

Renewable Energy: A Perspective

Tennessee Valley Authority

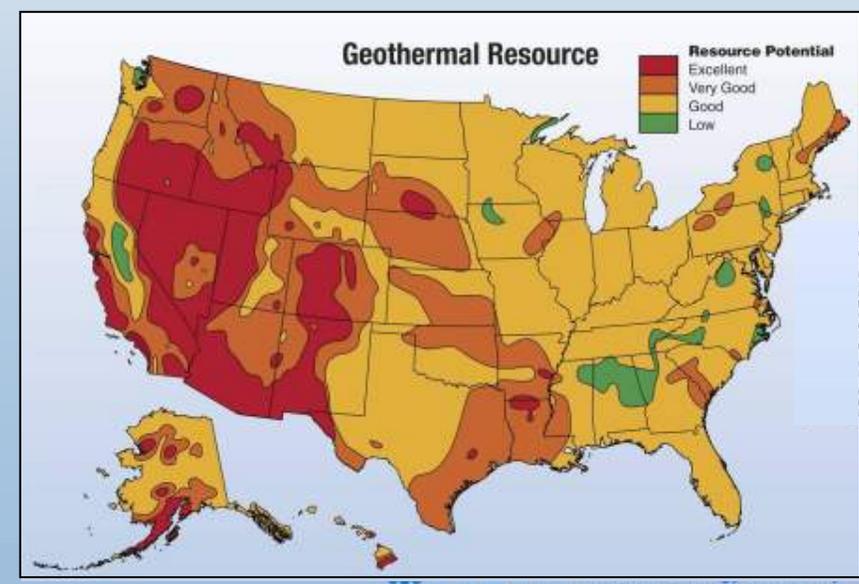
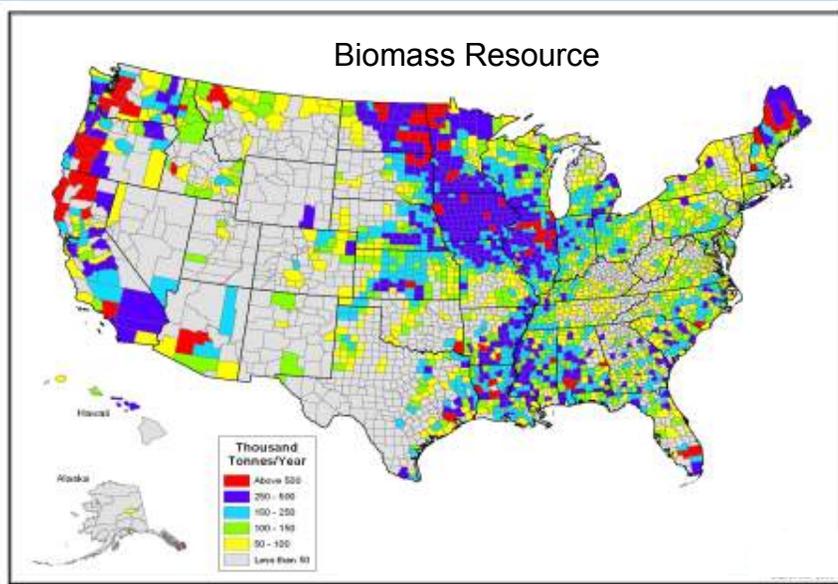
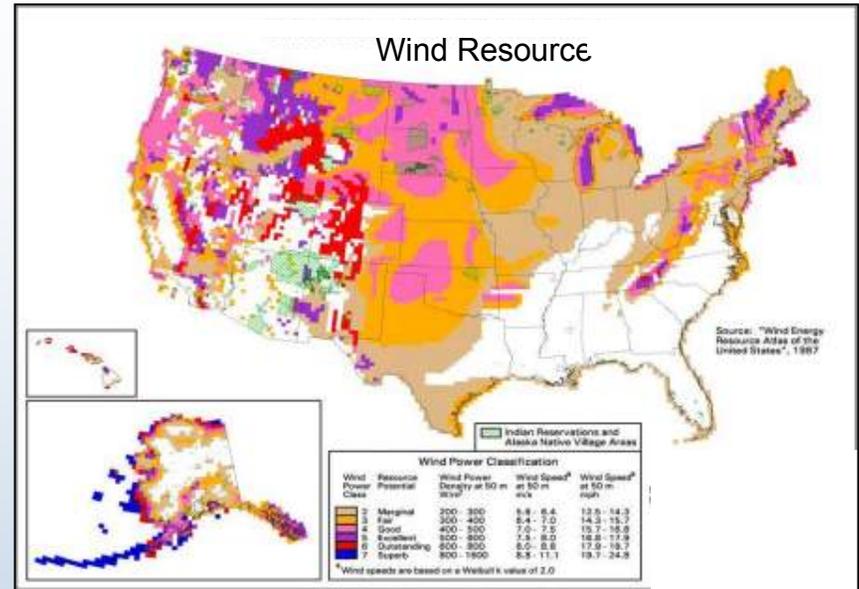
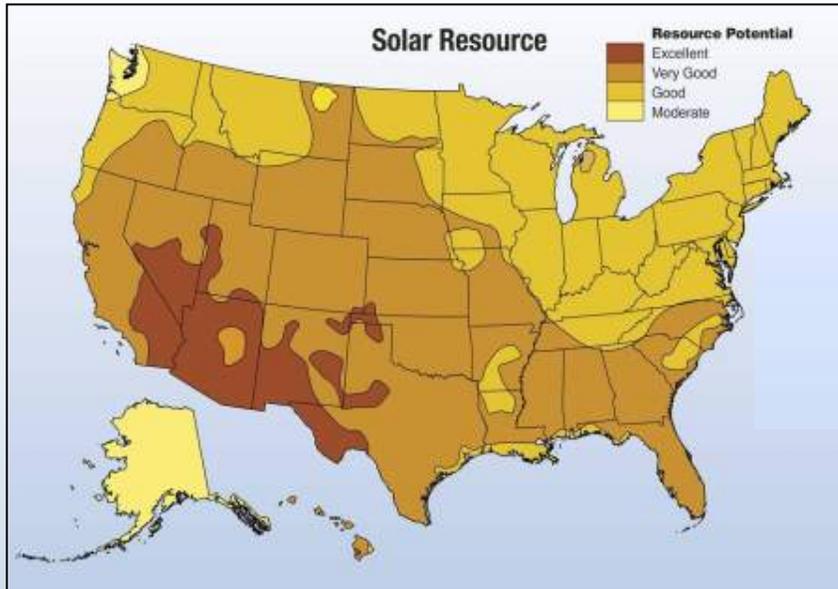
March 5, 2008

