

An aerial photograph of a desert landscape, likely in the southwestern United States, showing a grid of irrigation canals. The canals are visible as straight lines cutting through the arid, brownish terrain. The top portion of the image is dominated by a deep blue sky. The overall scene is a mix of natural desert features and human-made agricultural infrastructure.

Building New Traditions Using Traditional Concepts – a sustainable building workshop

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The Building Blocks of Green Building Programs

- LOCATION & SITE
- WATER
- ENERGY
- MATERIALS
- INDOOR ENVIRONMENTAL
QUALITY
- EDUCATION & TRAINING
- INNOVATION



An aerial photograph showing a coastal landscape. In the foreground, there is a sandy area with some sparse vegetation. A road or path runs horizontally across the middle of the image. Beyond the road, there is a large, flat, light-colored area, possibly a beach or a salt flat, leading to a dark blue body of water. The text "Site & Location" is overlaid in white in the center of the image.

Site & Location

SITE: A place fitted or chosen for any certain *permanent* use or occupation.



Typical site development in the Southwest:

- Scrape the site flat.
- Push rocks, vegetation, and topsoil to the side. Burn or dump this “debris” onto an adjacent site, or landfill it.
- Control stormwater by getting it off the site and into the municipal drainage system as quickly as possible.
- After construction, spread gravel over the site and add sparse landscape plantings.



The “Scrape it Clean” method of site preparation has become so commonplace, few developers ever consider other methods & techniques.

In the process, topsoil, vegetation and organisms unique to the site are lost. Soil biologists estimate it can take **ten years** for a site to regain its’ former composition after blading.



Thoughtless land development can also alter the natural hydrology of a site.

If the site shaping is done with a desire to get as much stormwater as possible off the site and into storm drains, the micro-habitat may never recover.

Erosion, loss of fertile topsoil, loss of site water recharge opportunities, and reduction in biodiversity and vegetative coverage may all result from site development techniques that place more value on the speed of the operation than the quality of the land left behind.



LOCATION: INFILL is Green



- Existing Utility Infrastructure
- Proximity to Public Transportation, Employment, Shopping
- Sense of Community
- Reduces Pressure on Existing Natural Open Space
- Redevelopment Potential for Blighted Areas

Sustainable Site Design Principles

- Get to know the place
- Preserve the natural hydrology of the site
- Provide additional opportunities for groundwater recharge
- Value topsoil, cacti & native trees/plants; use appropriate plantings for landscaping
- Leave as much open space as possible



Site Development Principles

- **Balance cut and fill. Do as little as possible of either. Design the building to work with the existing topography. Avoid building on desert slopes of over 15%.**
- **Protect remaining vegetation: Use wire cages around cacti and trees. Move plants that are in the building footprint. Fence or flag a no disturbance boundary. Use one driveway into and out of the site. Wash concrete trucks into containers, not out on to the soil.**
- **Move graded topsoil to an area where it can be covered and protected.**



Site Hydrology Principles

- Watch for the natural course water takes on site
- Slow the runoff down
- Direct runoff towards rain gardens & rainwater harvesting systems
- Minimize erosion
- Provide filtering, reduce pollutants

