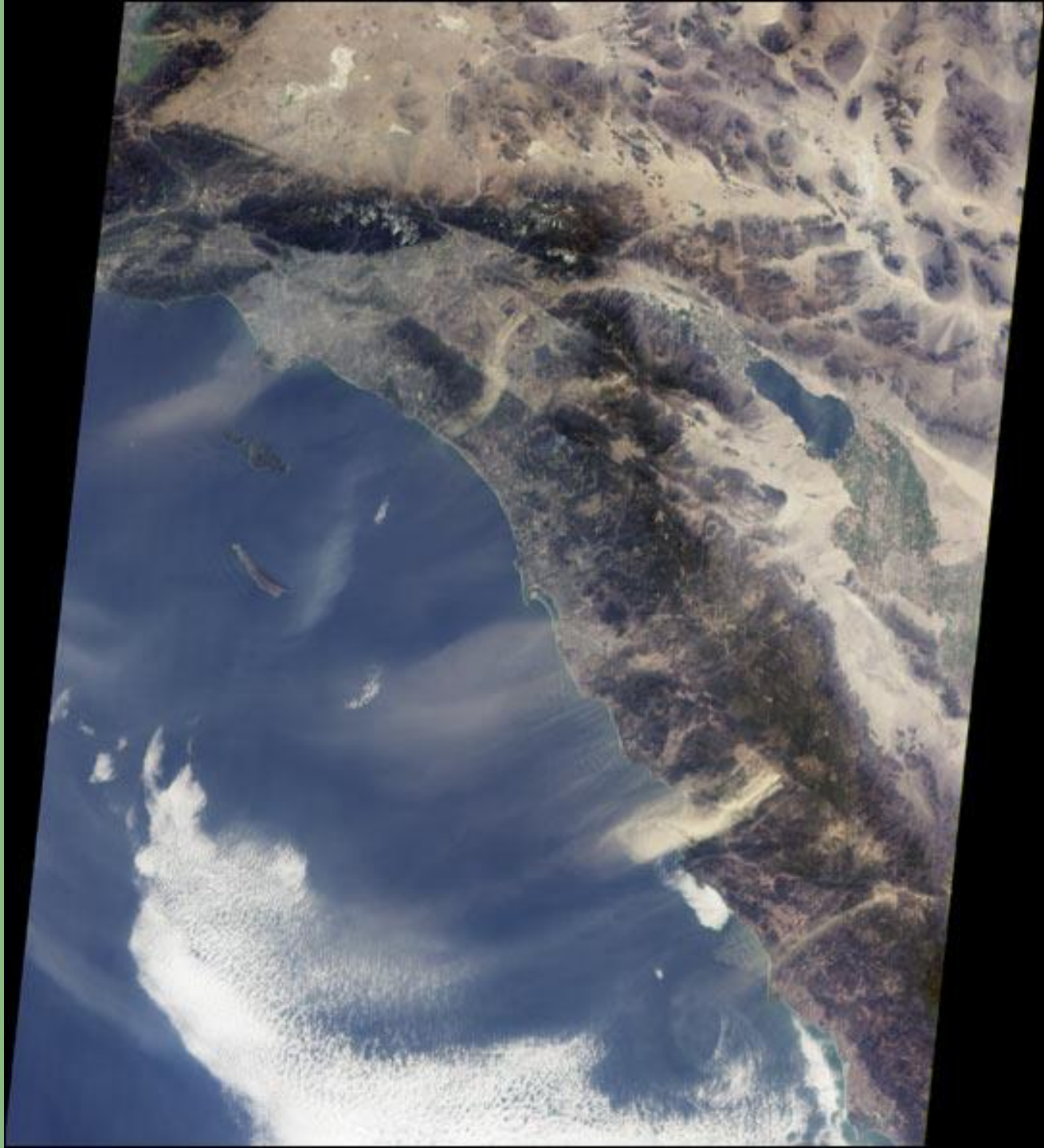
Windbreaks for Summer Winds

Santa Anas

- Low pressure in the Pacific
- High pressure in the Great Basin
- Winds turn southward along the Sierras
- Winds pulled through the mountain passes to the coastal areas