Stanley R. Bull

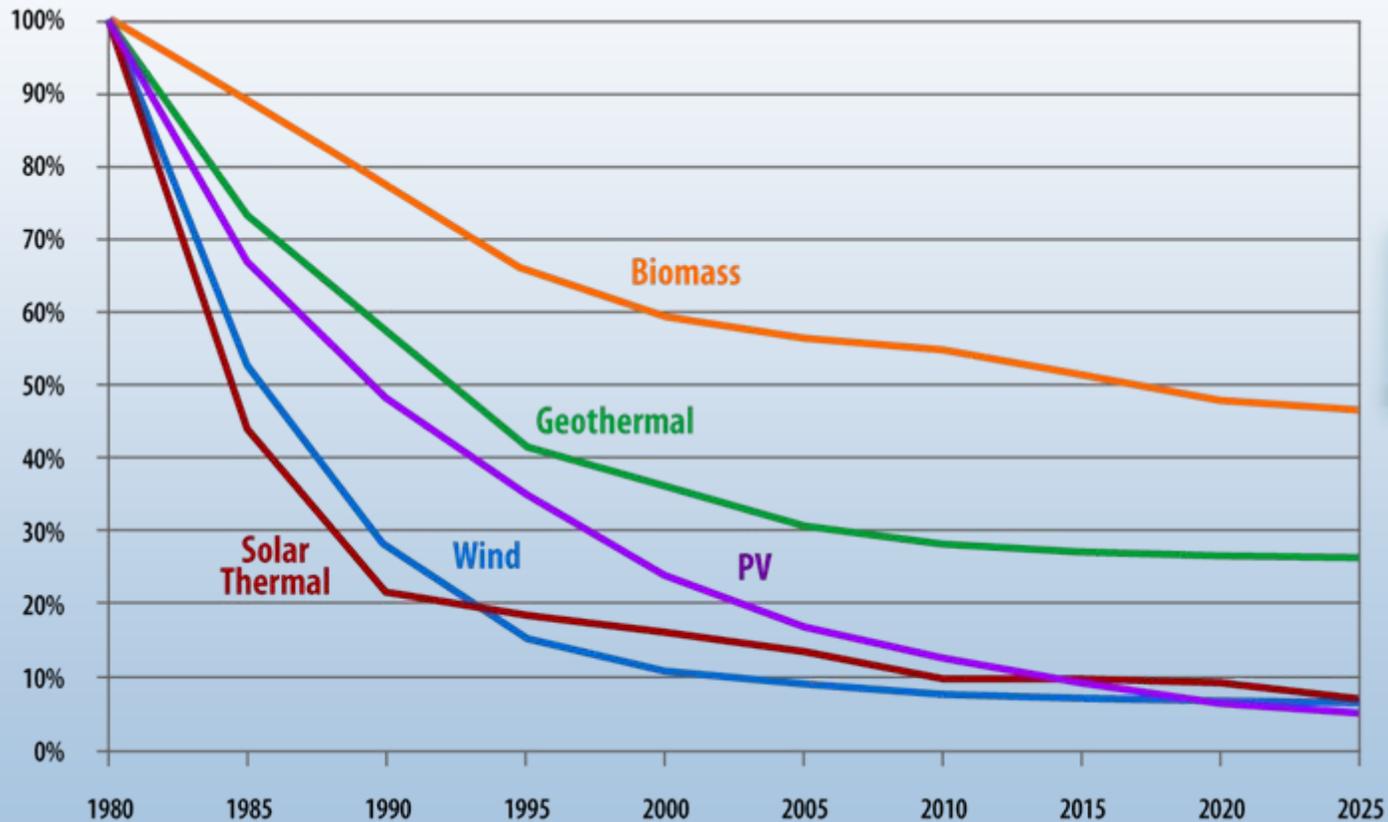
National Renewable Energy Laboratory

Golden, Colorado