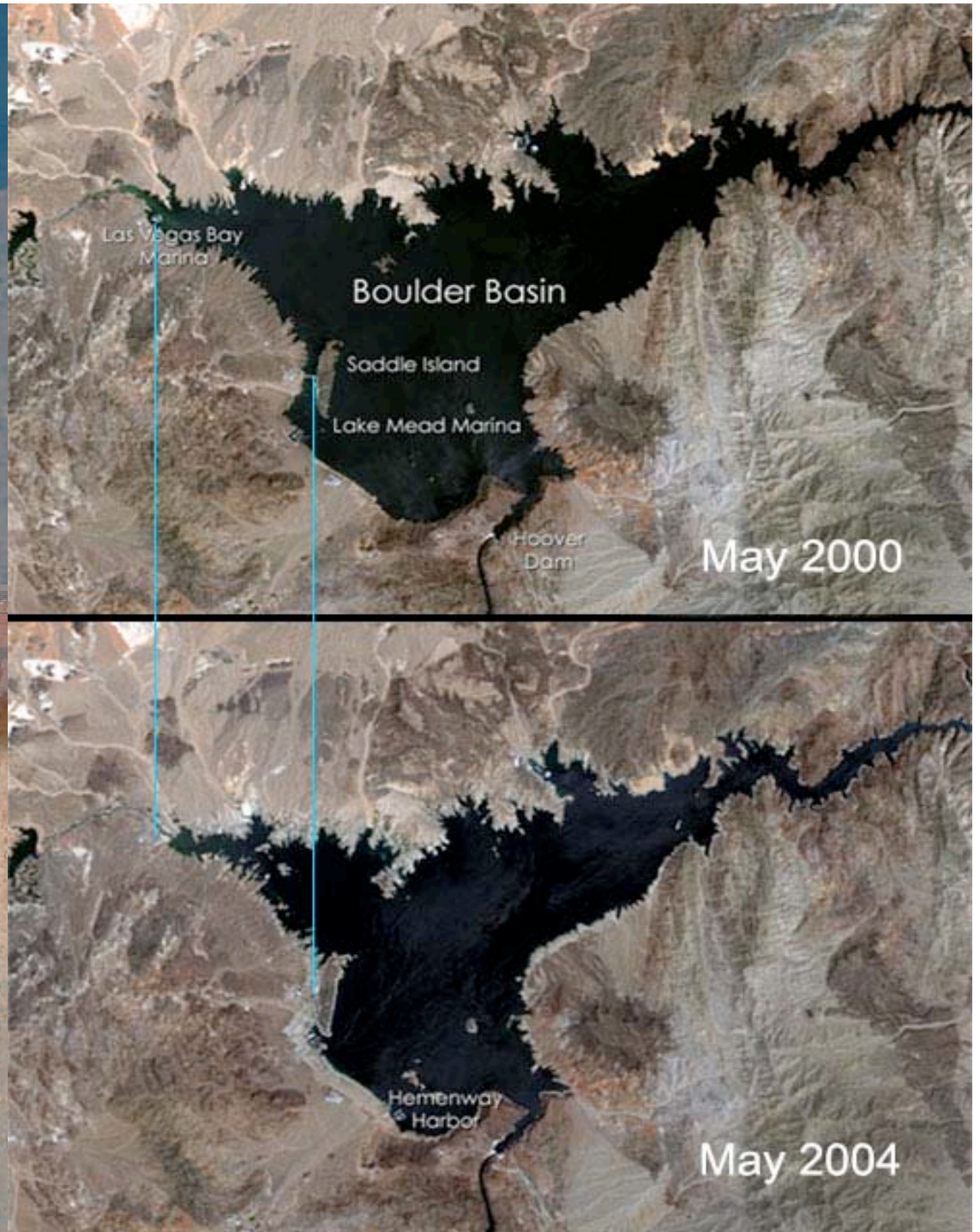


An aerial photograph of a coastal landscape. The top portion of the image shows a large, calm body of water in a deep blue color. Below the water is a wide, light-colored sandy beach. A thin, dark line of vegetation, possibly a dune or a strip of scrubland, runs horizontally across the middle of the image. The bottom portion of the image shows a sandy area with some sparse, low-lying vegetation. The word "WATER" is overlaid in the center of the image in a yellow, sans-serif font.

WATER

WATER: a common chemical substance that is *essential* to all known forms of life.

Source: Wikipedia



Where does the rain go?

- Hydrologists estimate that as much as 90% of the rain that falls on the desert is lost to the site through runoff and evaporation. Proper site preparation can ensure that much of the water that falls on a site stays on the site.



Water Use

- 40-60% of domestic water use in Arizona is for outdoor uses: landscaping, pools, irrigation, and washing cars, pets and sidewalks.
- It is estimated that 1/3 of water delivered to homes in Arizona is lost through undetected leaks.
- Rural areas and tribal lands are expected to suffer the greatest water shortages as population growth in AZ continues to stress groundwater levels.



WATER : Precious & Scarce

- If the world's water supply is compared to one gallon freshwater would make up 4 ounces or 3 percent, and readily accessible freshwater would make up 2 drops. (Miller, G.T. 1998. Living in the Environment, 10th Edition. Wadsworth Publishers, Belmont, California)
- Just a 10 percent improvement in efficiency of water delivery for irrigation systems could conserve enough water to double the global amount available for drinking.
www.solstice.crest.org

Going Blue-Green

- Rainwater Harvesting
- Low Flow Fixtures
- Greywater Harvesting
- Xeriscaping & Hydrozoning
- Reclaimed Water
- Energy Efficiency
- Reduce Leaks!

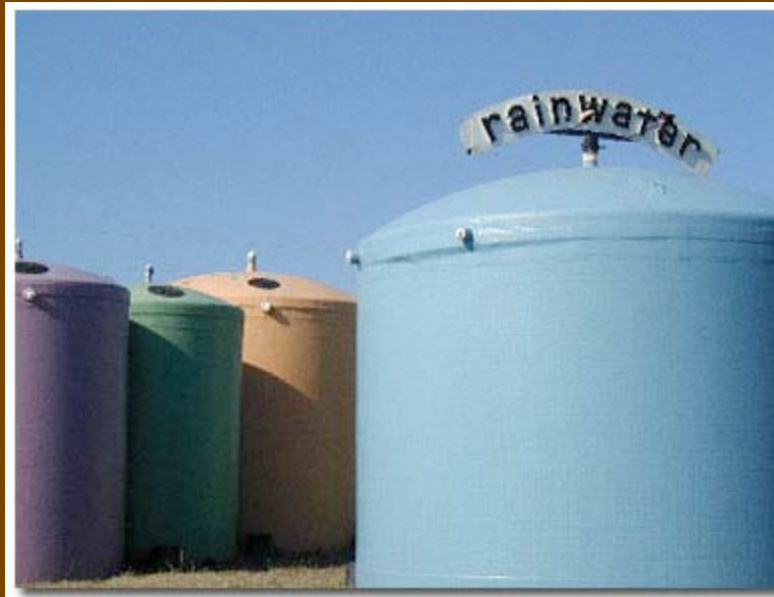


Rainwater Harvesting

Unlike greywater, rainwater will likely be lost to the regional watershed unless it is slowed and retained.