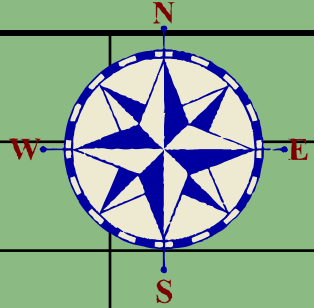
February
9, 2002

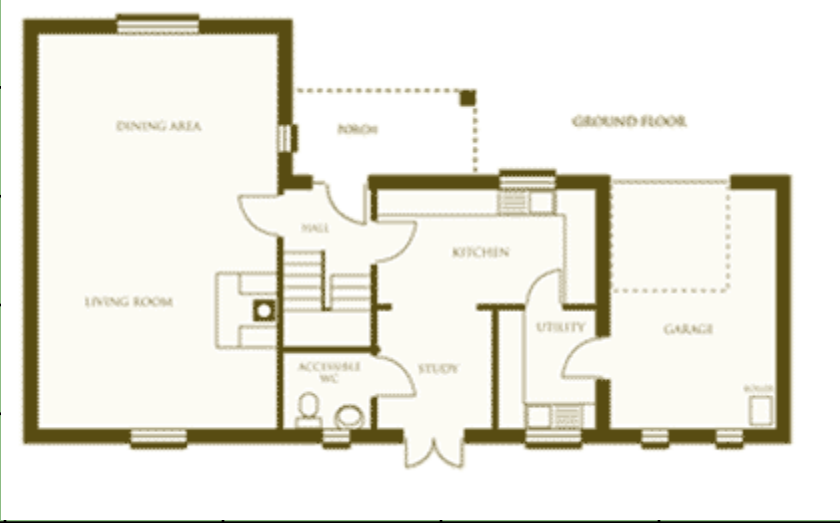


Sketch in your house on the grid

Add your windbreaks

March - Oct							
							Nov- Feb





Don't go home and cut down your trees!

- Mature healthy trees are difficult to replace!
- Start with existing trees
- Watch them for 1 year to assess energy performance
- Plant natives



What about xeriscaping?



UC Statewide IPM Project
© 2000 Regents, University of California

What about xeriscaping?

- Trees, shrubs, ground cover, outdoor pools and fountains
- Low maintenance (reduces that work term!)
- Bushes and shrubs reduce heat and glare
- Place water features upwind from house

Reducing glare

- Remember running barefoot across hot pavement in the summer?
- Strong sunshine reflected from paving, walls, water, or shiny objects
- Lawns, ground covers, low-growing shrubs absorb sunlight and re-radiate less