U.S. Renewable Energy Resources



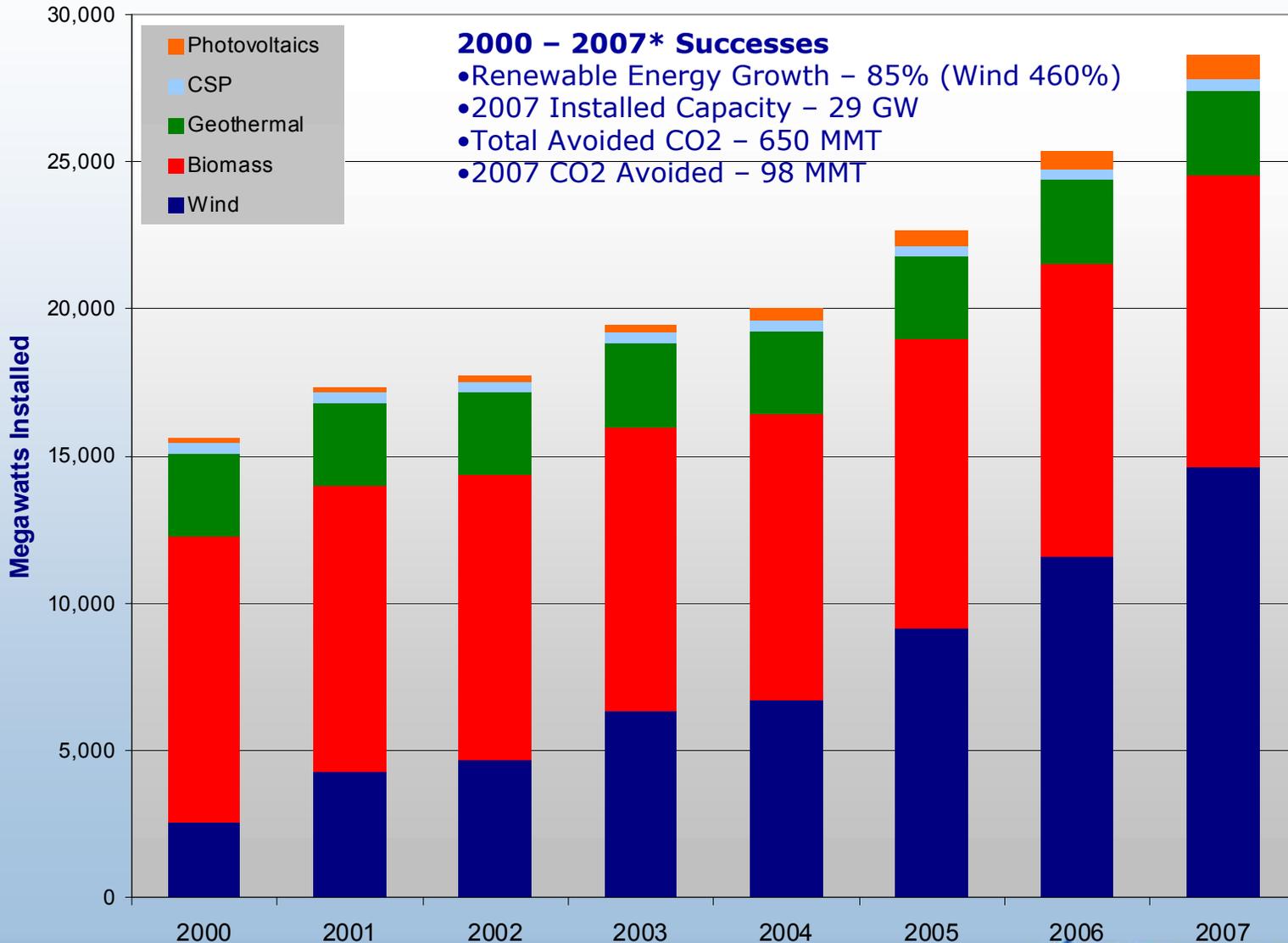
Past Investments Have Yielded Impressive Cost Reductions