A 1-inch rainfall on a 1000 sf roof generates 600 gallons of water.

Active rainwater harvesting systems usually consist of roof guttering connected to cisterns that can be installed above or below ground.



Source: Richard's Rainwater, Austin TX



Source: Scott Calhoun, ZonaGardens, Civano

Water-Efficient Fixtures

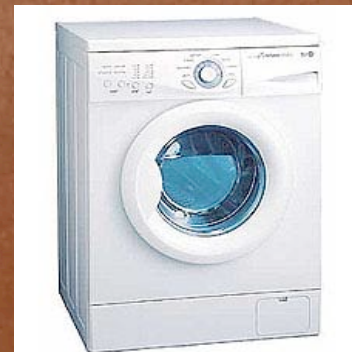
Dual Flush Toilets:
40-50% water savings over conventional toilets



Composting Toilets:
90-100% water savings over conventional toilets



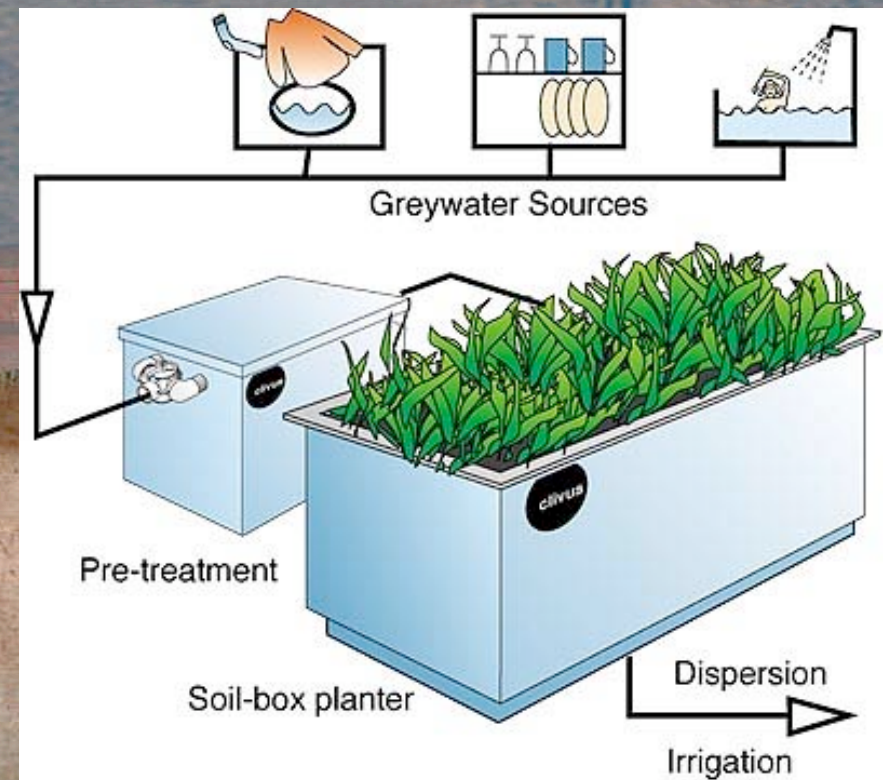
Horizontal Axis Washers: Use 25-50% less water than top loaders



The toilet is the largest water user of any appliance in the house...

Greywater Harvesting

- **Greywater** is water from the bath, shower, washing machine or bathroom in homes. Greywater can supply most, if not all the irrigation needs of a domestic dwelling landscaped with vegetation of a semiarid region.
- **Blackwater** is water from toilets or kitchen sinks and is not plumbed into a greywater harvesting system due to public health concerns



Source: Graywater.com

Xeriscaping & Hydrozoning

Xeriscaping is the use of native low water use plants in the landscape- can beautify the areas around a building & provide habitat for native species.

Hydrozoning is the practice of grouping plantings according to water needs. An irrigation system designed with hydrozoning in mind uses water more effectively & maintains a healthy landscape



Xeriscape™ at Tucson Water's Hayden-Udall Treatment Plant

The Water-Energy Link

- Production of electrical power results in one of the largest uses of water in the United States and worldwide. Water for thermoelectric power is used in generating electricity with steam-driven turbine generators. Surface water is the source for more than 99 percent of total thermoelectric-power withdrawals.
- In 2000, thermoelectric-power withdrawals accounted for 48 percent of total water use, 39 percent of total freshwater withdrawals for all categories, and 52 percent of fresh surface-water withdrawals.
- Three quarters of a gallon of water is required for every kilowatt hour of electricity generated by a coal-fired power plant.