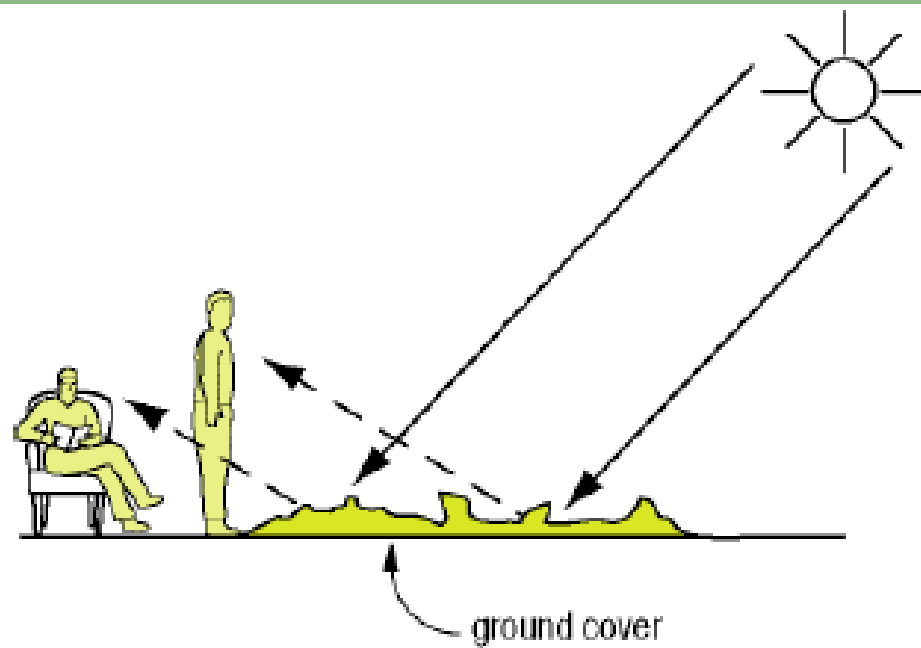


Figure 10.7: Low shrubs and ground covers can be used to reduce glare

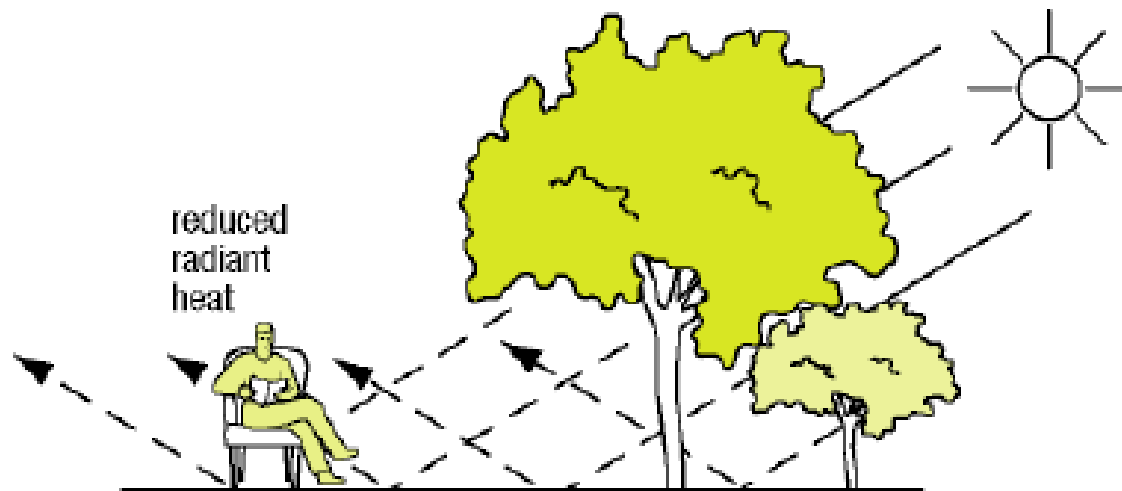

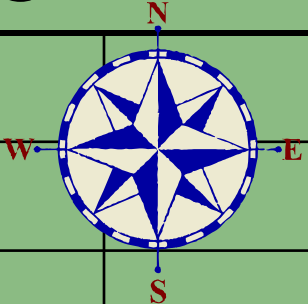
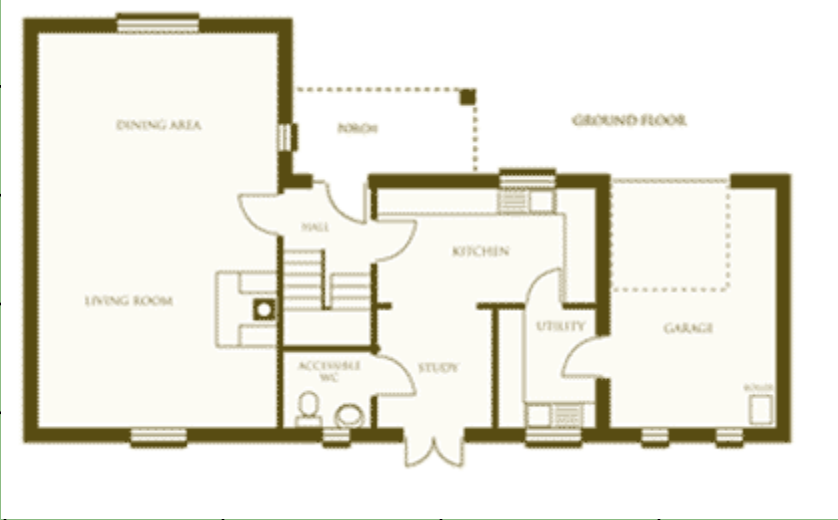



