Federal On-Site Renewable Projects and Renewable Purchases

Joint Services Environmental Management Conference

May 24, 2007

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Presentation Overview

- Federal Renewable Goal Information
- Renewable Resources & Costs
- Renewable Technologies
  - Solar
  - Wind
  - Biomass
  - Geothermal
- Renewable Power Purchasing Options
  - Innovative on-site renewable project examples
- Federal Renewable Use
- Why are Renewables Important?

Federal Renewable Goal

- EPACT 05, Section 203a - 3% in FY07-09, 5% in FY10-FY12, 7.5% in FY13 & each fiscal year thereafter.

- Renewable Definition - electric energy generated from solar, wind, biomass*, landfill gas, **ocean** (including tidal, wave, current, and thermal), geothermal, municipal solid waste, or **new hydroelectric** generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project.

- Renewable energy amount shall be doubled if:
  - Renewable energy is produced on-site, on federal lands or on Native American land & used at a Federal facility

**There is a detailed biomass definition in the law*

EO13423

- EO13423 “Strengthening Federal Environmental, Energy, Transportation Management” (issued 1/26/07)

- Section 2b - Ensure that:
  - (i) at least half of the statutorily required renewable energy consumed by the agency in a fiscal year comes from “New” renewable sources (“New” is defined as 1/1/99)
  - (ii) to the extent feasible, the agency implements renewable energy generation projects on agency property for agency use

EO13423 Instructions

- Instructions for Implementing EO13423
  - Issued 3/29/07
  - Section VI Energy and Water Management (p. 12-14)

- Renewable goal guidance due June 27

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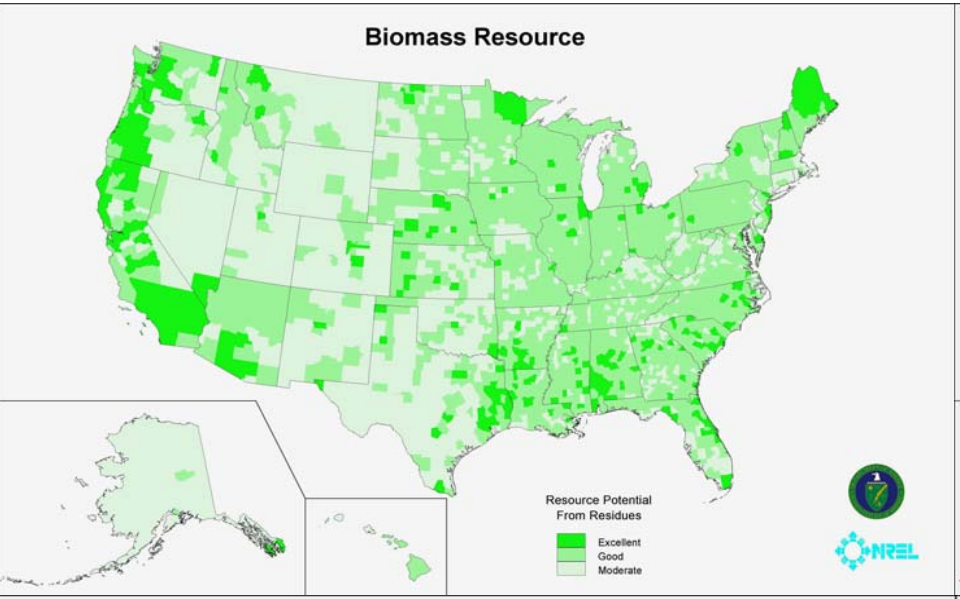
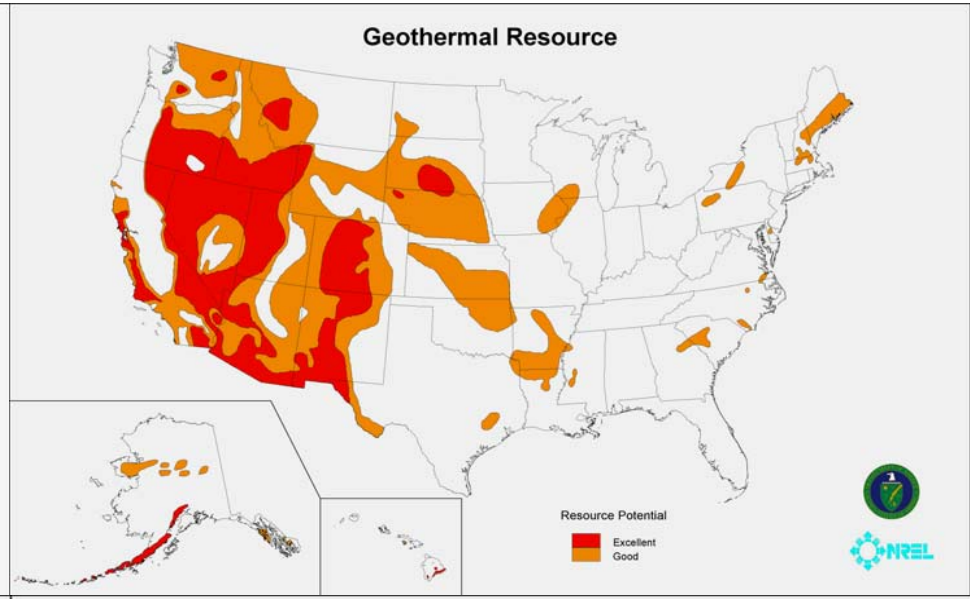
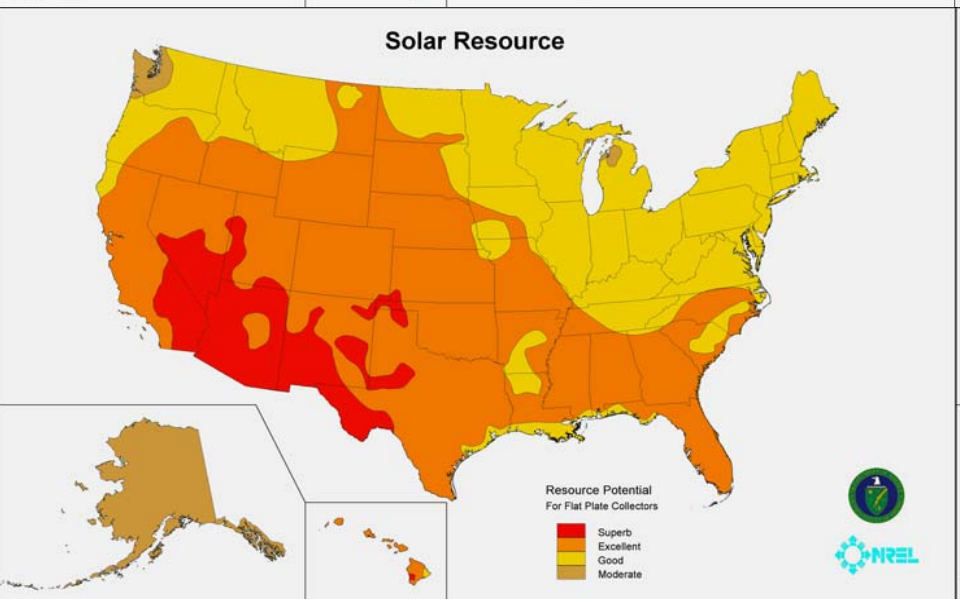
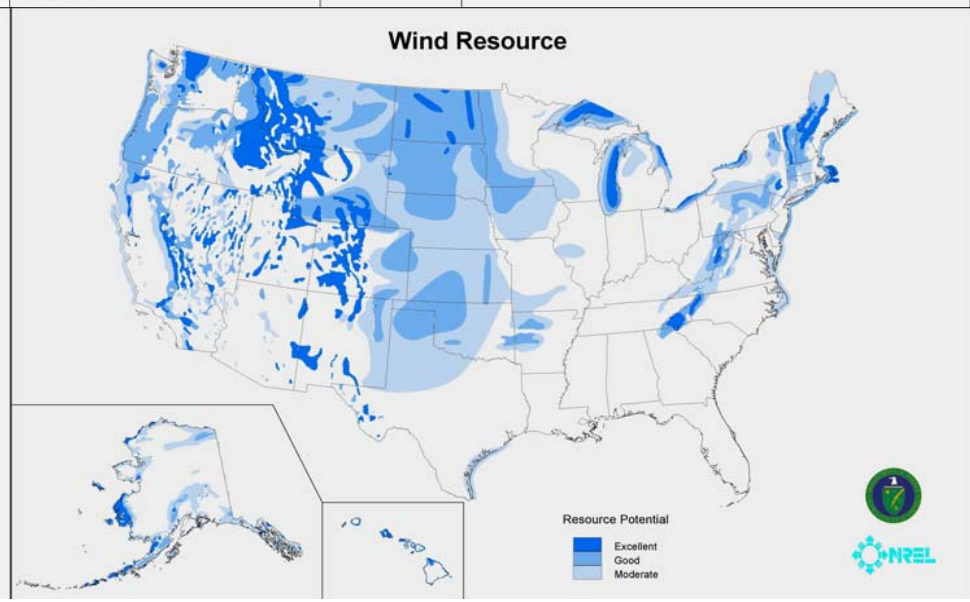
Energy Efficiency and Renewable Energy

Renewable Resource Availability









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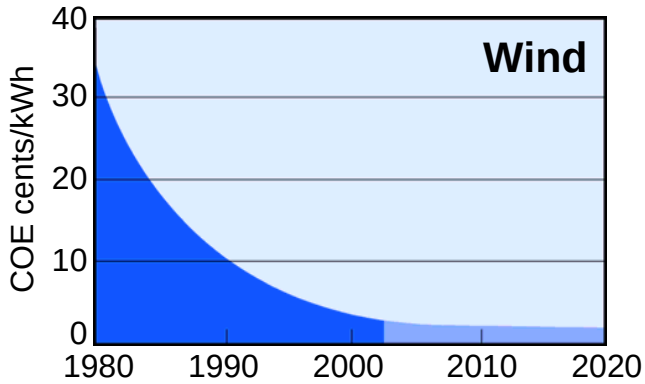
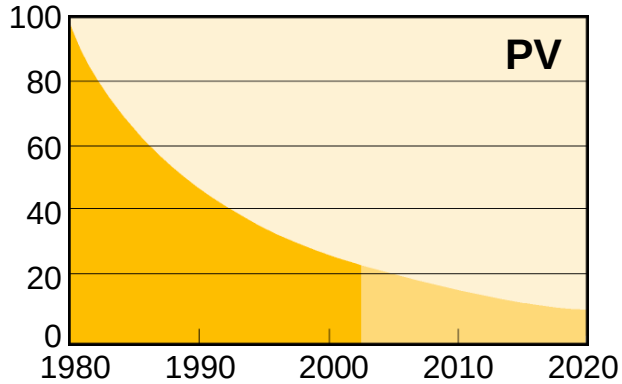
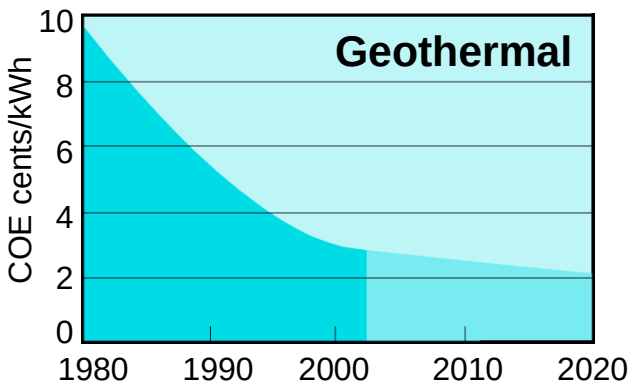
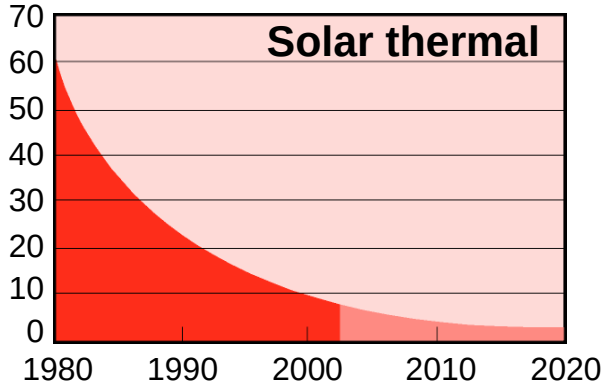
Renewable Energy Cost Trends