Source: Energy Information Administration

Water Waste through Faulty Infrastructure, “Unaccounted” Losses



Most municipalities report a 10-20% loss of water for reasons that are unaccounted for – leaks and cracks in the system are most likely the culprit.

Source: ADWR

An aerial photograph of a coastal landscape. The foreground shows a sandy beach with some sparse vegetation. A line of dunes runs across the middle ground, with a few trees and shrubs. The ocean is visible in the background, with a clear horizon line. The word "ENERGY" is overlaid in the center of the image in a yellow, sans-serif font.

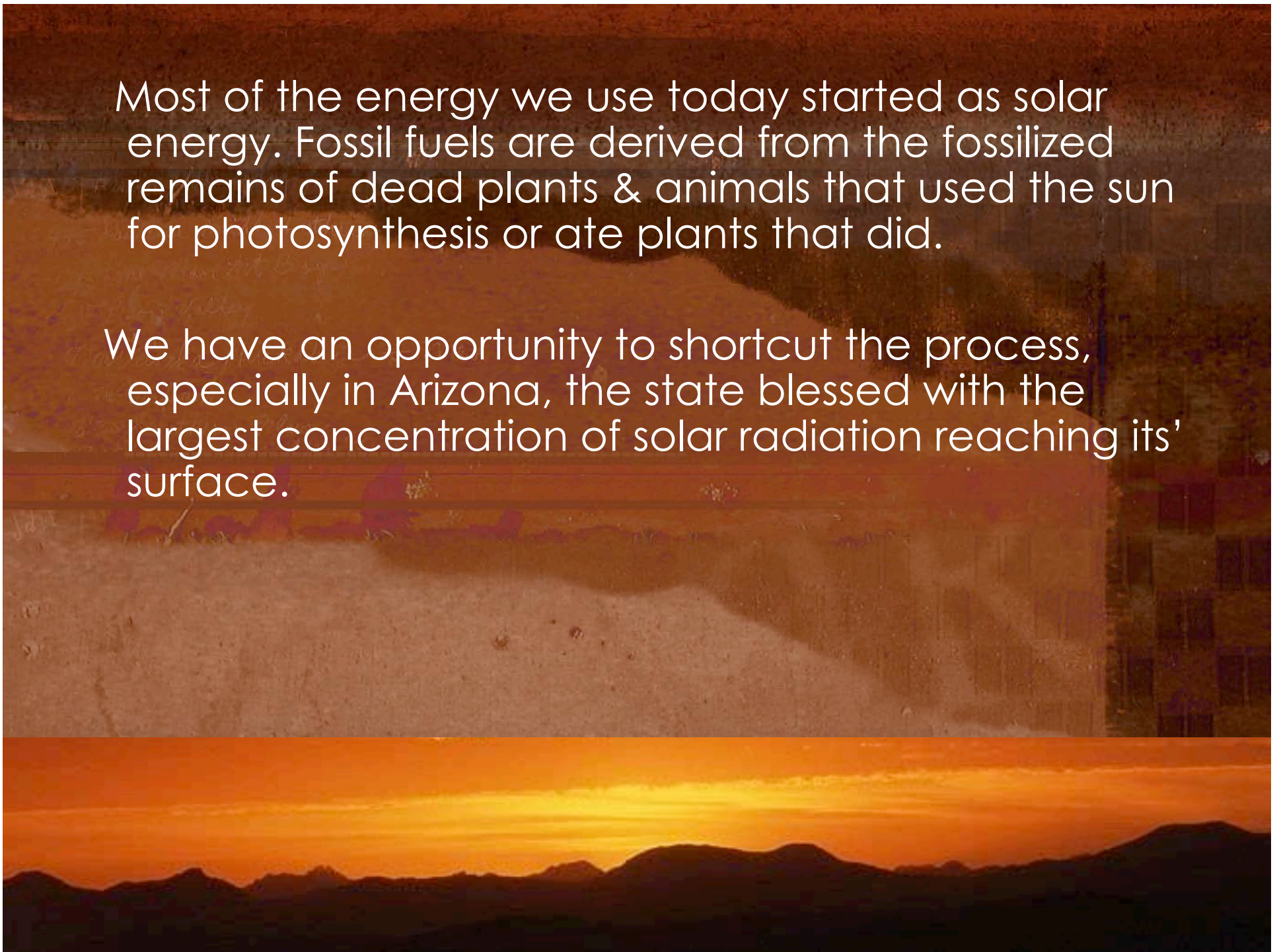
ENERGY

The United States has 5% of the world's population, 8% of fossil fuel reserves, but uses 25% of the energy consumed globally.



