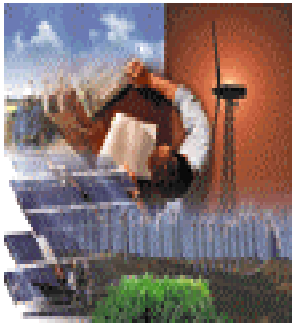


Renewable Energy: Opportunity or Challenge?

Terry Peterson and Chuck McGowin
Electric Power Research Institute
Palo Alto, California

NEMS/Annual Energy Outlook 2003 Conference
U.S. DOE Energy Information Administration
March 18, 2003, Washington, D.C.

Renewable Energy: Opportunity or Challenge?

- Renewable Energy Technologies
- Renewable Energy Market Drivers
- Renewable Portfolio Standards and Funds
- RPS v. NEMS Renewable Energy Forecasts
- Positive and Negative Factors and Impacts

Sustainable and Practical

Biomass, Vermont

NREL

Geothermal, California

Sustainable and Practical

Wind turbines, Minnesota

Sandia/NREL

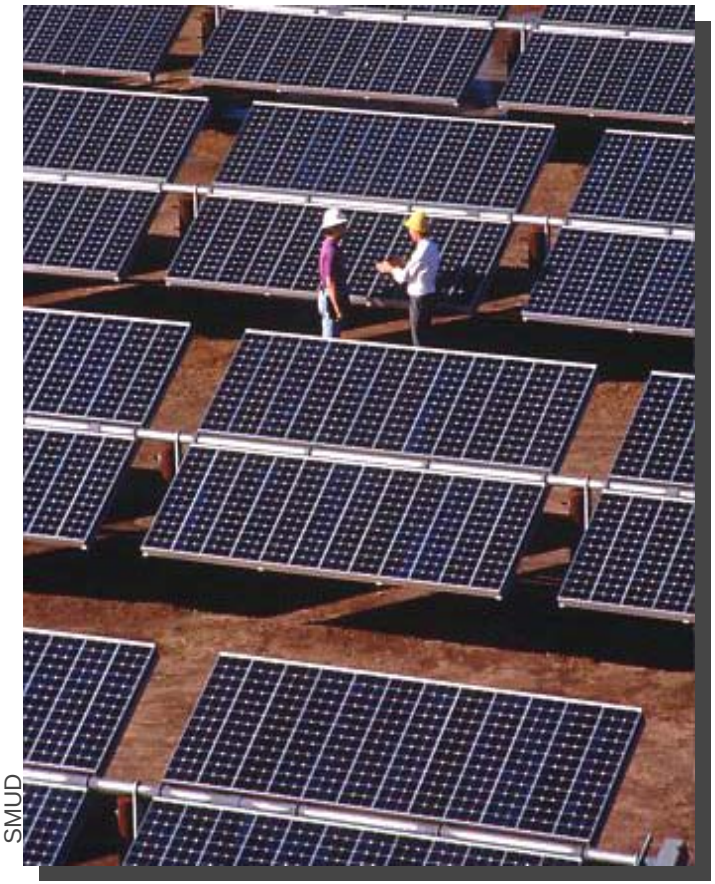
Distributed PV, Bolivia

Sustainable and Emerging

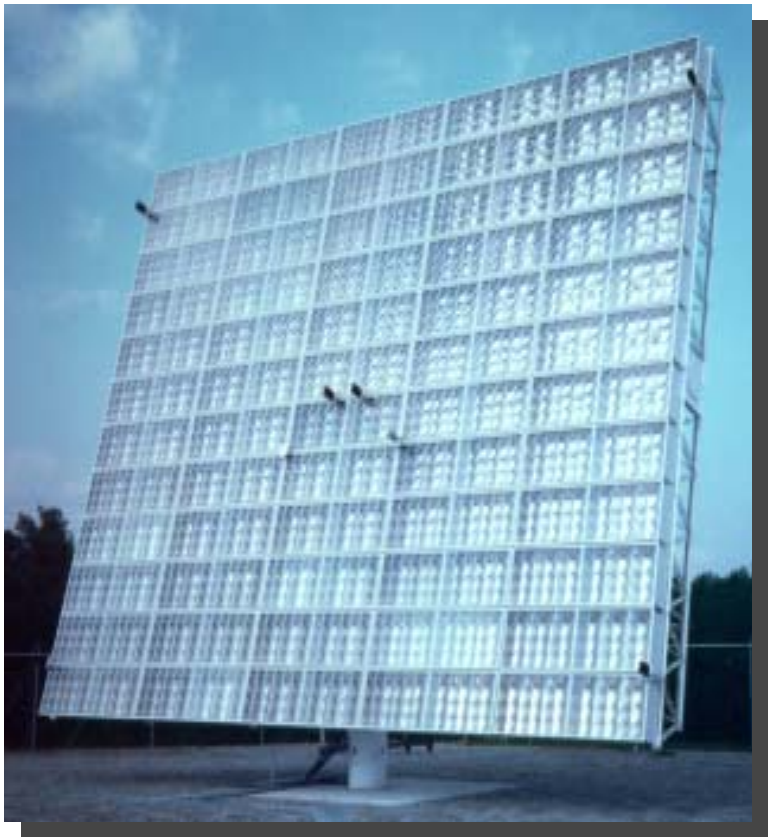
Solar thermal troughs, Calif.

Power tower and dish/engine, Calif.