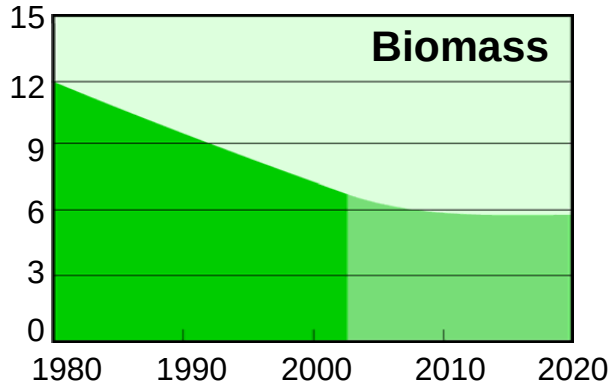
Levelized cents/kWh in constant $2000[1]









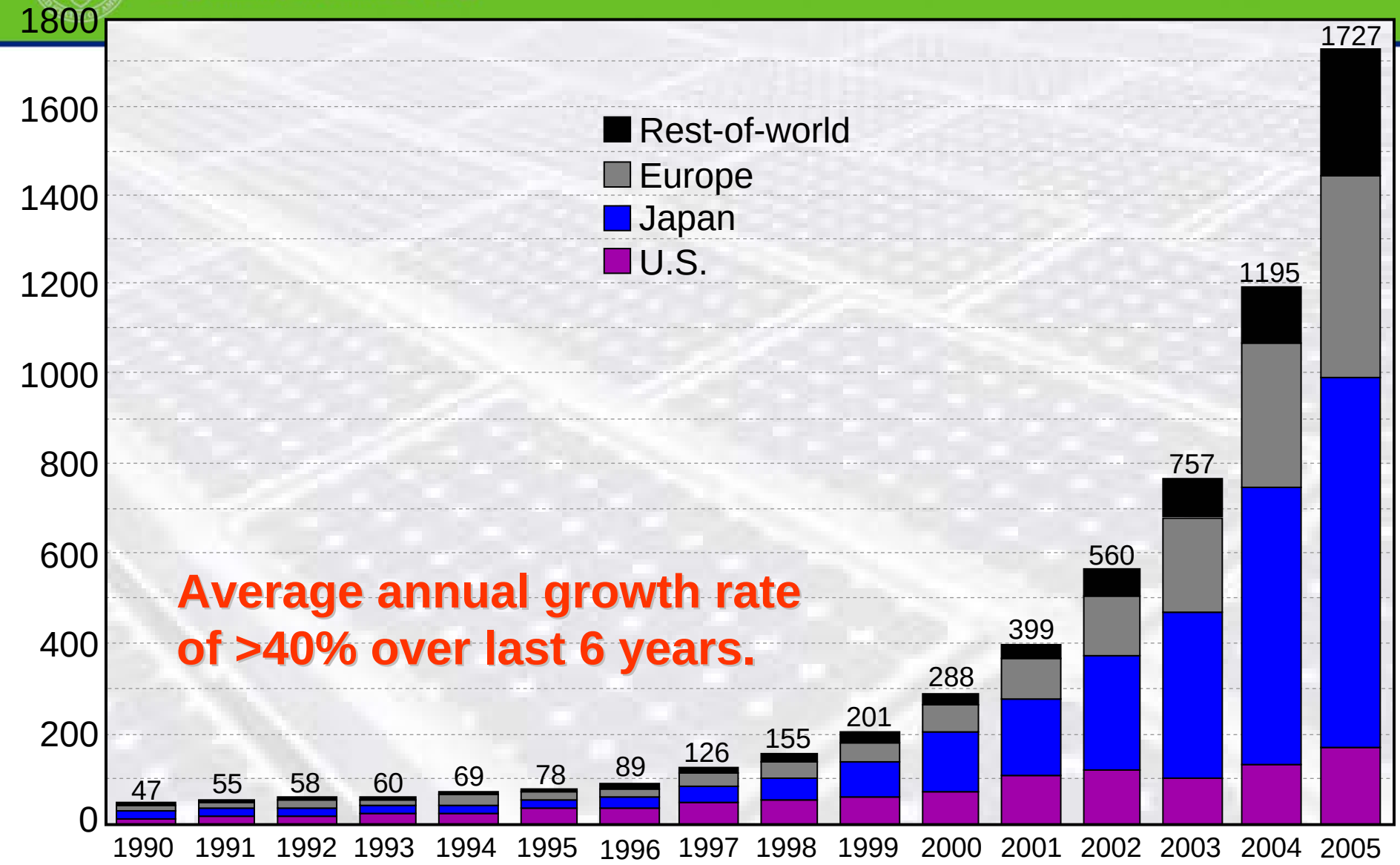


Source: NREL Energy Analysis Office (www.nrel.gov/analysis/docs/cost_curves_2002.ppt)
[1]These graphs are reflections of historical cost trends NOT precise annual historical data.
Updated: October 2002

Photovoltaics (PV)

- PV converts sunlight directly to electricity
  - Building-Integrated Photovoltaics (BIPV) - Systems where PV elements are integral part of the building & replace part of building skin costs
- Small Grid Connected ($6-20/watt)
  - 1 kilowatt or less
  - PV modules typically 50% or less of total cost
  - Other costs - inverters, other balance-of-system, installation
- Small Off Grid with Batteries, etc ($13-25/watt)
- Considerations:
  - Incentives (see http://www.dsireusa.org/)
  - Cost of alternatives (utility rates, diesel, utility line extension, etc)
  - Type of PV
  - Area required (lower efficiency modules→ more area required)
  - Resource quality

World PV Cell Production (MW)



Source: Paul Maycock, *PV News*, March 2006

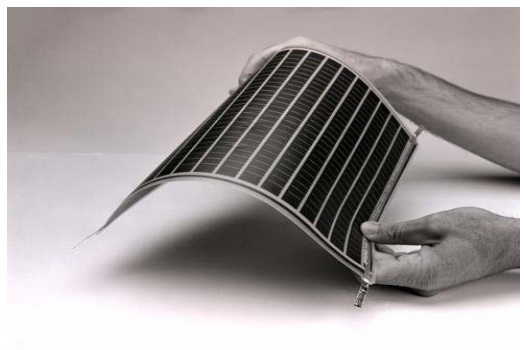
PV/BIPV Examples

PV Lighting
PJKK Federal Building, HI

BIPV, Mauna Lani Hotel

BIPV

4 Times Square, NY City
(Broadway & 42nd Street)



Naval Air Station N. Island

924 kW PV system providing shaded parking for 444 vehicles.

World's Largest PV Installations

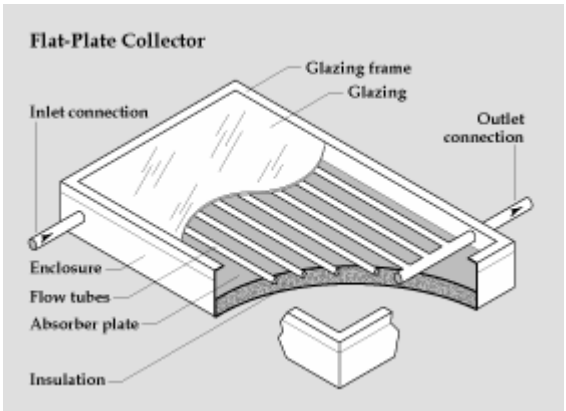
- 13 installations 4 MW or greater
- World's largest - 12 MW plant in Germany
- Largest US - 4.6 MW in Tucson, AZ
- Nellis AFB – 15 MW in development
- 62 MW in development (Portugal)

Source: http://www.pvresources.com/en/top50pv.php

Solar Hot Water

Low temperature system

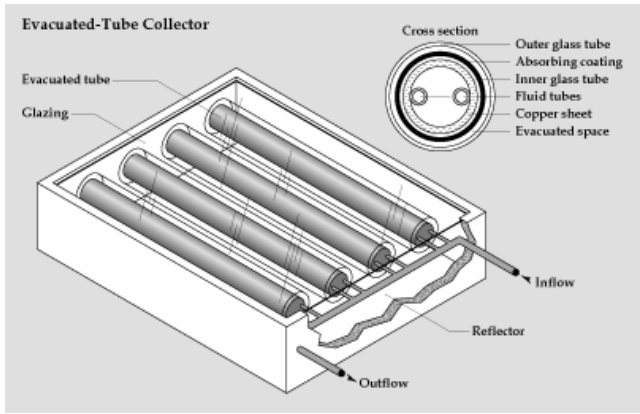
- Unglazed mats
- Glazed and insulated



Residential hot water
Swimming pools

Medium temperature system

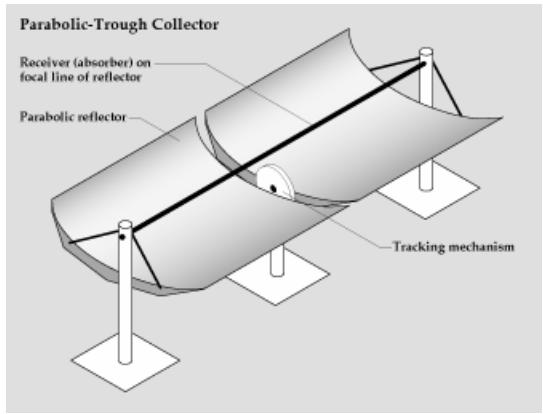
- Evacuated tubes



Cafeterias
Laundries

High temperature system

- Parabolic Concentrators



Industrial processes
Electrical generation

When to Use Solar Water Heating

- Water heating loads constant throughout week and year (or more load in the summer)
- High cost of backup energy (electricity, propane, etc.)
- Sufficient area to site collectors (1 ft^2/gal/day)
- Sunny climate helps but is not a requirement. Solar hot water works in cold & warm climates.