Figure 10.8: Glare control by interception

Sketch in your house on the grid

Add your plants that reduce glare

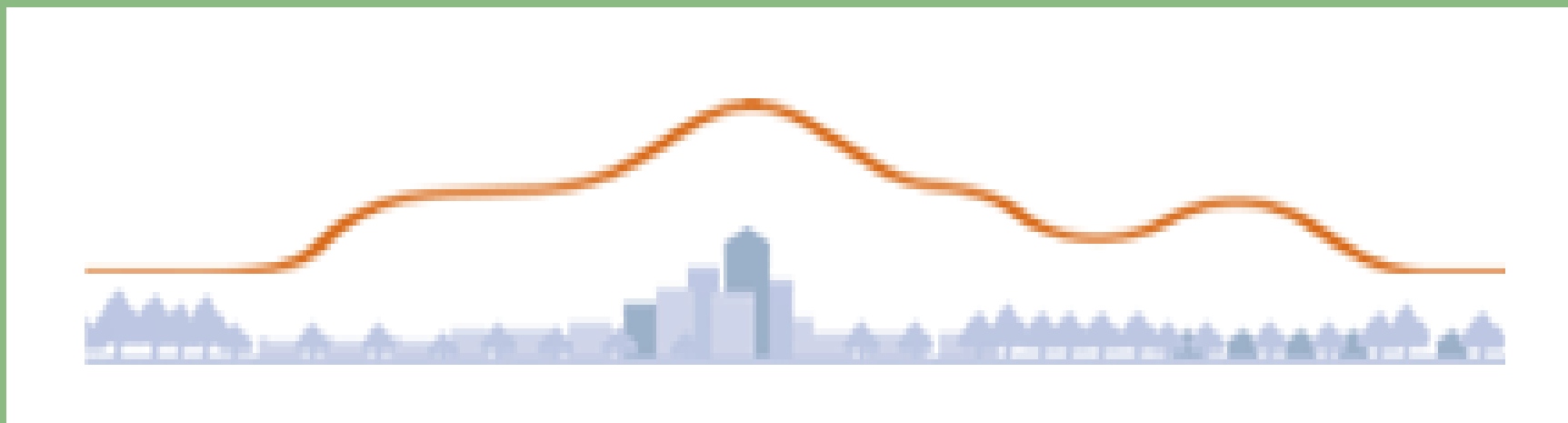
March - Oct							
							
							
							Nov- Feb

Web Resources for Plant Selection

Table 3: Web-Based Plant Selection Guides*

Name	Description	Web Link
General Information		
International Society of Arboriculture Tree Selection	Overview of variables to consider, including tree function, form, size, and site conditions.	< www.treesaregood.com/treecare/tree_selection.aspx >
Databases		
Tree Guide Advanced Search	Database of trees that can be searched by variables including sun exposure, hardiness zone, tree shape, and height.	< www.arborday.org/trees/treeguide/advancedsearch.cfm >
PLANTS Database	Database of information about U.S. plants, with an advance search by name, location, and environmental variables, such as soil type, fire tolerance, and flower color.	< http://plants.usda.gov >
SelecTree for California	Database of California trees that can be searched by name or environmental variable.	< http://selectree.calpoly.edu/ >