Sustainable and Emerging

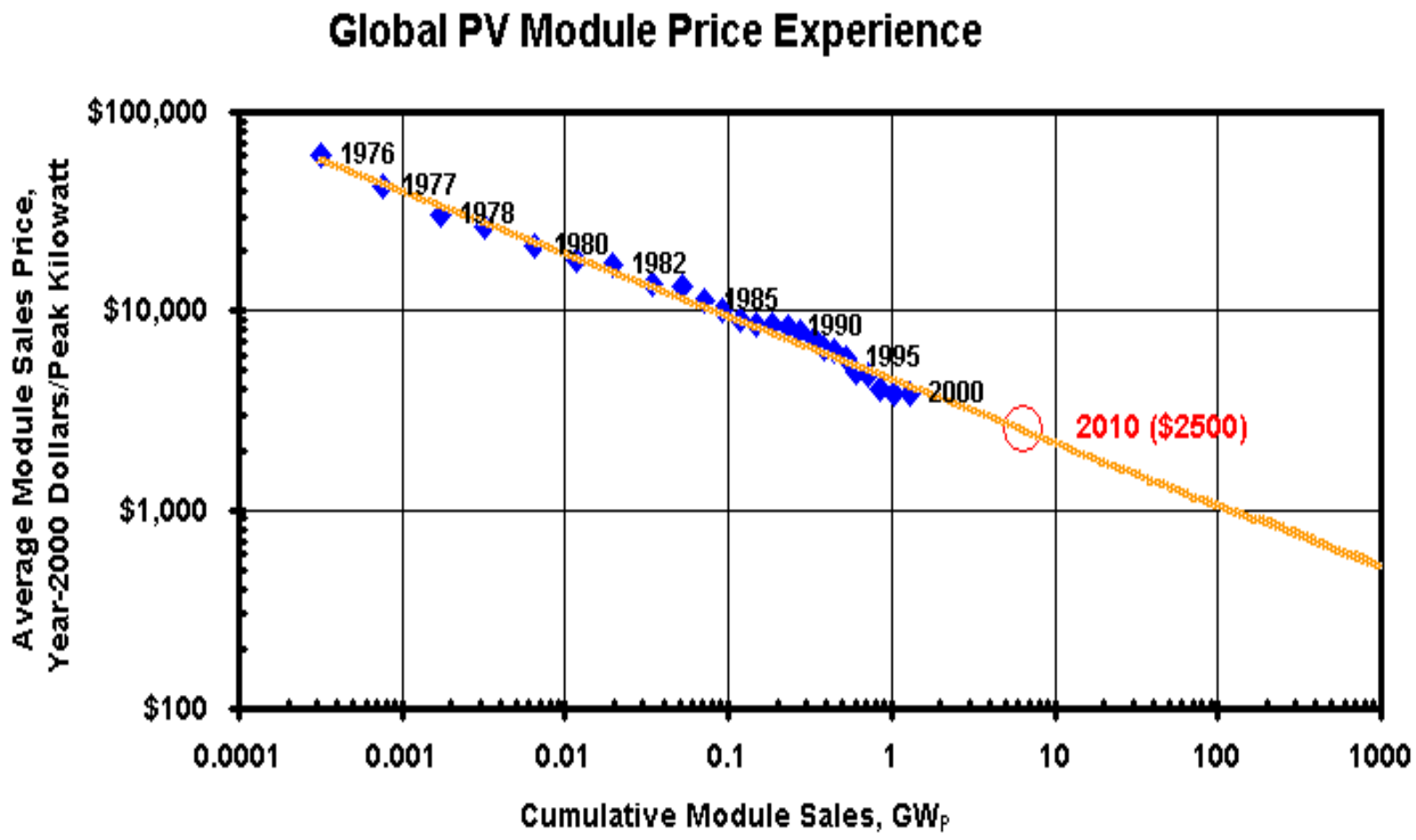


Utility-scale PV, California



Concentrator PV, California

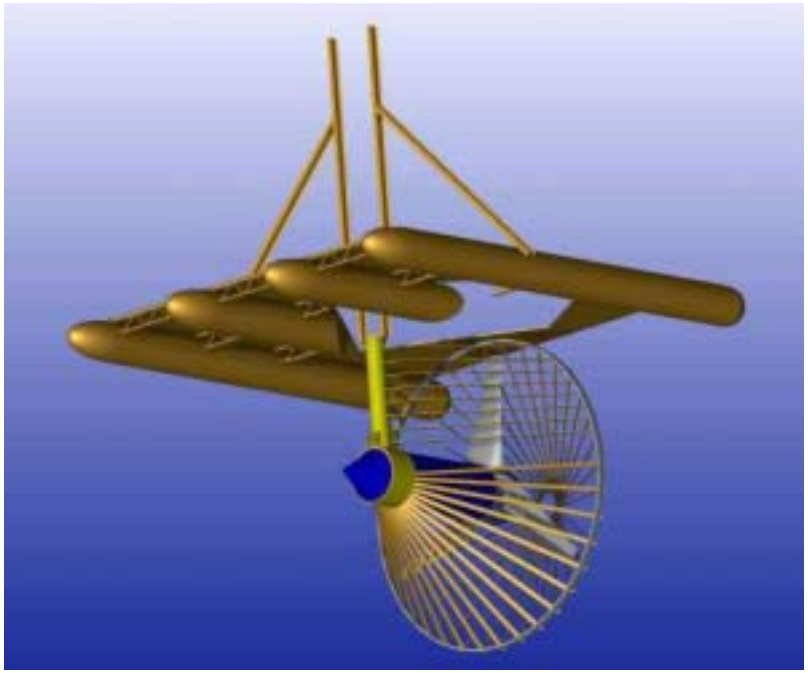
PV Price Trends



Data source: Strategies Unlimited

T.M. Peterson, EPRI