Drainback Solar Water Heating System

Federal SHW Examples

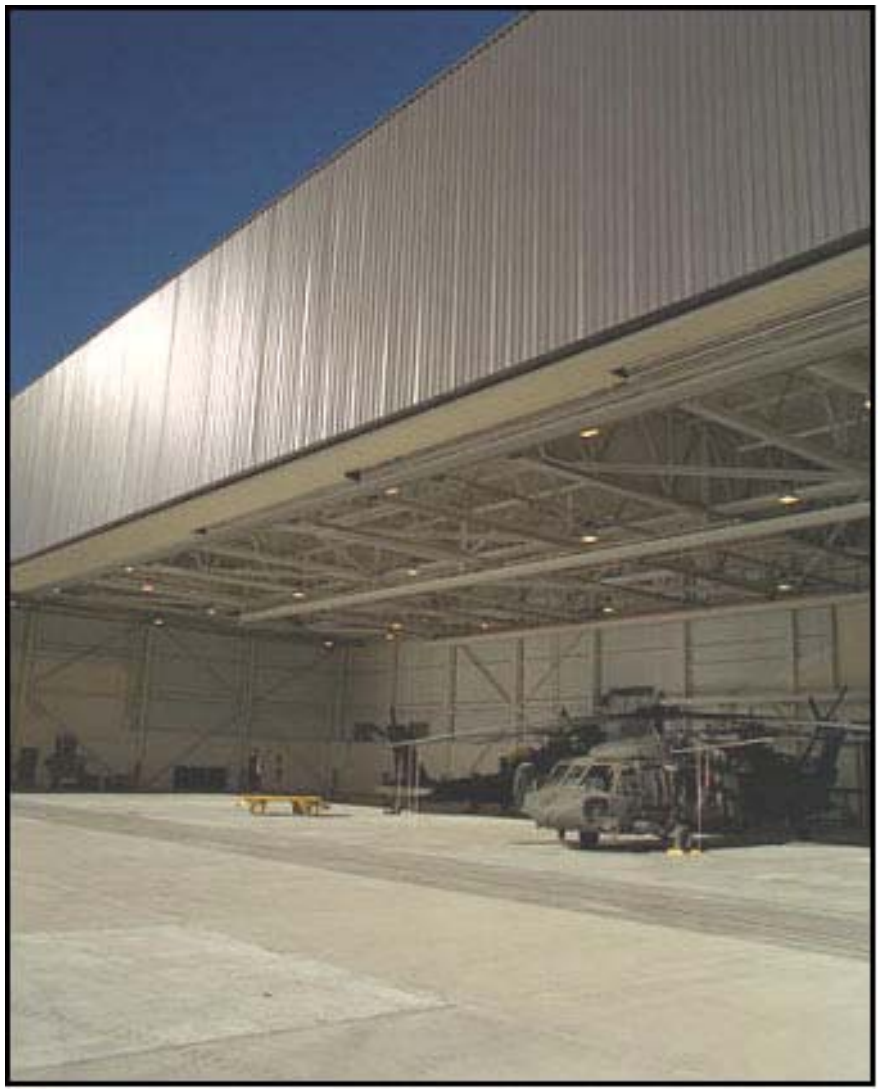
USCG Kia'i Kai Hale Housing Area, Honolulu, HI

Barnes Field House, Fort Huachuca, AZ

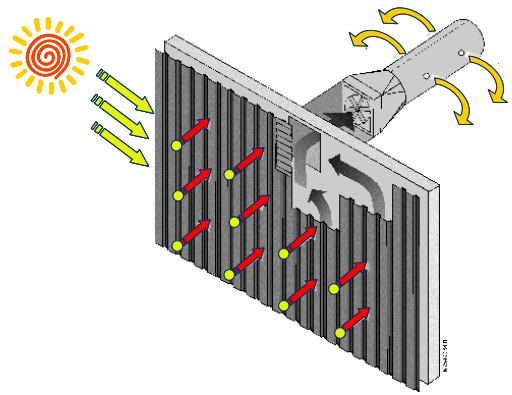
EPA Edison, New Jersey

Phoenix Federal Correctional Institution
http://www.eere.energy.gov/femp/pdfs/33211.pdf

Solar Ventilation Preheat



- High ventilation requirements
- New construction
- Retrofit - available south wall area with fan intake



Concentrating Solar Power

- Concentrating Solar Power (CSP) Operation
  - Concentrates & focuses sunlight onto a receiver mounted at the system's focal point
  - Receiver absorbs sunlight and heats working fluid
  - Working fluid is used in engine to produce electricity

- Requires a very good, direct solar resource

- Technologies
  - Parabolic Troughs
  - Dish/Engine Systems
  - Power Towers

- Western Governor's Association (WGA) - 30GW of clean energy by 2015 goal, including 1 GW CSP

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Concentrating Solar Power

Dish Stirling

Trough
Mojave Desert, California

Solar One Power Tower
Daggett, California

Research Focus in Solar

- Higher efficiency cells
- Advanced manufacturing techniques & lower production costs
- Cheaper/less material
- New nanomaterials applications
- Concentrating PV

Bottom line – reduce ¢/kWh

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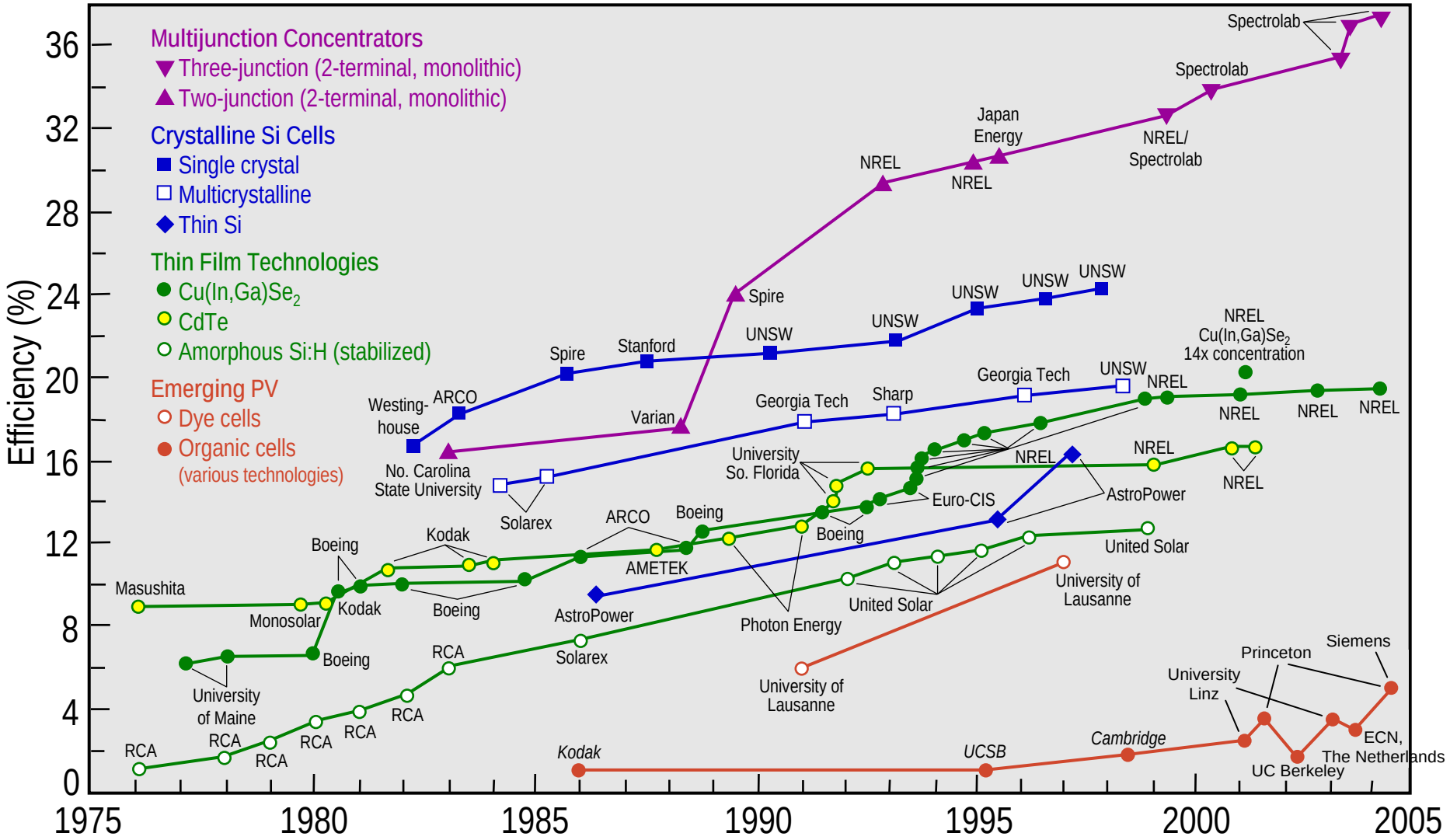
Best Research Solar Cell Efficiencies



Advanced "3rd-Generation" Solar

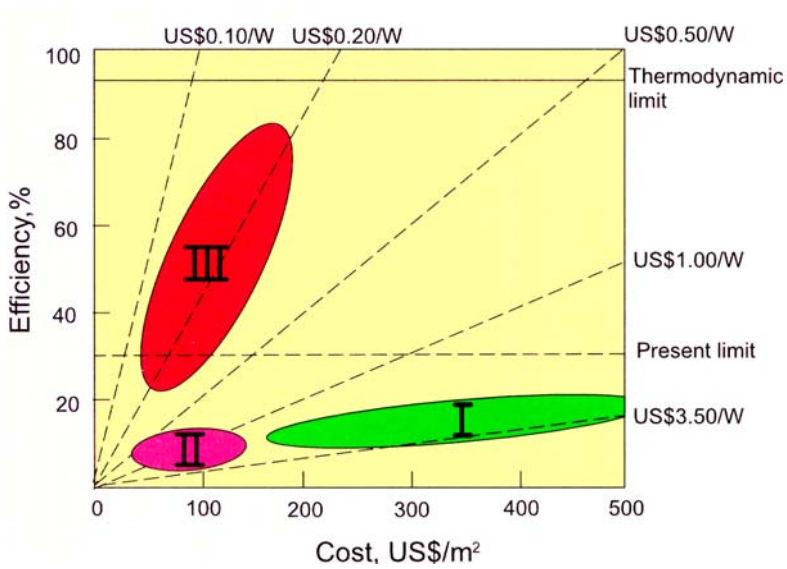
Current Technologies

I. 1st Generation – Crystalline
   - Expensive & low efficiency

II. 2nd Generation (Polycrystalline Thin Film)
   - Cheaper, but still low efficiency

Future Possibilities

I. 3rd Generation
   - Multi-junction cells (>30% efficiency)
   - Quantum dots (>60% efficiency)



Region III indicates potential efficiencies higher than previous theoretical limits, at lower costs, made possible by nanostructures such as quantum dots

Wind Power

Resource:

Wind power is created by the uneven heating of the earth's surface by the sun.