Most of the energy we use today started as solar energy. Fossil fuels are derived from the fossilized remains of dead plants & animals that used the sun for photosynthesis or ate plants that did.

We have an opportunity to shortcut the process, especially in Arizona, the state blessed with the largest concentration of solar radiation reaching its' surface.





Energy Conservation

Use Less Energy

Energy Efficiency

Use It Wisely

Renewable Energy

Use Clean Sources

Energy Conservation

The most important environmental issue is one that is rarely mentioned, and that is the lack of a conservation ethic in our culture.

Gaylord Nelson



Photo: Rich Legg

Buildings account for nearly 40% of energy use, and 20-45% of all energy use in buildings occurs when they are unoccupied.



Affordability & Energy Utilities

- *“Inability to pay utilities is second only to inability to pay rent as a reason for homelessness.”*

Karen Brown, Ex Dir, Colorado Energy Assistance Foundation. James Benfield, Ex Dir, Campaign for Home Energy Assistance.



Energy Efficiency

Efficiency is doing things right;
Effectiveness is doing the right things.

-Peter Drucker



Energy Efficiency

- Properly designed mechanical systems
- Task lighting/Individual thermal Controls
- Occupancy sensors
- Properly sized HVAC Units

Renewable Energy For Arizona

- SOLAR
- Wind?
- Geothermal?
- Biomass?

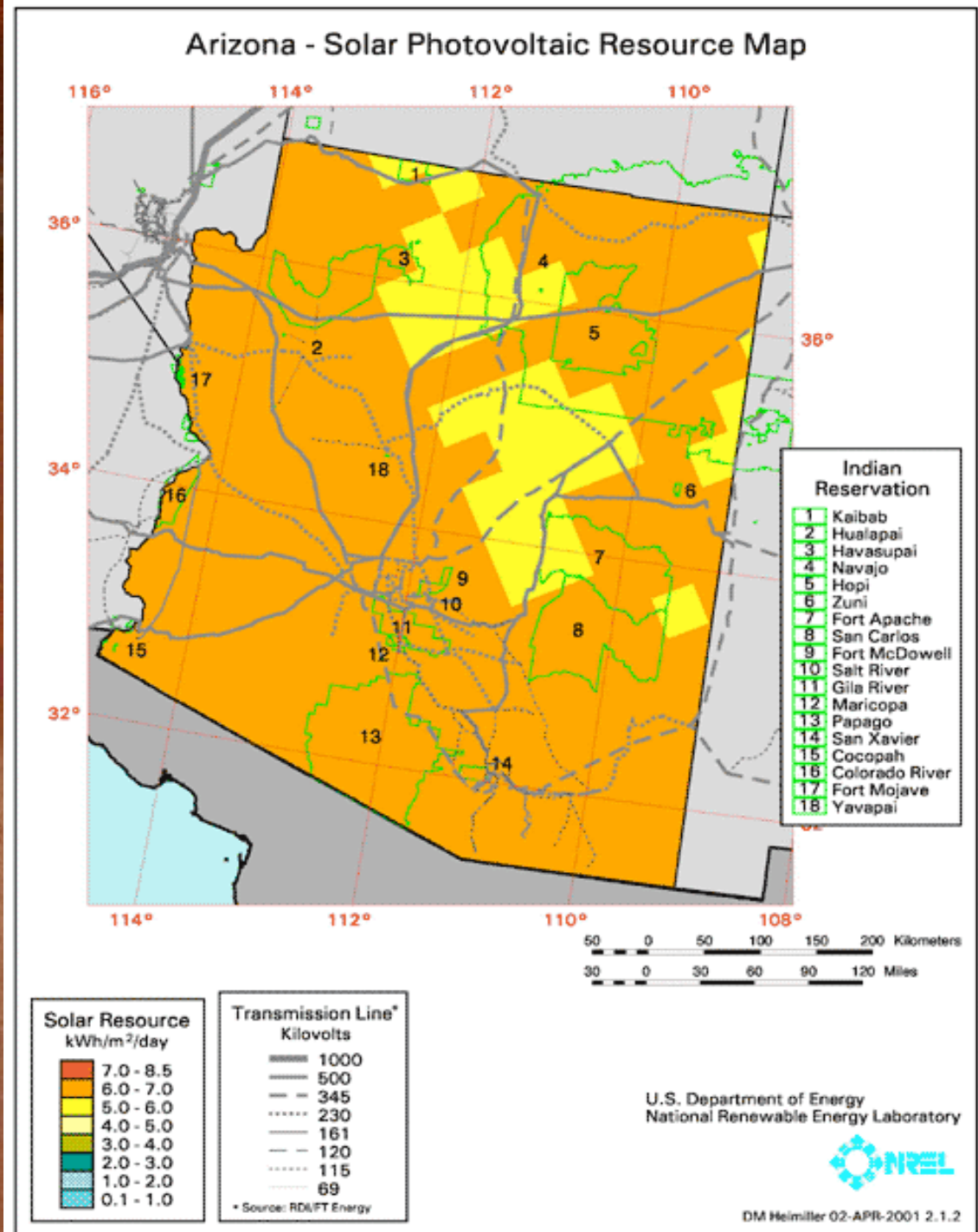


AZ Solar Potential

Arizona's insolation (a measure of solar radiation energy received on a given surface area in a given time), exceed that of any place in the United States.