U.S. RE Capacity Rapidly Expanding

Percent of Annual New Capacity			
	2004	2005	2006
Renewables	2%	11%	22%
Natural Gas	72%	85%	72%
Coal	2%	2%	5%
Petroleum	1%	1%	1%
Dual Fired	22%	0%	0%
Other*	0%	1%	0%

U.S. Renewable Electricity Capacity



*All 2007 numbers are projections.

Wind

Today's Status in U.S.

- 16,740 MW installed at end of 2007
- Cost 6-9¢/kWh at good wind sites*

DOE Cost Goals

- 3.6¢/kWh, onshore at low wind sites by 2012
- 7¢/kWh, offshore in shallow water by 2014

Long Term Potential

- 20% of the nation's electricity supply

NREL Research Thrusts

- Improved performance and reliability
- Distributed wind technology
- Advanced rotor development
- Utility grid integration

* With no Production Tax Credit

Updated January 28, 2008

Source: U.S. Department of Energy, American Wind Energy Association



Solar

Photovoltaics and Concentrating Solar Power

Status in U.S.

PV

- 824 MW
- Cost 18-23¢/kWh

CSP

- 419 MW
- Cost 12¢/kWh

Potential:

PV

- 11-18¢/kWh by 2010
- 5-10 ¢/kWh by 2015

CSP

- 8.5 ¢/kWh by 2010
- 6 ¢/kWh by 2015



NREL Research Thrusts:

PV

- Partnering with industry
- Higher efficiency devices
- New nanomaterials applications
- Advanced manufacturing techniques

CSP

- High performance, low cost storage for baseload markets
- Advanced absorbers, reflectors, and heat transfer fluids
- Next generation solar concentrators

Advanced Vehicles and Fuels Options

Conventional
Vehicles



Hybrid Electric
Vehicles



Plug-in Hybrid
Vehicles



Hydrogen
Vehicles—ICE
or Fuel Cell



Corn Ethanol, Cellulosic Ethanol
Biodiesel, Fischer-Tropsch Diesel
Natural Gas other Petrochemicals