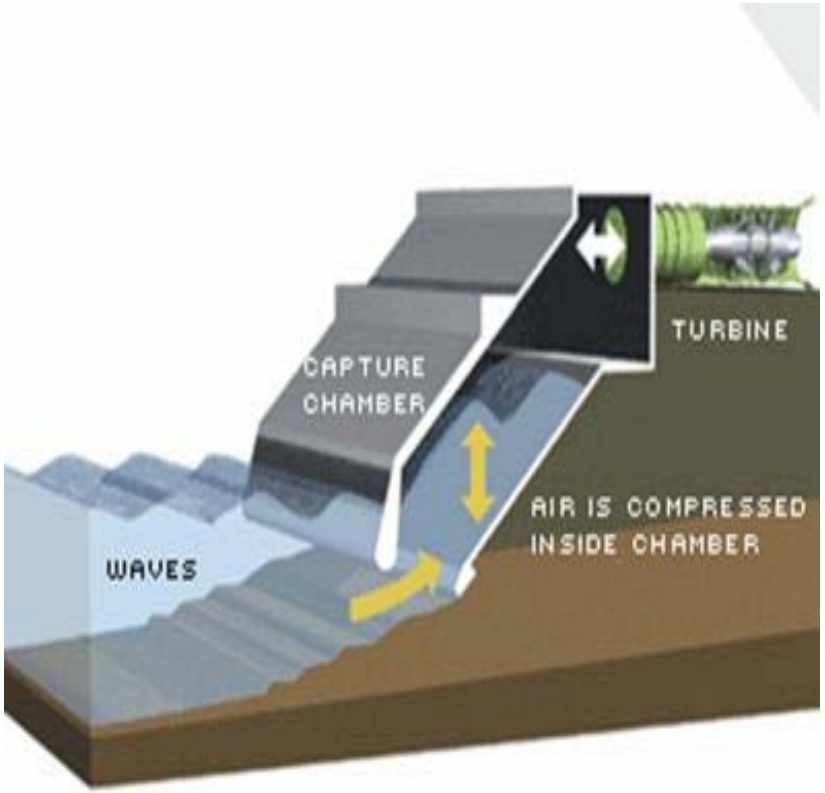
Sustainable and Emerging



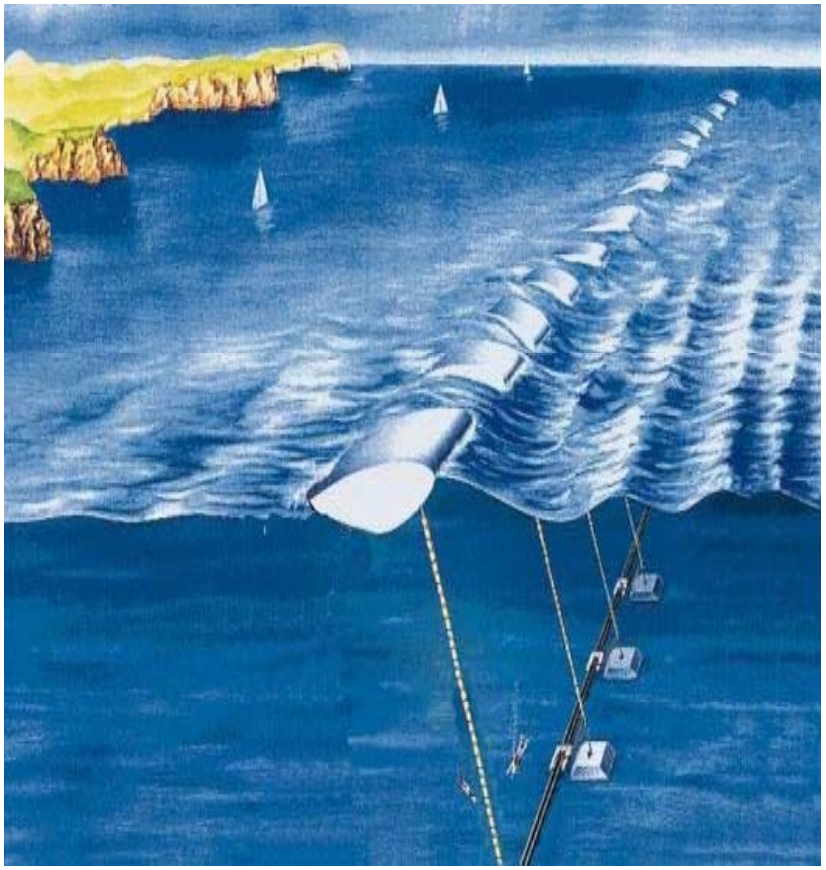
In-Stream Hydro Turbine

Dual Tidal Turbine Monopile

Sustainable and Emerging



Oscillating Water Column
Ocean Wave Energy System



Buoy Ocean Wave Energy System

Renewable Energy Market Drivers

- Worldwide global climate change and other concerns
- Public support
- Government mandates:
  - Renewable Portfolio Standards
  - System Benefit Charge
- Green power marketing programs
- Declining cost, especially for wind and solar.