Solar Potential is nearly uniformly promising throughout the state, therefore the potential to use the Solar Photovoltaic Resources for energy production is high.

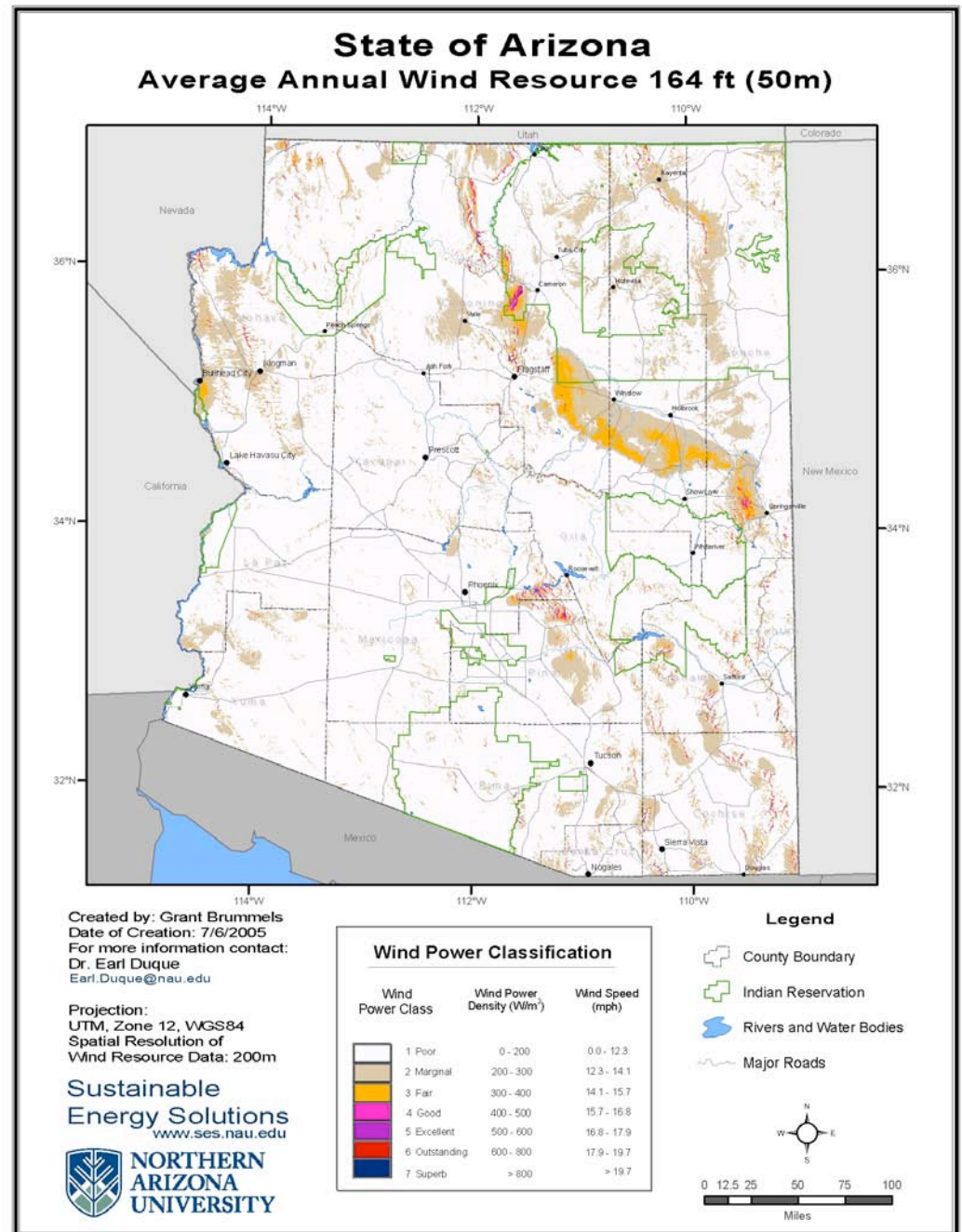
(NREL)



AZ Wind Potential

As confirmed by Arizona's new high-resolution wind energy map, Arizona has a significant wind resource that is developable on the commercial scale. This wind resource, however, has historically been under-reported.