Electricity
from Grid
Distributed
Renewable
Electricity

Hydrogen
from Natural
Gas
Renewable
Hydrogen

Current Policy Environment for Renewable Power Development

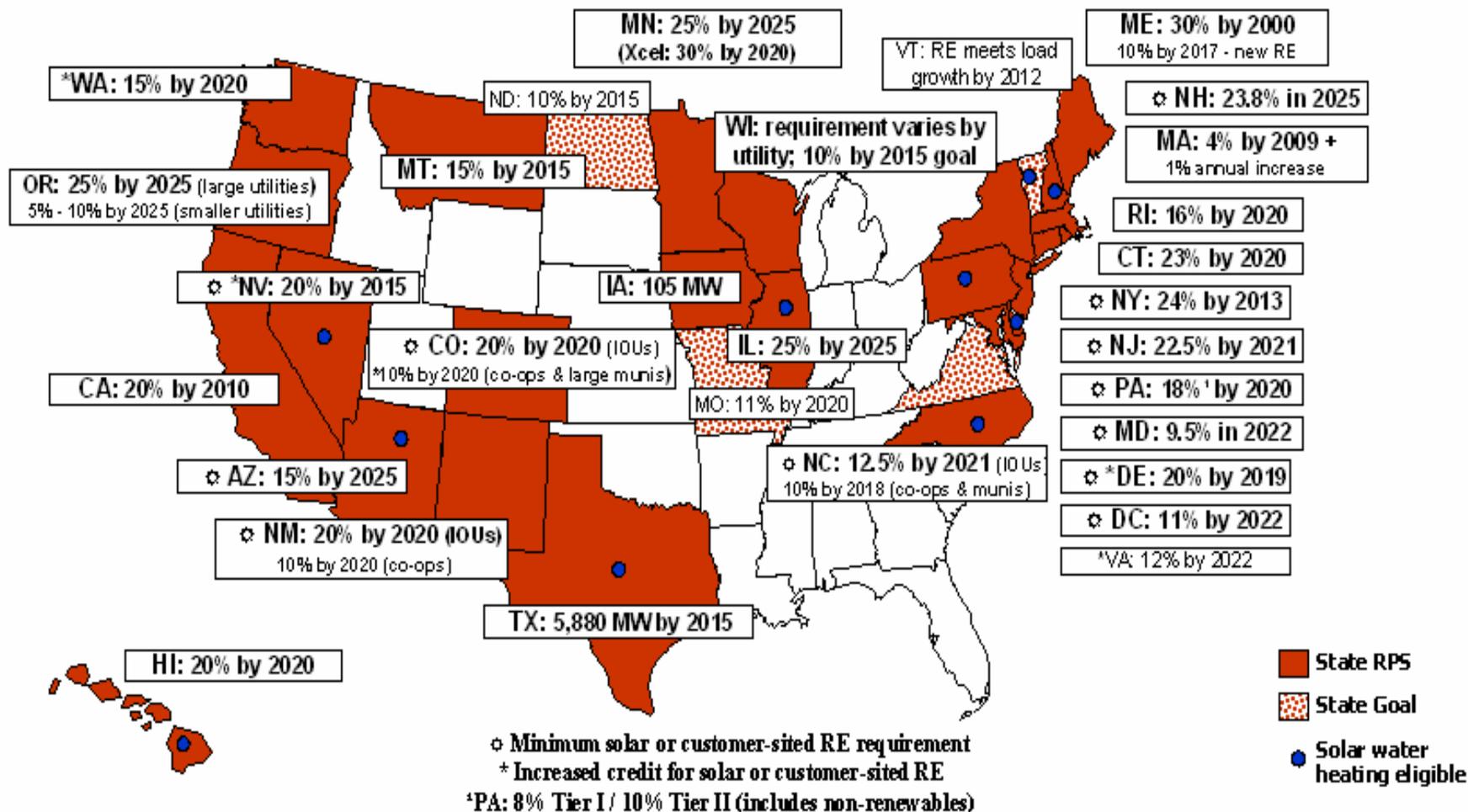
- ***Federal***
 - PURPA law requires utilities to purchase power from “qualifying facilities” at the utility’s “avoided cost” of generation.
 - No national renewables portfolio requirement.
 - **Various financial incentives available:**
 - 10-year production tax credits (1.9¢/kWh maximum) for new projects through 2008.
 - 30% tax credit (\$2,000 maximum) for residential solar systems through 2007.
 - investment tax credit for solar and geothermal.
 - accelerated depreciation for various renewable sources.
- ***States***
 - 24 states (and D.C.) have enacted a renewable portfolio standard (RPS), ranging from 1% to 30% of total supply.
 - 16 states have established customer-funded programs to financially support development of renewable energy sources.
 - 42 states (and DC) have enacted state policies for net metering