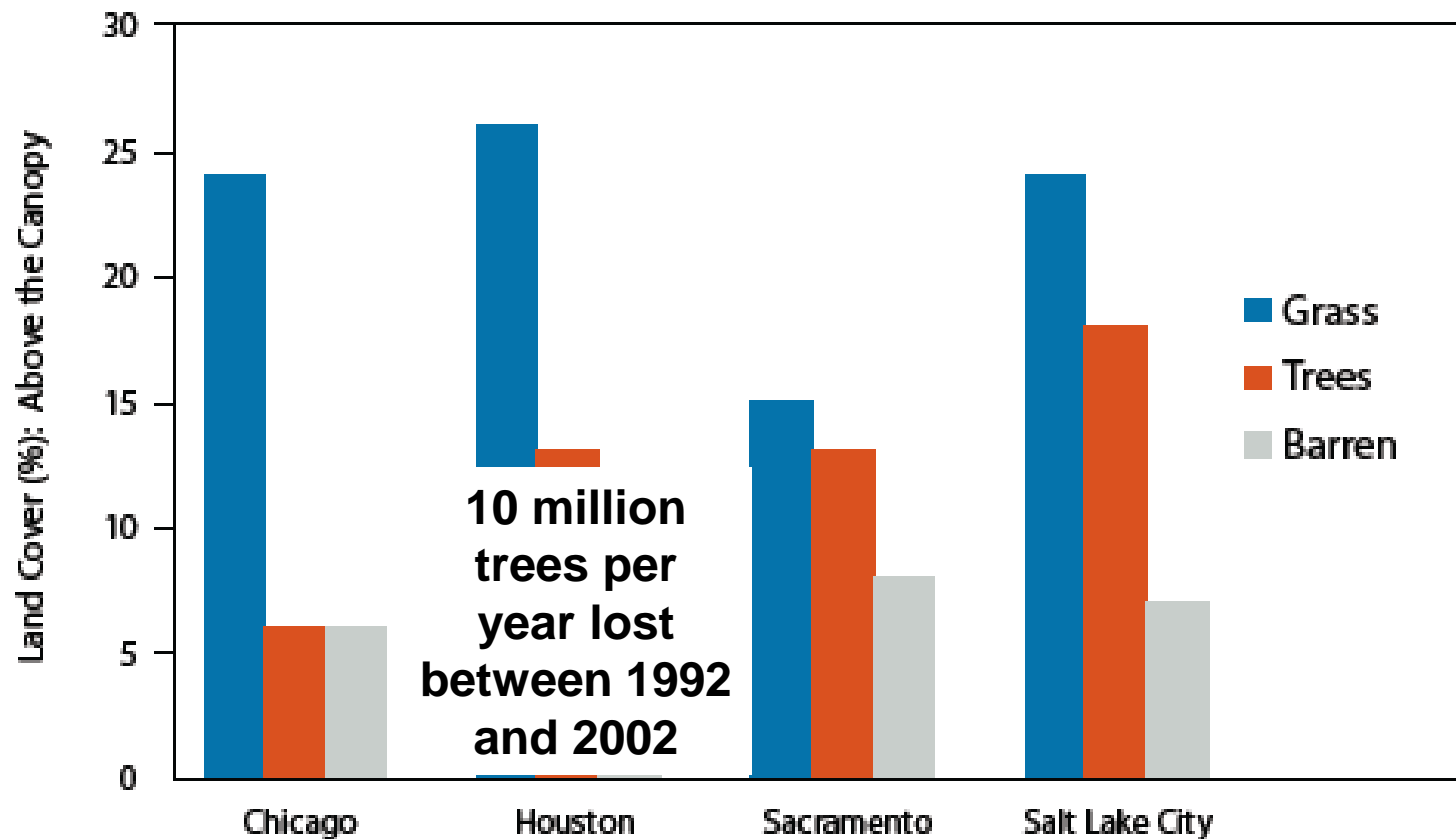
Heat Islands



- Built up areas that are hotter than nearby rural areas
- Annual mean air temperature of a city of 1 million
 - Daytime 1.8 to 5.4° F hotter
 - Evening as high as 22° F hotter
- Increases peak energy demand, air conditioning costs, greenhouse gas emissions, heat related illness, affects water quality

Percentage of vegetated and barren land in four urban areas

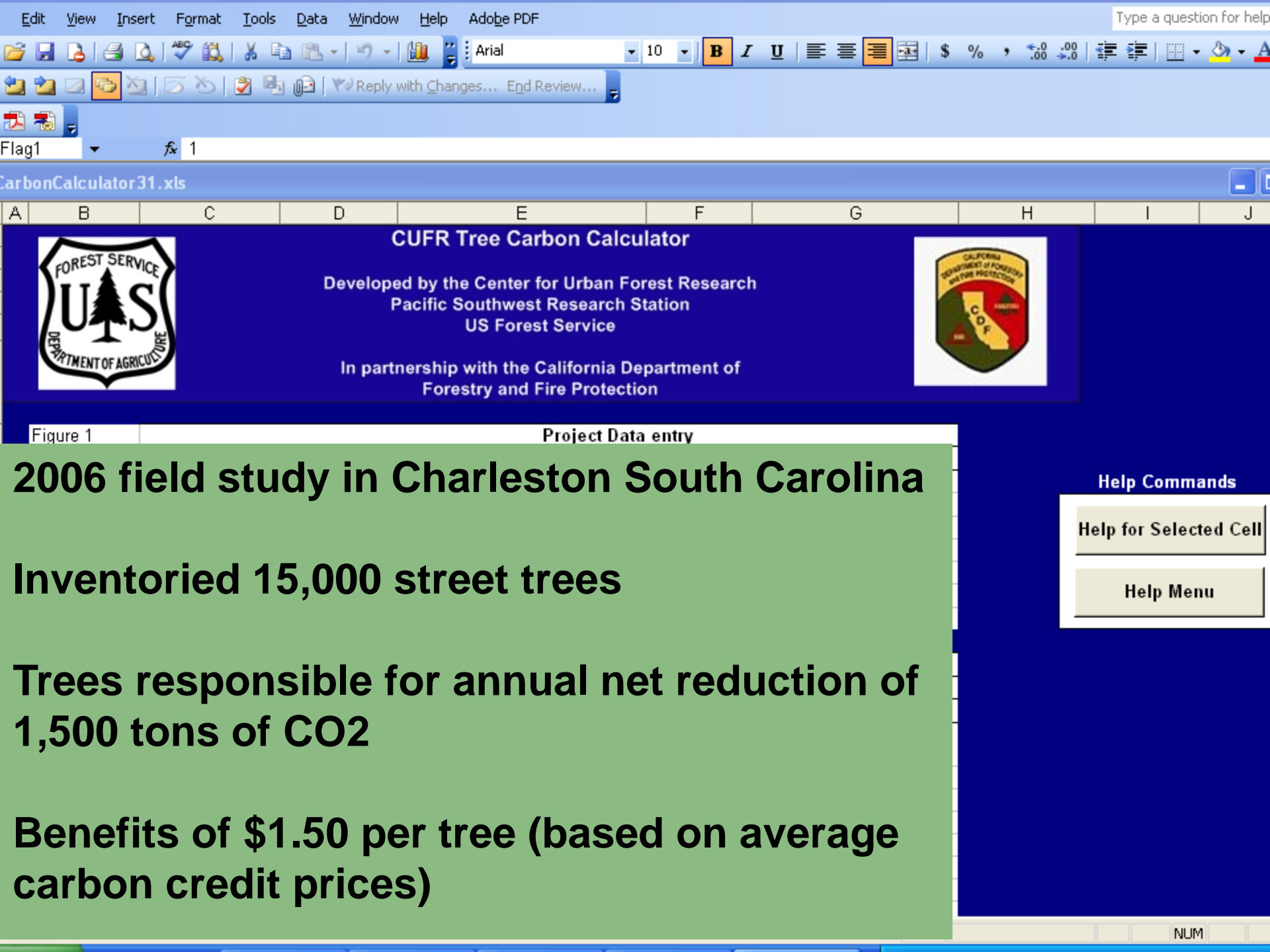
Figure 1: Land Cover Statistics for Various U.S. Cities (Above Tree Canopy)