Energy production is proportional to wind speed cubed (V^3)

-Wind speed increases with height

Sizes and Applications

Small (≤10 kW)

- Homes (Grid connected)
- Farms
- Remote Applications

(e.g. battery changing, water pumping, telecom sites, icemaking)

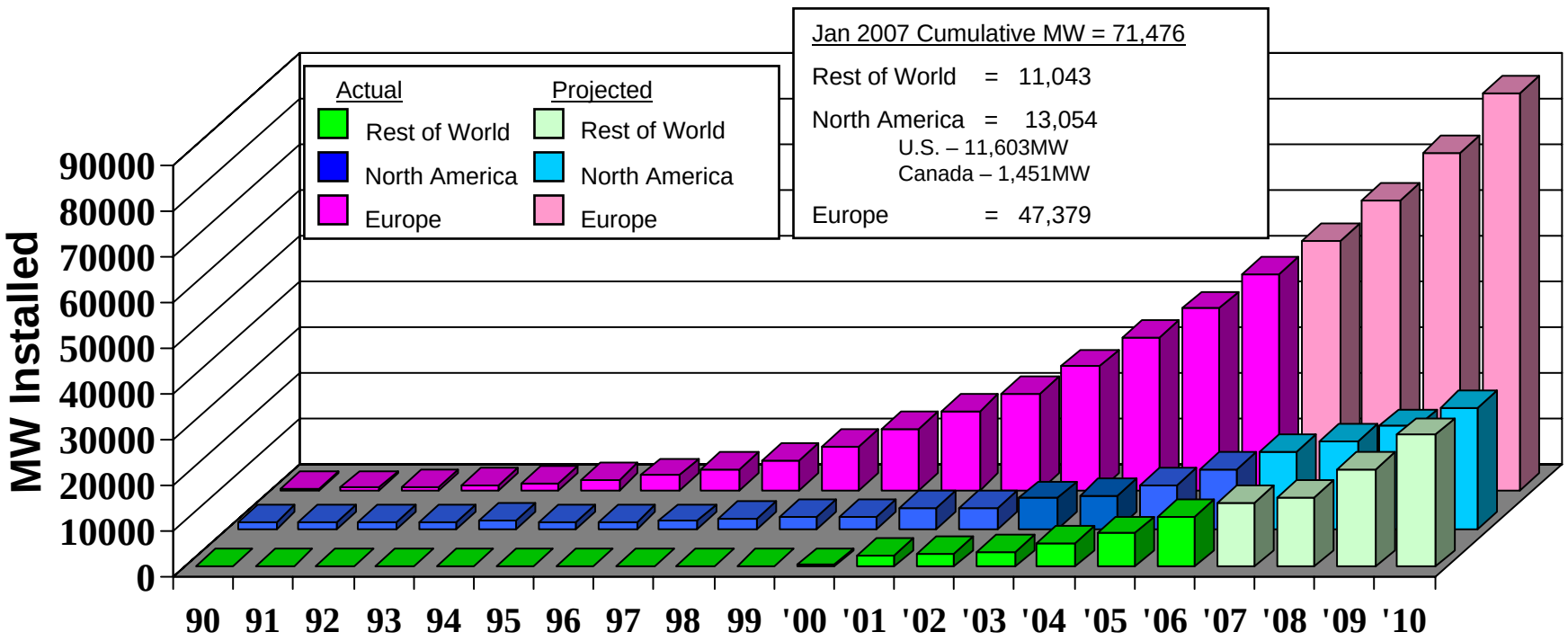
Intermediate (10-500 kW)

- Village Power
- Hybrid Systems
- Distributed Power

Large (500 kW – 6 MW)

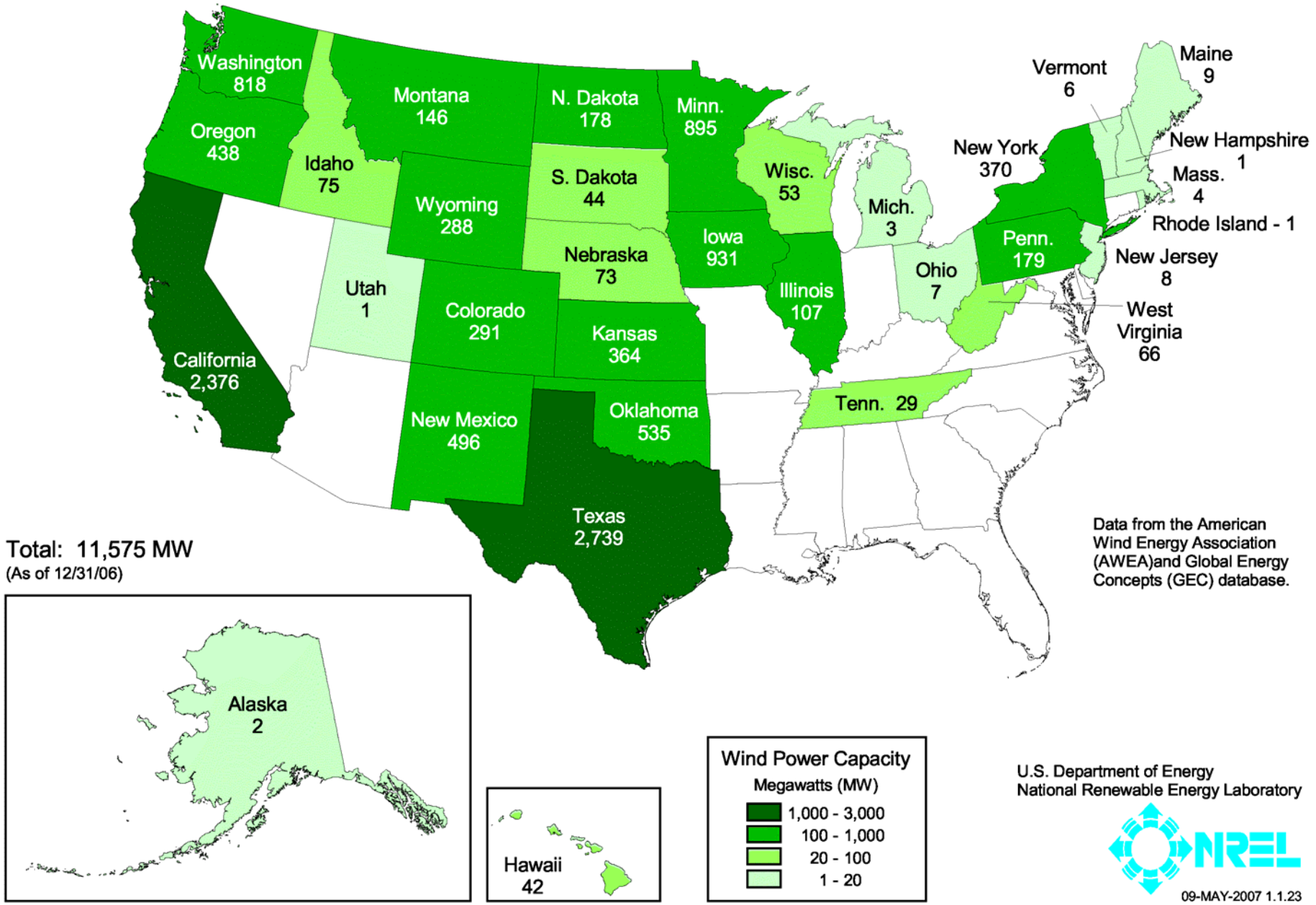
- Central Station Wind Farms
- Distributed Power
- Offshore Wind Generation Stations

Growth of Wind Energy Capacity Worldwide



Sources: BTM Consult Aps, March 2005
Windpower Monthly, January 2007
*NREL Estimate for 2007

United States - Current Installed Wind Power Capacity (MW)



Total: 11,575 MW
(As of 12/31/06)

Data from the American Wind Energy Association (AWEA)and Global Energy Concepts (GEC) database.

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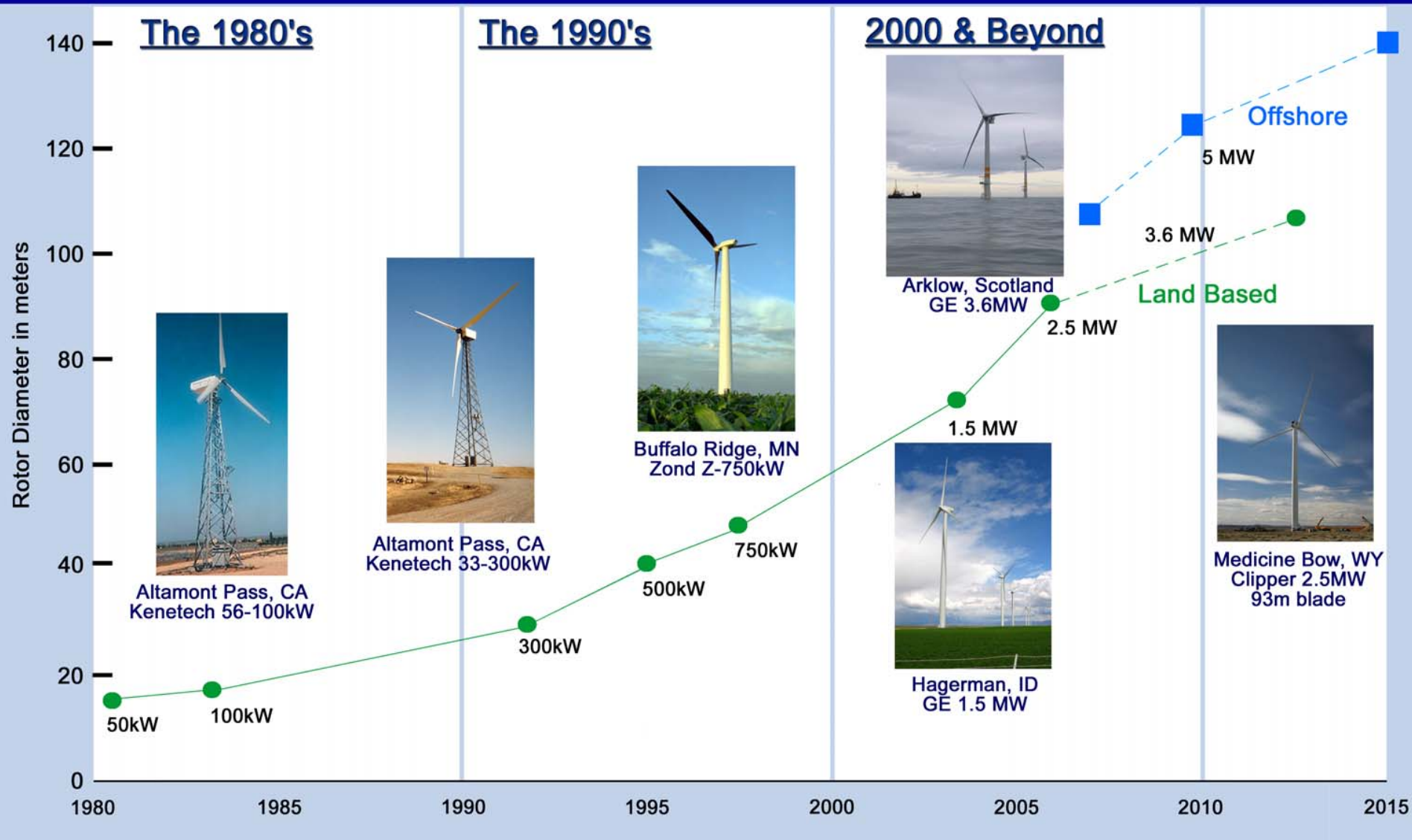
National Renewable Energy Laboratory