State Portfolio Standards Create Opportunities for Renewable Project Development

DSIRE: www.dsireusa.org

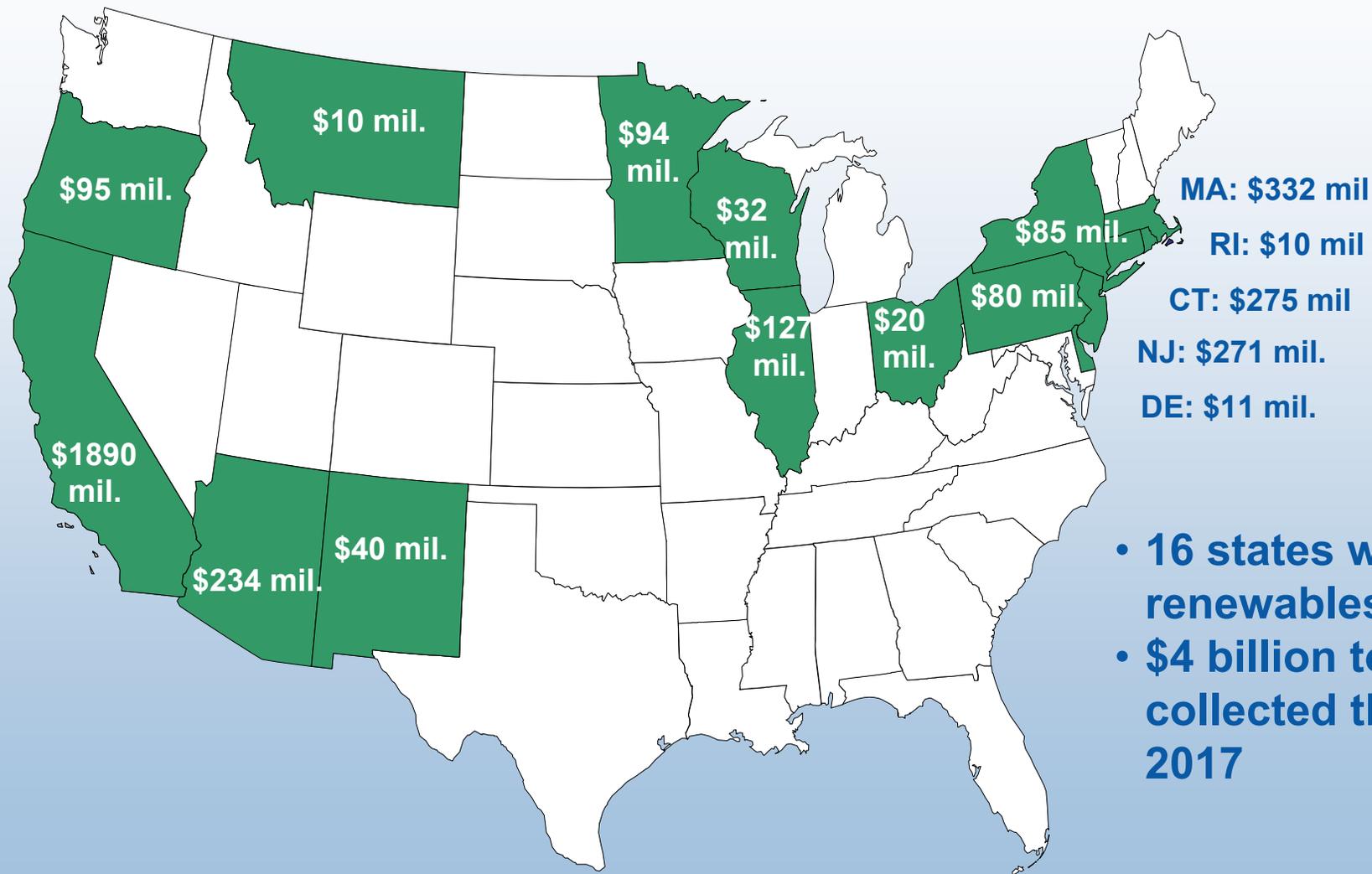
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Renewables Portfolio Standards



States with Renewable Energy Funds

Cumulative 1998-2012 (million \$)



- 16 states with renewables funds
- \$4 billion to be collected through 2017

How are Renewable Energy Funds Used?