Plants and Carbon

- **Storage:** Carbon currently held in plant tissue (tree bole, branches, and roots).
- **Sequestration:** The estimated amount of carbon removed annually by plants, through the process of photosynthesis.





CUFR Tree Carbon Calculator

Developed by the Center for Urban Forest Research
Pacific Southwest Research Station
US Forest Service

In partnership with the California Department of
Forestry and Fire Protection



Figure 1

Project Data entry

2006 field study in Charleston South Carolina

Inventoried 15,000 street trees

**Trees responsible for annual net reduction of
1,500 tons of CO₂**

**Benefits of \$1.50 per tree (based on average
carbon credit prices)**

Help Commands

Help for Selected Cell

Help Menu

NUM

What is energy?

- Ability to do work
- Moving or lifting
- Warming, cooling, and
- Lighting

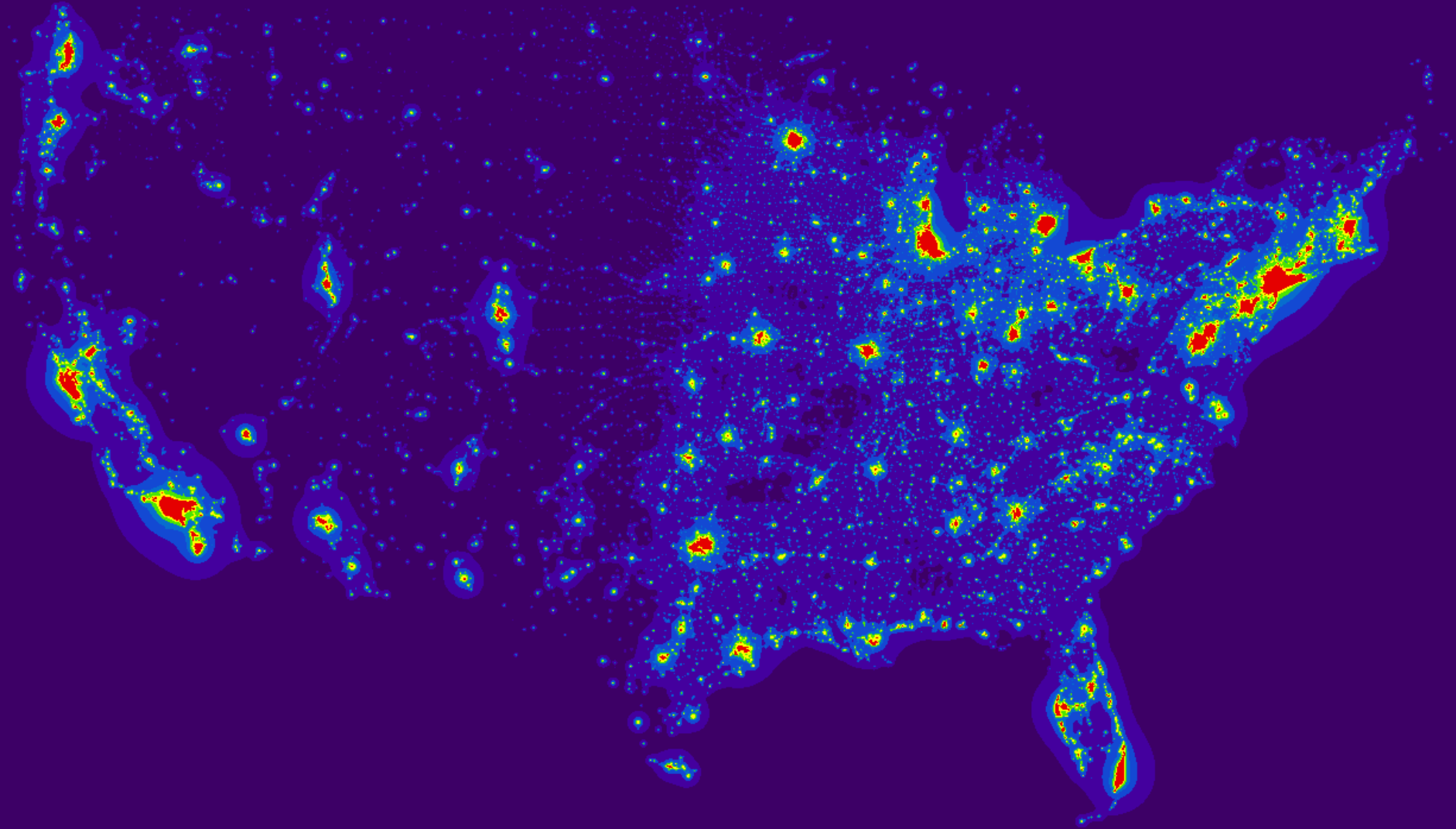


What is energy?

- Ability to do work
- Moving or lifting
- Warming, cooling, and
- Lighting



Light Pollution



Outdoor lighting

- Safety feature
- Reduce accidents
- Beautiful

- Lighting accounts for 25% of average home electric bill



phot credit: National Renewable Energy Laboratory

Solar powered lighting

- Photovoltaic panel charges battery
- Can be turned on
 - Manually
 - light sensing controls
 - Motion detectors
- No CO₂ produced and powered by renewable energy



Solar powered LED lighting

- Light Emitting Diode
- Can be turned on
 - Manually
 - light sensing controls
 - Motion detectors
- No CO₂ produced and powered by renewable energy



Energy calculators for light bulbs

Energy Savings Calculator for Replacing Light Bulbs

	Incandescent Light Bulbs	CFL (Compact Fluorescent Light Bulbs)	LED (Light-Emitting Diode Light Bulbs)
Life Span (in hours)	1,500	10,000	60,000
Watts	60	14	6
Cost	\$1.345	\$2.98	\$54.95