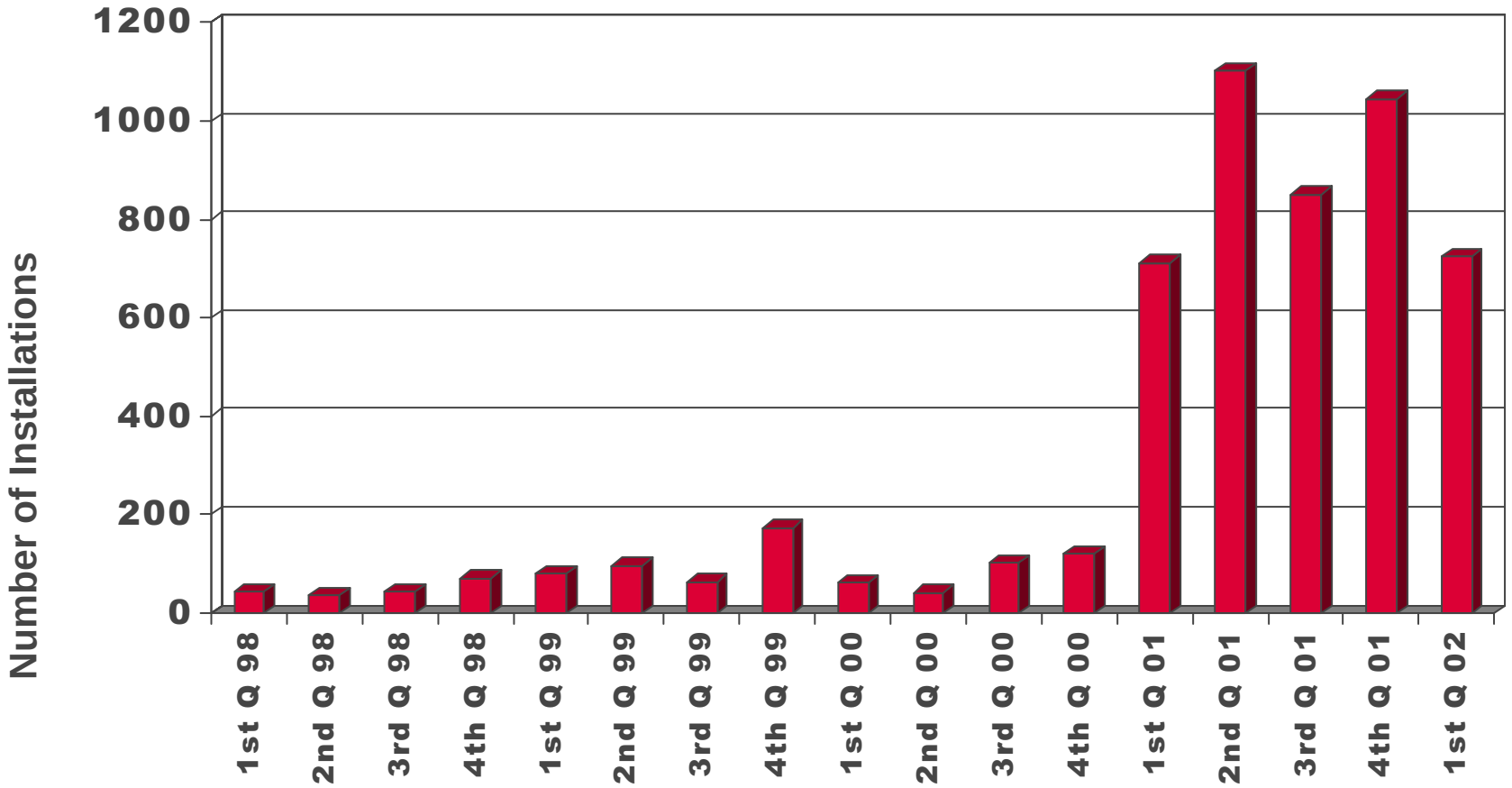
Overview of the EU Renewable Policy

- EC policies continue to promote a considerable increase in the fraction of electricity generated from renewable sources such as wind: the EU Directive on Renewable Energy Sources sets a target of 22% electricity from renewables by 2020.
- Latest EWEA targets :