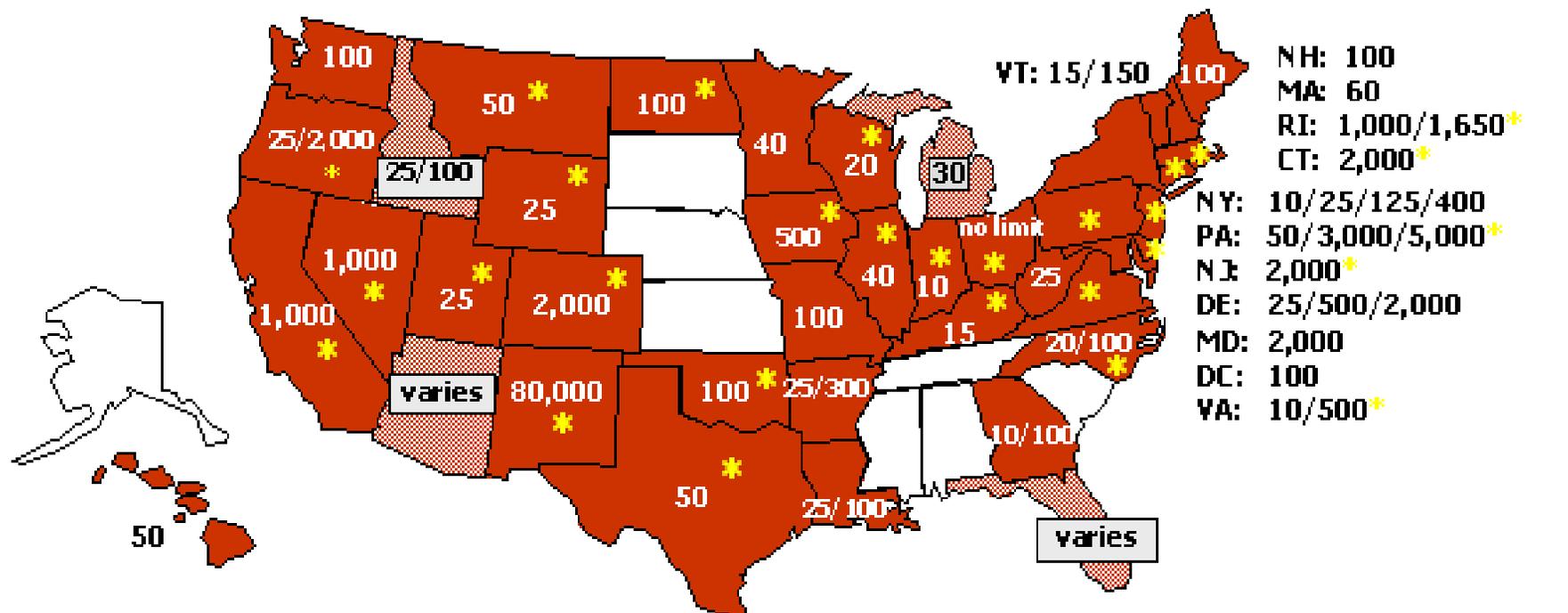
- Provide financial incentives for system deployment.
 - Production incentives, grants, customer rebates, etc.
- Provide price guarantees for electricity output in order to facilitate project financing.
- Support development of in-state industry and delivery infrastructure.
 - Resource assessments
 - Business development
 - Contractor training
 - Some states are taking an equity position in companies.
- Educate the public about renewable energy options.

State Policies for Net Metering Allow Consumers to Sell Solar Generated Electricity Back to the Grid

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December 2007

Net Metering



Net metering is available in 42 states + D.C.

Green Power Requirements

- Most utility green pricing programs are voluntary
- Six states require utilities to provide customers with green power options (IA, MN, MT, NM, OR, and WA)
- A number of states have established green power purchasing targets for state government (“lead by example”):
 - Maryland – 6%
 - Pennsylvania – 10%
 - New Jersey – 10%
 - New York – goal of 10% by 2005 and 20% by 2010
 - Connecticut – 20% by 2010
 - Maine – goal of 50%
- Counties and municipalities are also setting purchase goals.

Why Renewables?

- “Cleaner” energy production
- No or low water consumption (for some RE)
- Fixed, predictable costs
- Use of local or in-state resources
- Local and statewide economic benefits
- Waste reduction
- Can be deployed in various system sizes
 - Utility-scale
 - Communities
 - Farms and ranches
 - Businesses
 - Homes

The U.S. Department of Energy's National Renewable Energy Laboratory

www.nrel.gov



Golden, Colorado