NREL

09-MAY-2007 1.1.23

Evolution of U.S. Commercial Wind Technology




GE WindEnergy
3.6 MW Turbine
Boeing 747-200
Arklow Banks Windfarm
The Irish Sea
Photo: R. Thresher

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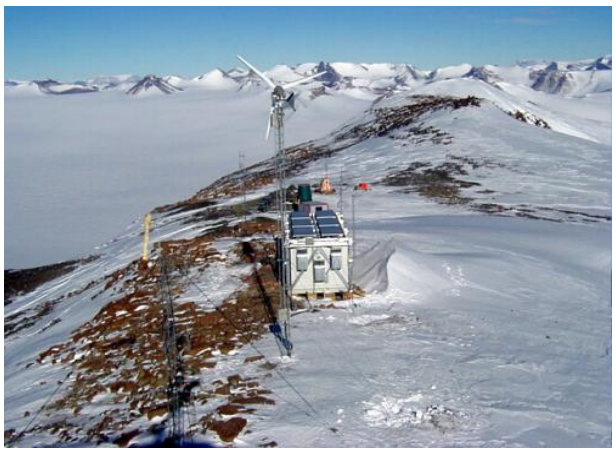
Federal Wind Examples



Research Focus in Wind

- Technology transfer to ocean-based systems
- Low-wind speed turbines (LWST)
- Better aerodynamic blades, new materials
- Advanced power electronics

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The New Bio-Industry

Biomass Feedstock

– Trees
– Grasses
– Agricultural Crops
– Agricultural Residues
– Animal Wastes
– Municipal Solid Waste

Conversion Processes

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Combustion
- Co-firing

USES

Fuels:
– **Ethanol**
– **Renewable Diesel**

Power:
– **Electricity**
– **Heat**

Chemicals
– **Plastics**
– **Solvents**
– **Chemical Intermediates**
– **Phenolics**
– **Adhesives**
– **Furfural**
– **Fatty acids**
– **Acetic Acid**
– **Carbon black**
– **Paints**
– **Dyes, Pigments, and Ink**
– **Detergents**
– **Lubricants**
– **Etc.**

Food and Feed and Fiber

… and new concepts from plants to products

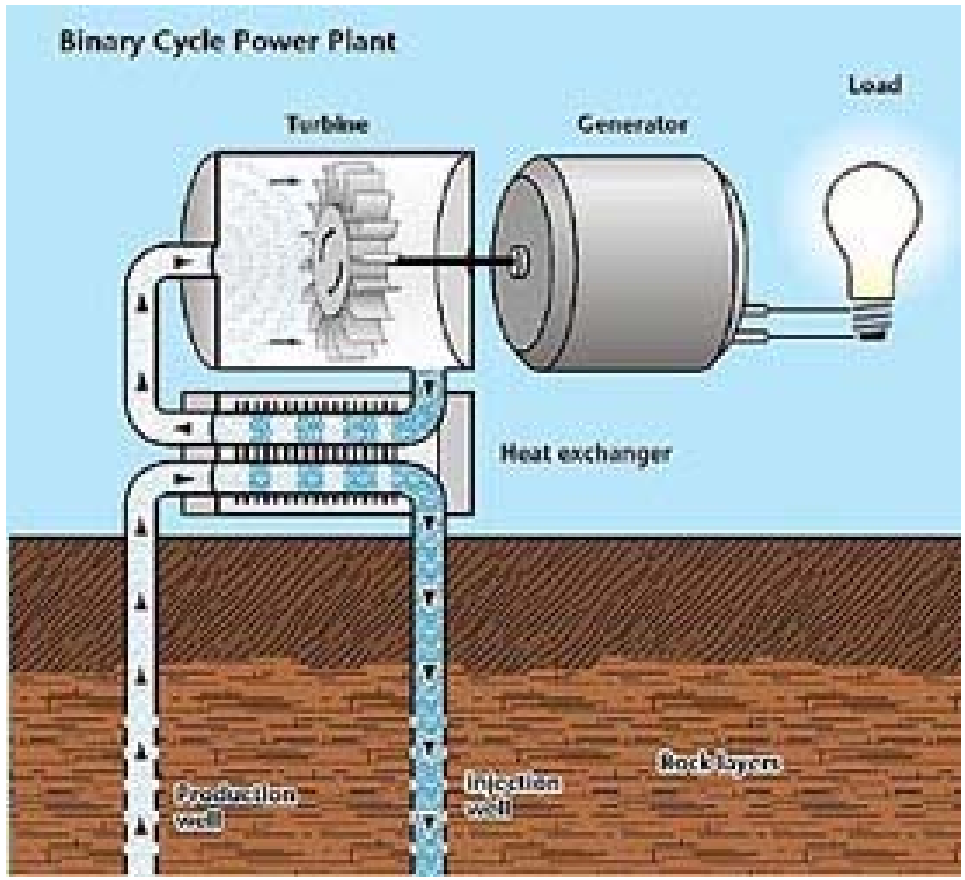
Biomass Issues/Research

- Feedstock issues
  - Crop production cycle
  - Drying and storage - potential degradation problems
  - Transportation
  - Varying feedstock characteristics
- New feedstocks - advanced energy crops, under-utilized waste
- “Biorefinery Concept”

Geothermal Energy

Resource:

Geothermal energy, energy from heat and hot water in the Earth, can provide heat or electricity.



Technologies

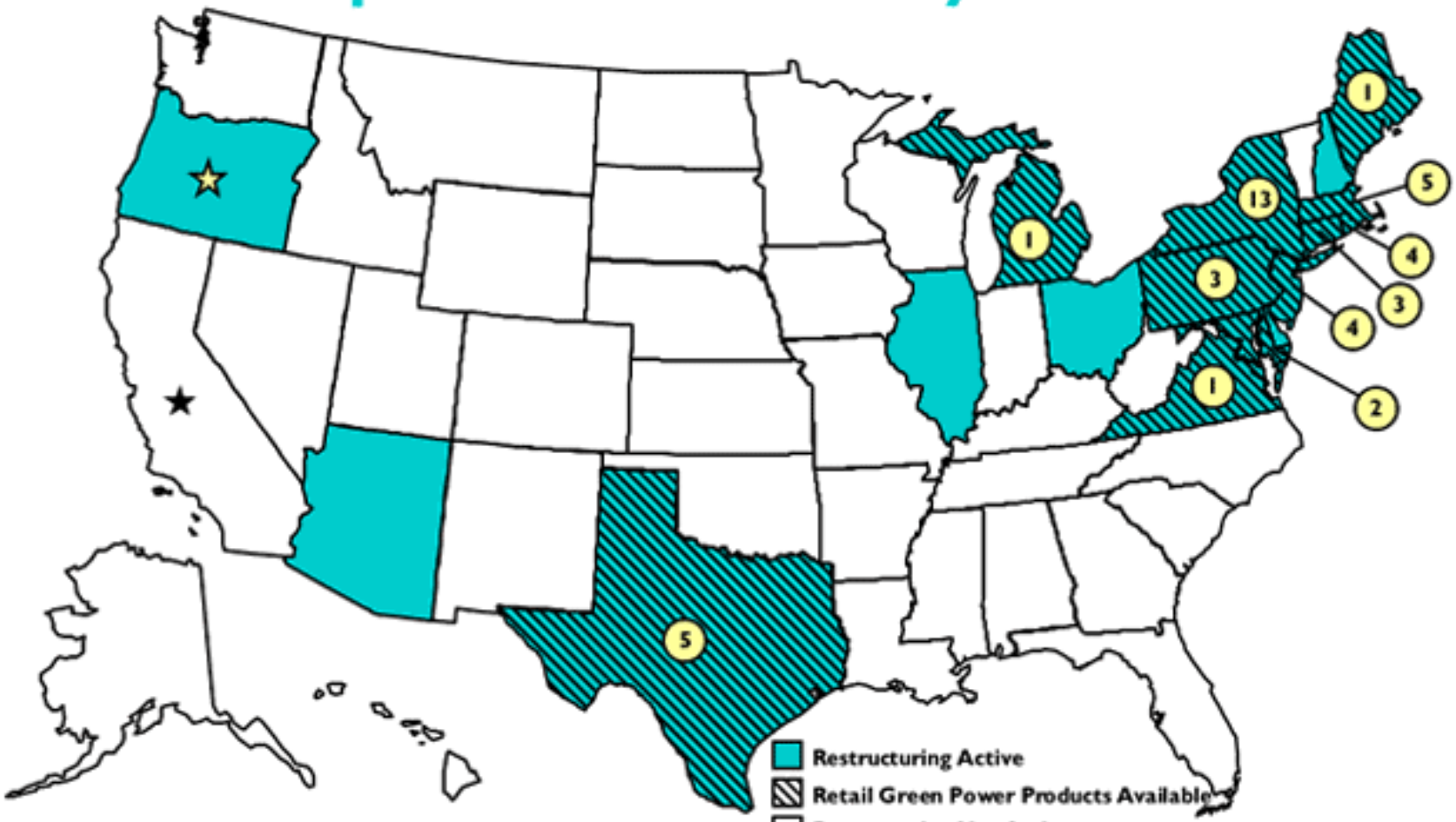
- Geothermal heat pumps: Use moderate temperatures of shallow ground to heat and cool buildings
- Geothermal direct use: Heat produced directly by the hot water within the Earth
- Geothermal electricity: Uses Earth's and steam of natural geysers to produce power - 2800 MW of capacity exists in U.S.