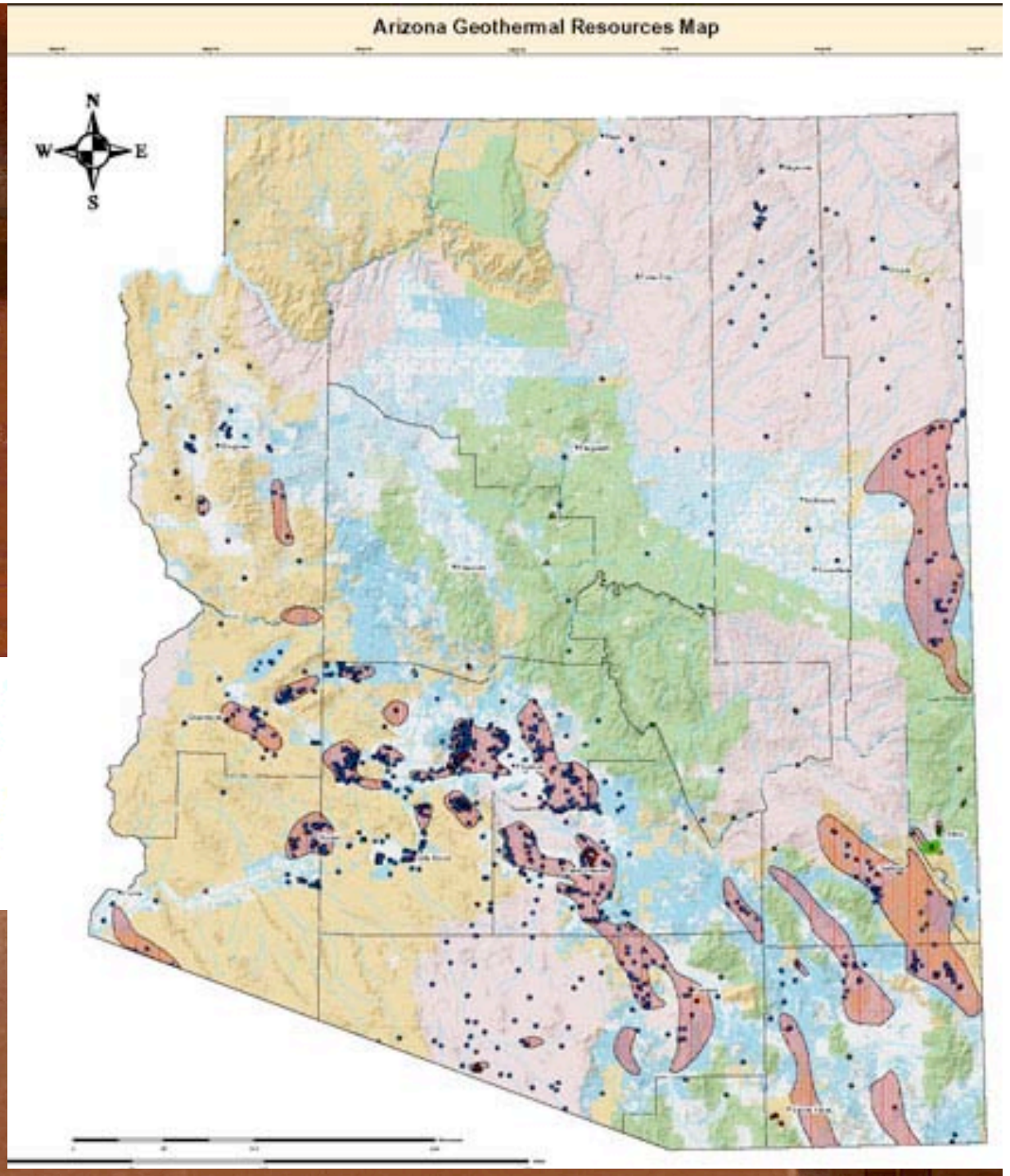
Two of the most promising tracks of contiguous windy lands in the state appear to be on the Navajo Nation near Cameron, and in eastern Arizona near Springerville (Arizona Wind Atlas, NAU)