KWh of electricity used over 60k hours	3,600	840	360
Electricity Cost (@ \$0.23 per KWh)	\$821.72	\$191.73	\$82.17
Bulbs needed for 60k hours of usage	40	6	1
Equivalent 60k hour bulb expense	\$53.80	\$17.88	\$54.95
Total 60,000 Hour Lighting Spend	\$875.52	\$209.61	\$137.12

Calculate Your Energy Savings

# of household light bulbs	30	30	30
Your estimated daily usage (hours)	5	5	5
Days in month	30	30	30
<i>Household savings over 60,000 hours (energy + replacement)</i>			
Household cost	\$26,265.54	\$6,288.43	\$4,113.65
Savings by switching from Incandescent	\$0.00	\$19,977.11	\$22,151.89
<i>Monthly household energy savings</i>			
KWh used per month	270	63	27
Electricity Cost (@ \$0.23 per KWh)	\$61.63	\$14.38	\$6.16
Savings by switching from Incandescent	\$0.00	\$47.25	\$55.47
<i>Yearly household energy savings</i>			
KWh used per year	3,285	767	329
Electricity Cost (@ \$0.23 per KWh)	\$749.82	\$174.96	\$74.98
Savings by switching from Incandescent	\$0.00	\$574.86	\$674.84

Energy calculators for light bulbs

- http://www.energystar.gov/ia/partners/promotions/change_light/downloads/bulb.html


Your approximate savings, pay-off, and lifespan are:

Estimated energy savings per year	304 kilowatt hours
Estimated savings per year	\$25.33
Estimated ENERGY STAR® pay-off	9 months
Estimated ENERGY STAR® lifespan	4.1 years

Update any fields to evaluate another scenario.



Existing incandescent light bulb size	75	watts	
Replacement ENERGY STAR® compact fluorescent bulb size	23	watts	
Number of light bulbs	4	bulbs	
Hours of use per day	4	hours	
Cost per incandescent light bulb	0	.75	dollars
Cost per ENERGY STAR® compact fluorescent bulb	5	.00	dollars
Electricity cost	8	.5	cents per KWH

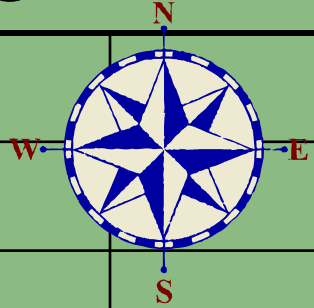
Calculator provided courtesy of the sponsoring organizations of Northeast Energy Efficiency Partnerships, Inc. (NEEP).