Renewable Power Purchasing (RPP) Options

- **Utility Green Pricing Programs**
  - Best programs exempt renewable customers from fuel cost adjustments (ex. Austin Energy, Xcel Energy)
- **Competitive Electricity Market**
- **Renewable Energy Certificates (REC)**
  - Typically the lowest cost option

Long term renewable power purchase contracts are strongly encouraged!

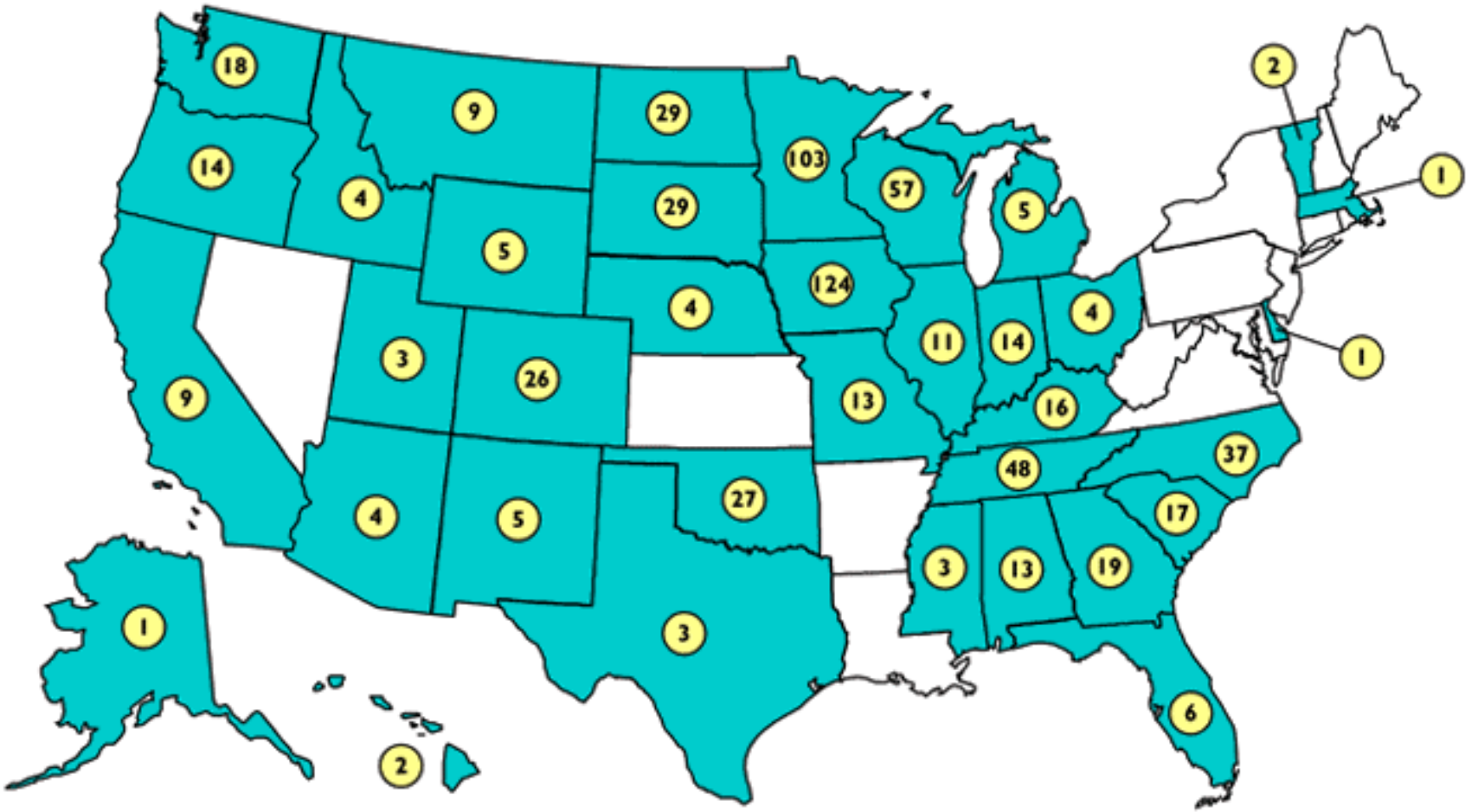
Green Power Marketing Activity in Competitive Electricity Markets*



* Represents bundled renewable electricity products available to residential and small commercial customers.

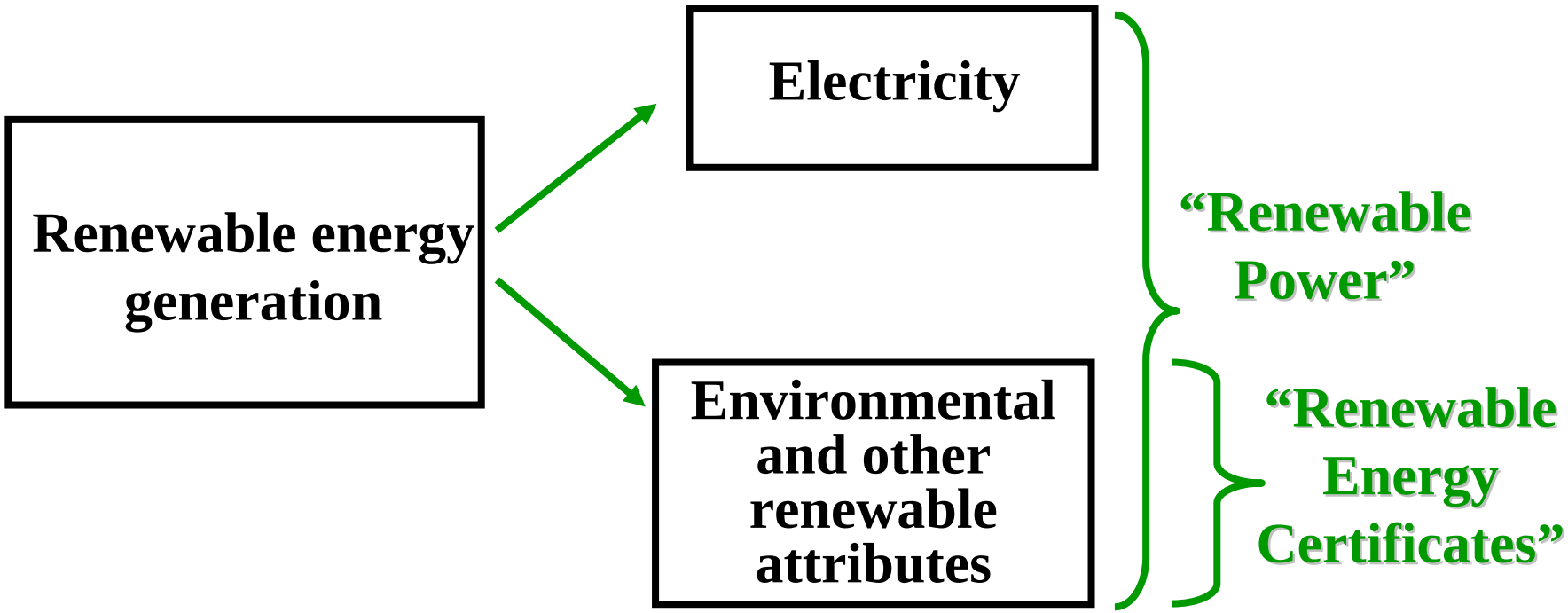
Source: National Renewable Energy Laboratory (November 2006)

Utility Green Pricing Activities



Source: National Renewable Energy Laboratory (October 2006)

REC Diagram


Renewable energy generation
Electricity
Environmental and other renewable attributes
"Renewable Power"
"Renewable Energy Certificates"

Innovative Renewable Projects

- On-site renewable projects
  - Private entity installs, owns, operates and maintains equipment
  - Site purchases electricity through power purchase agreement (PPA)
  - Private entity eligible for tax and other incentives (possible to offset up to ~60% of renewable system cost)
  - Can utilize Western Area Power Administration (and possibly other Power Marketing Administrations) - long term contract authority benefit

- Examples
  - Nellis AFB
  - GSA Sacramento

Innovative Renewable Projects

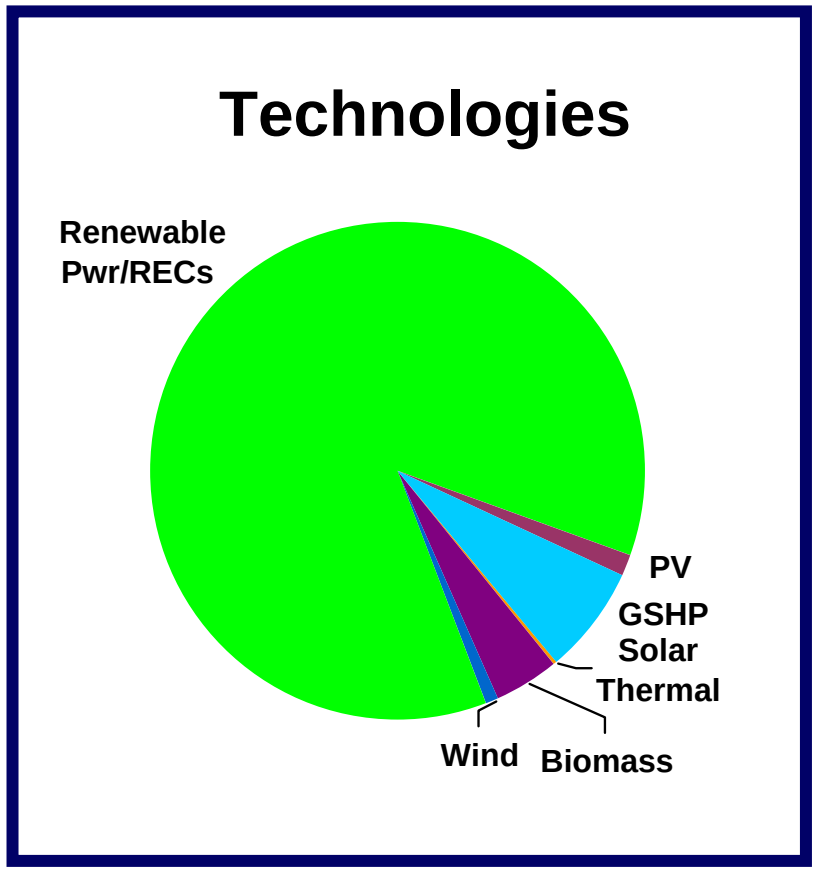
- GSA Sacramento
  - 1 MW roof-top PV
  - 10-year contract
  - Price matched to SMUD time-of-use tariff with price floor
  - PG&E rebate and federal incentives (30% tax credit and accelerated depreciation) will pay for approximately half the cost of the system.
  - Installation will begin this summer
  - Private entity retains RECs
  - Modified FAR Part 41 with Part 12 (Acquisition of Commercial Items) for the contract.
  - License for use of roof

- Case study and FEMP Focus article pending

Federal Renewable Use
*(As of Sept **2005**)*

Renewable Power/RECs	2246	GWh
Ground Source Heat Pump	179	GWh
Biomass Thermal	108	GWh
Photovoltaics (PV)	34	GWh
Wind	18	GWh
Solar Thermal	10	GWh
TOTAL	2595	GWh*