Geothermal Potential in AZ

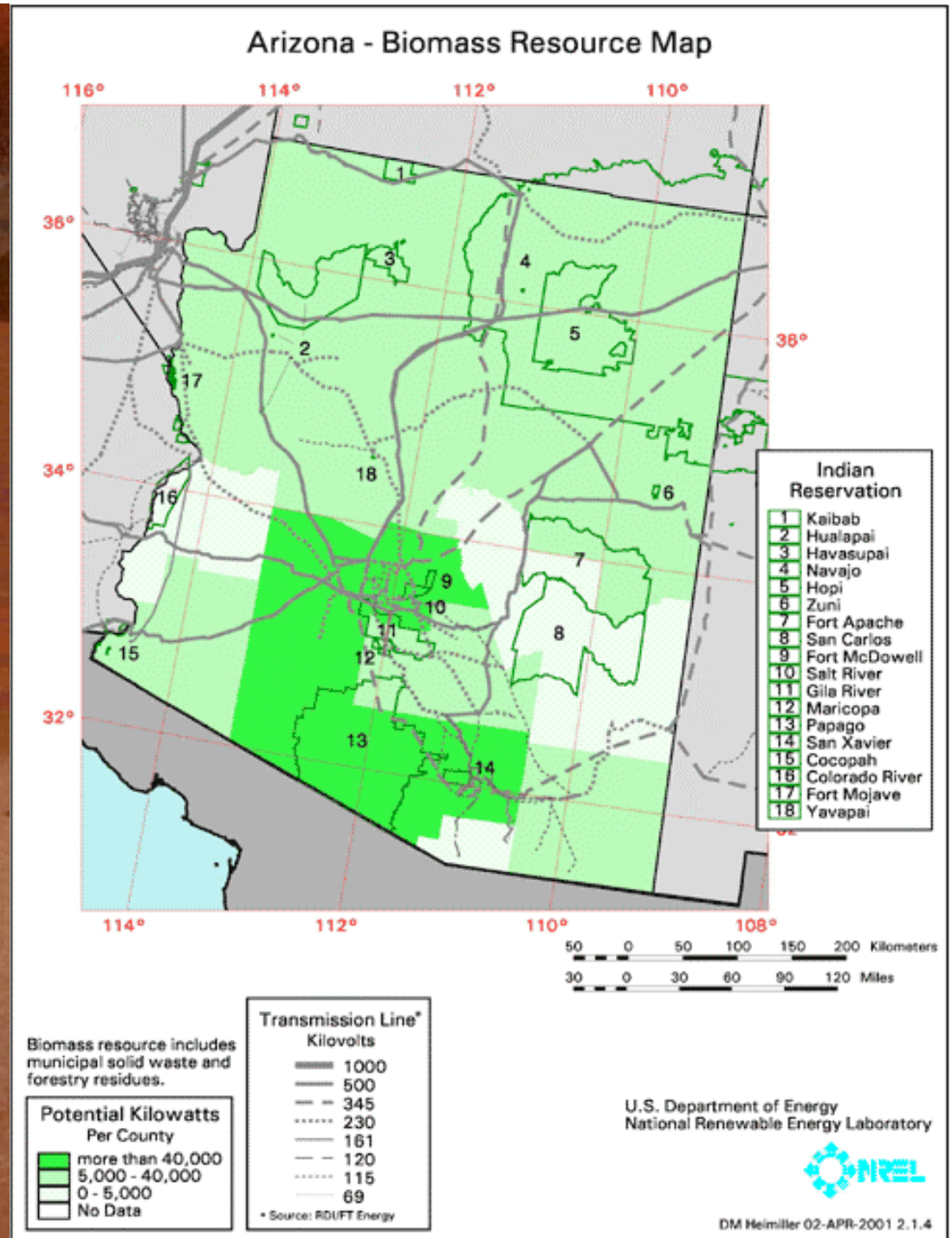
- ◆ Space Heating
- ▲ Aquaculture
- ▲ Spas/Resorts/Recreation Sites
- ▨ Areas with Potential for Direct Use Applications
- Areas with Potential for Electrical Generation

Map prepared by Patrick Laney and Julie Brizzee, INEEL for US DoE, based on data from Geo-Heat Center Geothermal Database, 2002 & NOAA, 1982.



AZ Biomass Potential

The biomass resource maps show county-level estimates of biomass resources available for biofuels production or biomass power stations. The map includes only the resources available from crop and forest residues. They do not include managed crop or forest resources, urban residues, municipal solid waste (MSW), or landfill gas (LFG). (AZ Solar Center)





MATERIALS

Materials

- Reclaimed/Salvaged



- Recycled



- Rapidly Renewable



- Local





30% Post Consumer Content

Indoor Environmental Quality

The air inside buildings can contain 10-15 times the toxins & pollutants when compared to the air outside the same building.

- Off-gassing of materials, especially paints, carpets, & furnishings
- Air Handling Intake location
- Inadequate fresh-air ventilation
- Molds & Pollen
- Tobacco smoke
- Overheating/overcooling
- Radon
- Asbestos



Getting to good air

1. Eliminate at Source
2. Filter
3. Ventilate



Indoor Environmental Quality

The National Energy Management Institute estimates over 300 billion dollars is lost in annual sick time attributed to poor indoor air quality.



Effects of Poor Indoor Environmental Quality

- Loss of Productivity in Workers – from 6-16 % in recent studies. Often the indoor air quality issues are imperceptible to occupants.
- Visitor satisfaction –poorer scores reported when small amounts of VOCs are introduced into atmosphere for as little as 5 hours.
- Increased sick time
- Increased worker stress and dissatisfaction

J. V. Bakke, D. Norbäck, G. Wieslander, B.-E. Hollund, E. Florvaag, E. N. Haugen, B. E. Moen. Symptoms, complaints, ocular and nasal physiological signs in university staff in relation to indoor environment – temperature and gender interactions. *Indoor Air* doi: 10.1111/j.1600-0668.2007.00515.