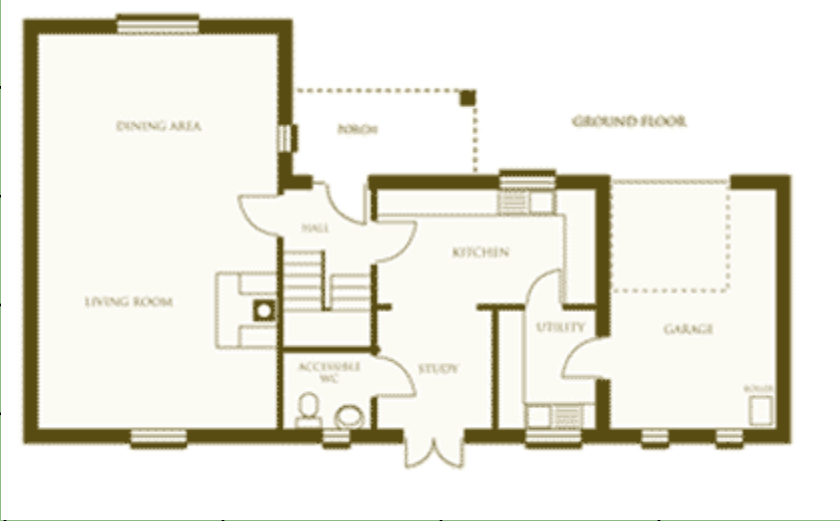
 CHANGE A LIGHT	Savings are for wattages shown. Your actual savings will vary based on the wattages you purchase. When comparing incandescent or halogen bulbs to ENERGY STAR qualified bulbs or fixtures, compare the light output, or lumens, and not Watts. Watts equal the energy used, not the amount of light.
---	--

Sketch in your house on the grid

Add your outdoor lighting

March - Oct							
							Nov- Feb





What about my swimming pool?



- Which uses more water – a swimming pool or an irrigated lawn?
- water conscious behavior of those living in the house is the principal factor in determining if the swimming pool or the irrigated lawn uses more water.

Outdoor pools and energy



- According to the Sacramento Municipal Utility District, during the summer season a typical backyard California pool can use enough energy to power an entire home for three months.

Ways to Save Energy in Your Pool

- Think about the pump
 - Reducing filter operating times will reduce electrical consumption by 40 to 50%
 - 4 to 5 hours in summer and 2 to 3 hours in winter
- Consider a time clock
 - Run pump during off peak hours
- Do regular preventative maintenance
- Use automatic pool cleaners

Ways to Save Energy in Your Pool

- Cover it up
 - Can keep pool an average of 10 degrees warmer
 - Cuts summertime heating costs by up to 90 percent
 - Keeps pool clean, reducing pump time
- Heat your pool efficiently
 - Locate the pool in the sunniest part of your yard
 - Screen it from prevailing winds
- Heat it with the sun
 - Solar heaters cost \$2,000 to \$4,000
 - Should pay for itself in 1.5 to 7 years depending on location

What Are Sustainable Landscape Practices?

- Remember, the key goals of sustainable gardening practices are to:
 - sustain water availability and quality
 - reduce off-site water movement into storm drains, lakes, rivers and creeks
 - reduce energy use
 - reduce our green waste to landfill
 - prevent soil degradation
 - facilitate wildlife, and
 - reduce the spread of invasive plant species

Which Sustainable Landscape Practices Save Energy?


1. Landscaping in harmony with the natural conditions of the watershed.
 2. Reducing waste and recycling materials.
 3. Keeping greenwaste on site
 4. Nurturing healthy soils while reducing fertilizer use.
 5. Conserving water and topsoil.
 6. Using IPM to minimize chemical use.
 7. Reducing stormwater runoff.
 8. Creating wildlife habitat.
- From “River Friendly Landscape Guidelines”

Which Sustainable Landscape Practices Save Energy?

1. Landscaping in harmony with the natural conditions of the watershed.
 2. Reducing waste and recycling materials.
 3. Keeping greenwaste on site
 4. Nurturing healthy soils while reducing fertilizer use.
 5. Conserving water and topsoil.
 6. Using IPM to minimize chemical use.
 7. Reducing stormwater runoff.
 8. Creating wildlife habitat.
- From “River Friendly Landscape Guidelines”



Master Gardener Program

University of California Cooperative Extension 

Thank You
Any Questions?

Resources

- Lighting
 - <http://www.consumerenergycenter.org/index.html>
- Tree Selection
 - <http://www.milliontreesla.org/>
- Energy Use
 - <http://www.ecosmart.gov/default.asp> (In Dev.)