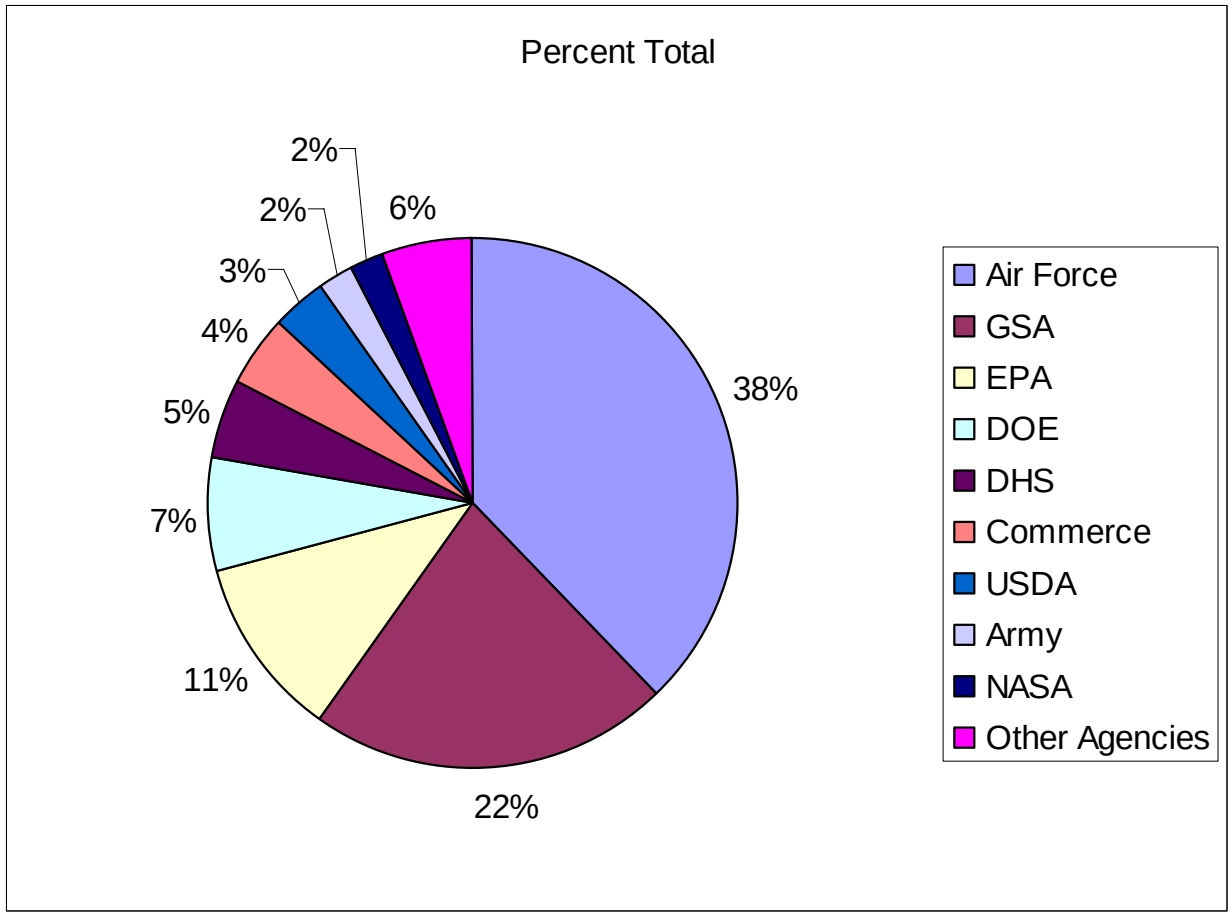
*2.5% = 1395 GWh



Federal Renewable Use *(As of Sept 2006)*

Who is Buying Renewable Power/RECs?*

DRAFT



* Does not include on-site renewable projects

Federal Renewable Power/REC Procurement Contacts

- Defense Energy Support Center (DESC)
  - John Nelson (703) 767-8523, john.nelson@dla.mil
  - Andrea Kincaid (703) 767-8669, andrea.kincaid@dla.mil

- General Services Administration (GSA)
  - Ken Shutika (202) 260-9713, ken.shutika@gsa.gov

- Western Area Power Administration (Western)
  - Randy Manion (720) 962-7423, manion@wapa.gov
  - Chandra Shah (303) 384-7557, chandra_shah@nrel.gov

- Bonneville Power Administration (Bonneville) - option for sites with a power allocation (ex. Fairchild AFB, DOE Richland)
  - Debra Malin (503) 230-5701, djmalin@bpa.gov

Why Use Renewables?

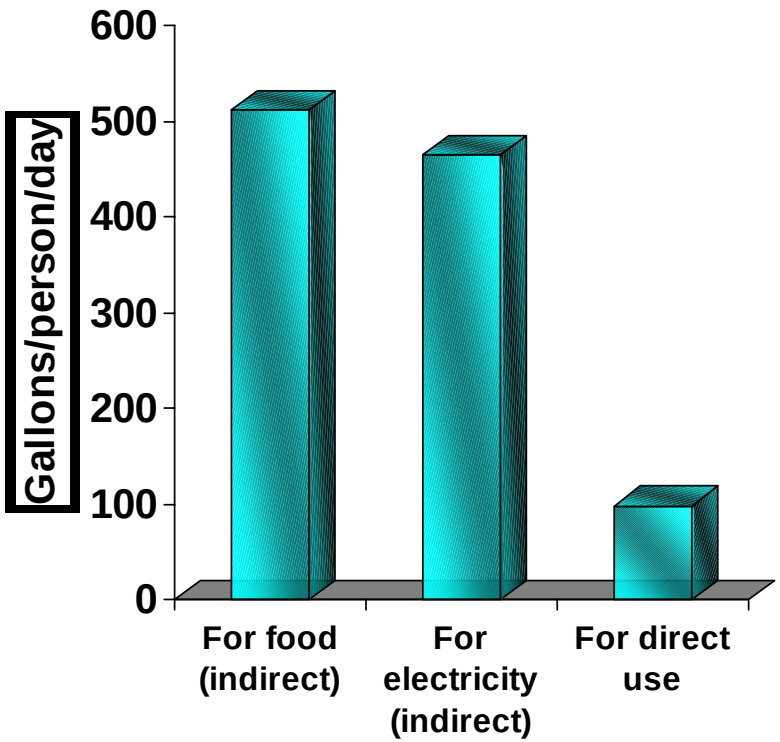
- Volatile energy market – price risk management
- Reduce dependence on fossil fuel imports – “homegrown” energy instead
- Fuel diversity
- Economic development
- Market transformation
- Lead by example
- Reduced air emissions, mining and transportation impacts and other environmental impacts
- Demonstrate environmental stewardship
- Water

Total Water Withdrawals, 2000

Source: **USGS Circular 1268, 15 figures, 14 tables** (released March 2004 and revised April and May 2004).Available at: http://water.usgs.gov/pubs/circ/2004/circ1268/index.html

Energy Requires Water

Water used to produce household electricity exceeds direct household water use



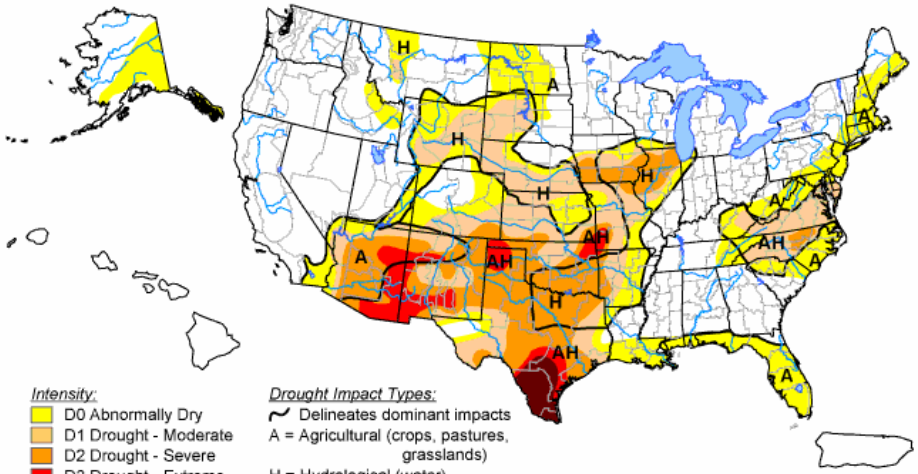
GALLONS PER PERSON PER DAY

- 510 for food production
  - includes irrigation and livestock
- 465 to produce household electricity
  - Range: 30 to 600 depending on technology
- 100 direct household use
  - includes bathing, laundry, lawn watering, etc.

Source: derived from Gleick, P. (2002), *World's Water 2002-2003*.

U.S. Drought Monitor

March 28, 2006
Valid 7 a.m. EST



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

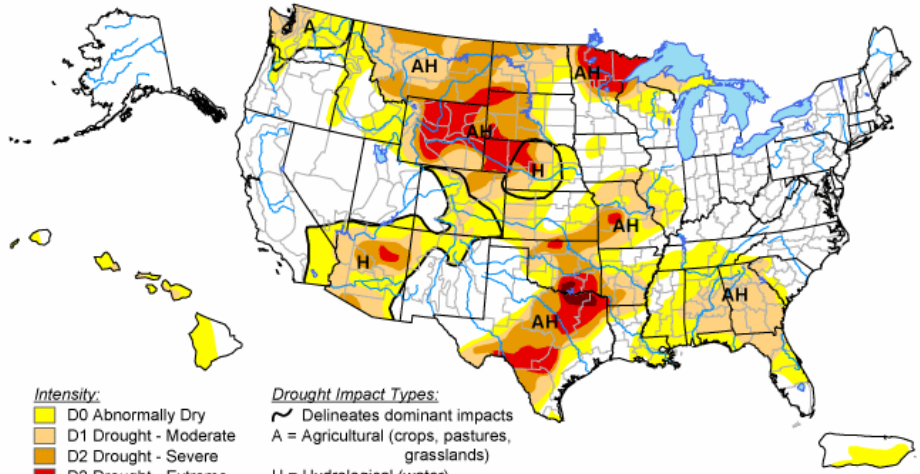
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, March 30, 2006
Author: C. Tankersley/L. Love-Brotak, NOAA/NESDIS/NCDC

U.S. Drought Monitor

October 17, 2006
Valid 8 a.m. EDT



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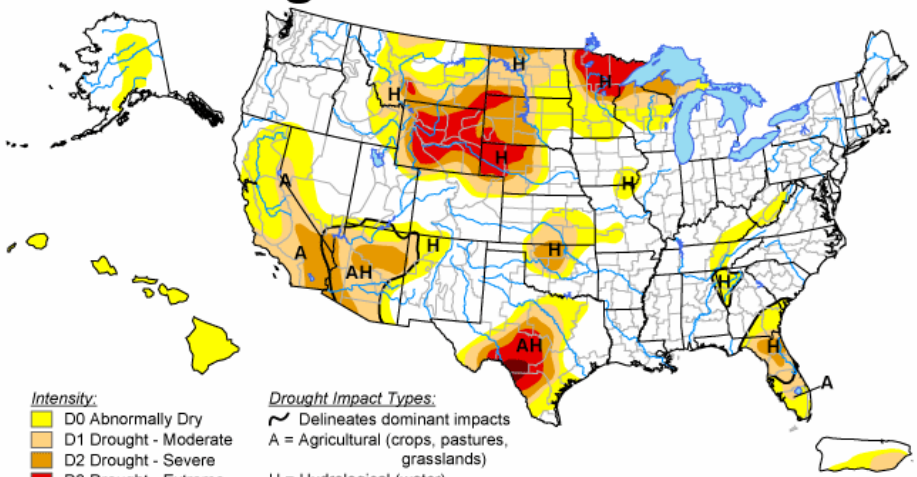
http://drought.unl.edu/dm

Released Thursday, October 19, 2006
Author: Ned Guttman/Liz Love-Brotak, NOAA/NESDIS/NCDC

U.S. Drought Monitor

January 23, 2007
Valid 7 a.m. EST



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

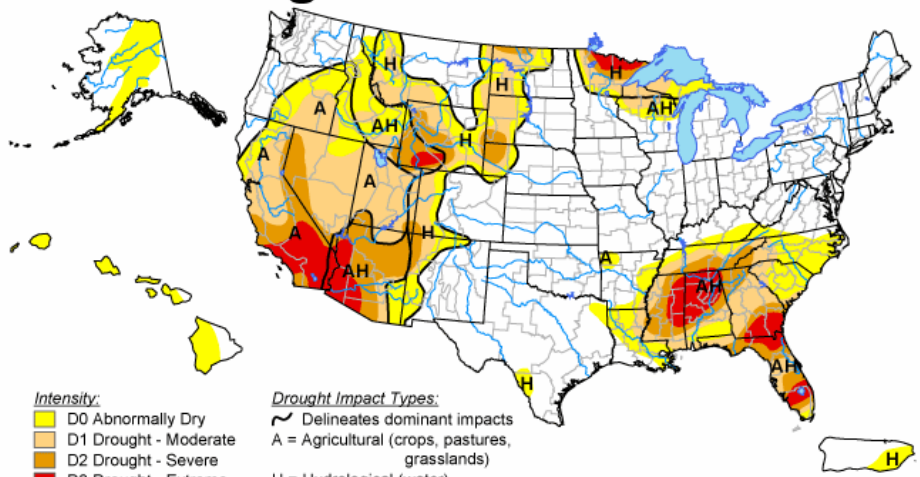
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, January 25, 2007
Author: David Miskus, JAWF/CPC/NOAA

U.S. Drought Monitor

May 8, 2007
Valid 8 a.m. EDT



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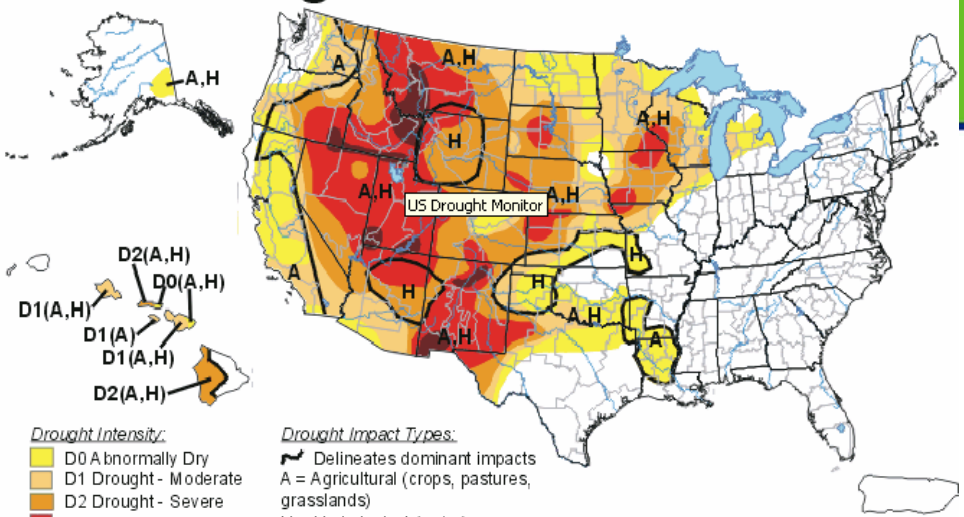
http://drought.unl.edu/dm

Released Thursday, May 10, 2007
Author: Brian Fuchs, National Drought Mitigation Center

U.S. Drought Monitor

October 28, 2003
Valid 8 a.m. EST



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- D2 Drought - Severe
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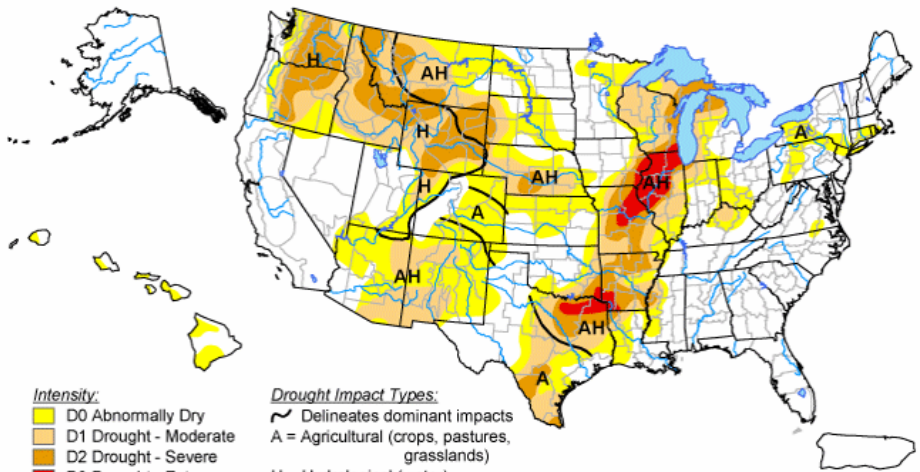
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
(No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary

USDA National Drought Mitigation Center

U.S. Drought Monitor

August 2, 2005
Valid 8 a.m. EDT



Intensity:
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Drought Impact Types:
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A = Agricultural (crops, pastures, grasslands)
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(No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

USDA National Drought Mitigation Center

Released Thursday, August 4, 2005
Author: Michael Hayes, NDMC

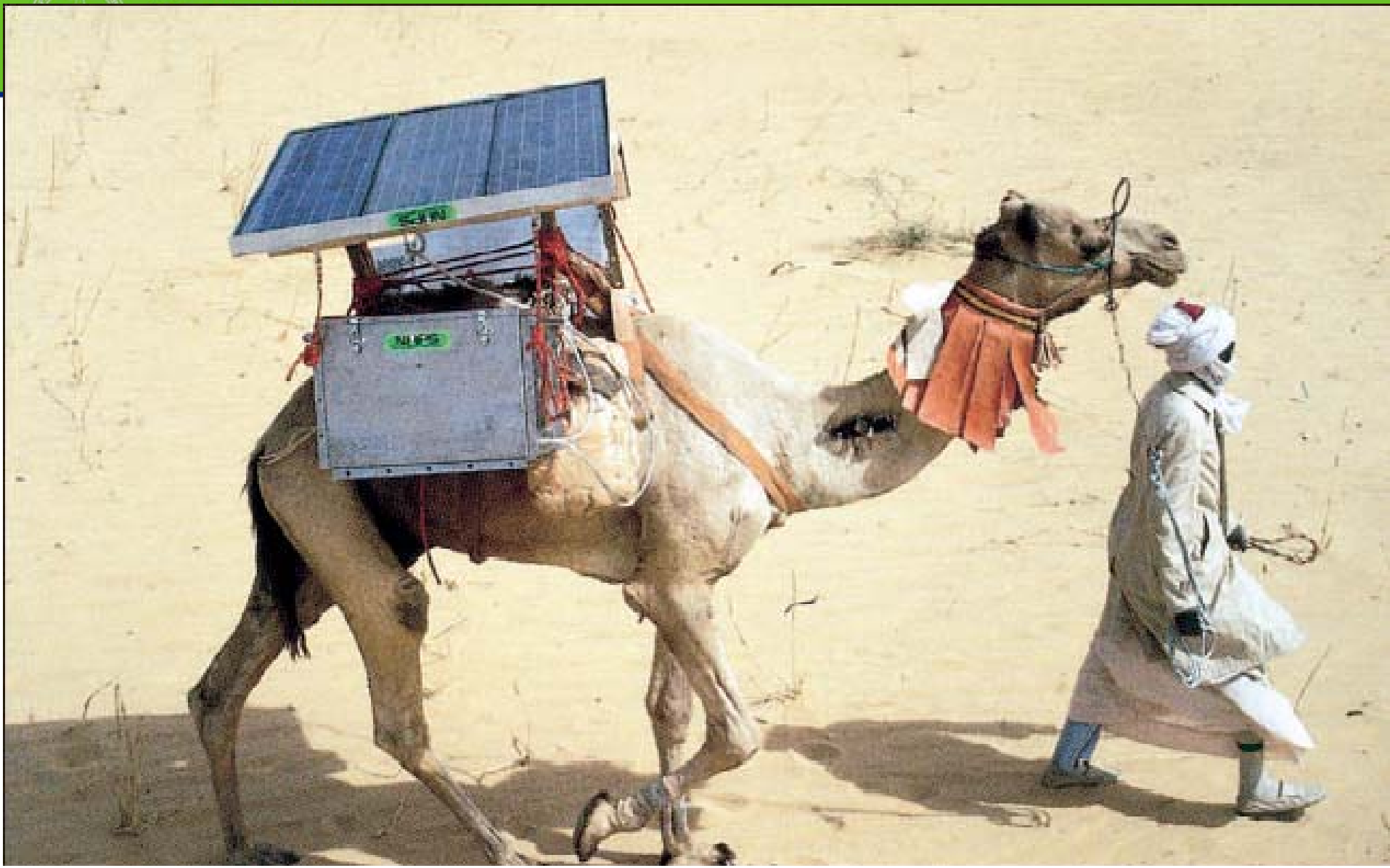
http://drought.unl.edu/dm

Humanity's Top Ten Problems for next 50 years

1. **ENERGY**
2. WATER
3. FOOD
4. ENVIRONMENT
5. POVERTY
6. TERRORISM & WAR
7. DISEASE
8. EDUCATION
9. DEMOCRACY
10. POPULATION

2003	6.3	Billion People
2050	9-10	Billion People

Source: Nobel laureate, Richard Smalley



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