Year	Total (MW)	Offshore (MW)
2010	60,000	5,000
2020	150,000	50,000

Completed Solar PV Systems by Quarter

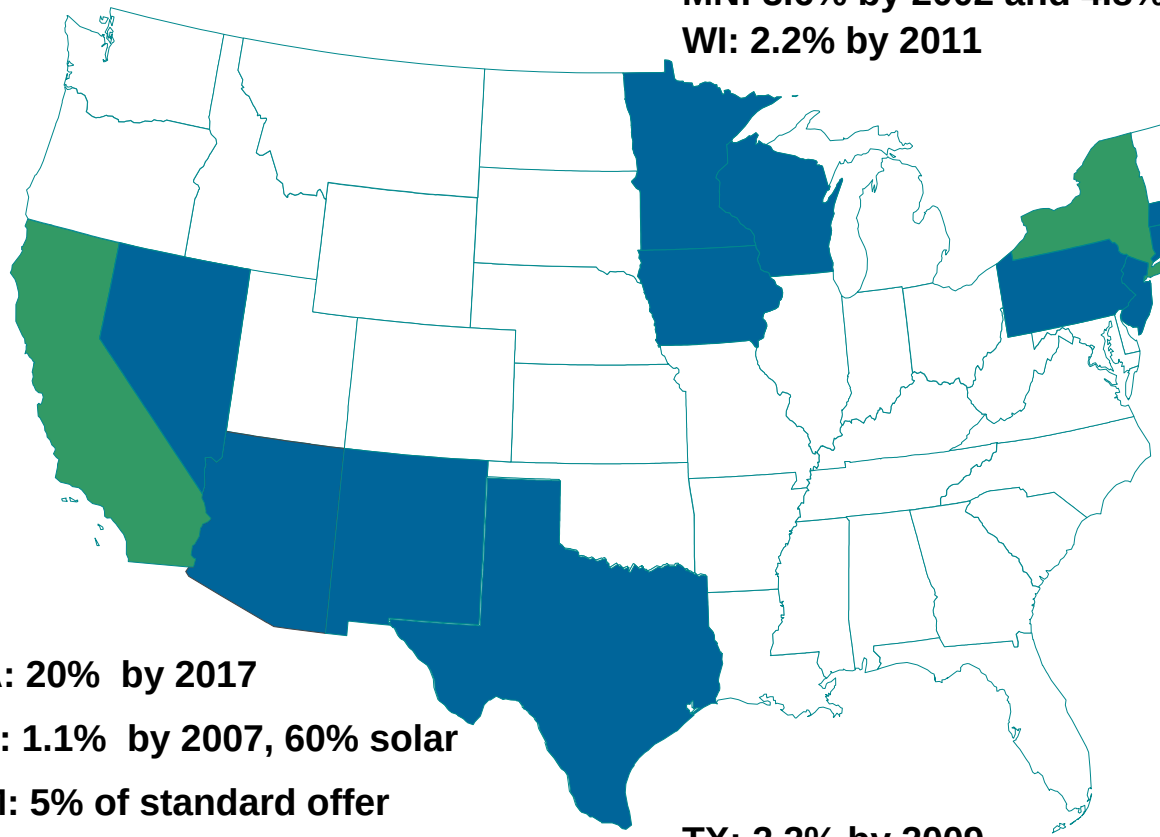
(January 1998 to March 2002)



Source: Tony Brasil, Renewable Energy Program, California Energy Commission

U.S. Renewable Portfolio Standards

Source: Union of Concerned Scientists



IA: 2% by 1999
MN: 3.6% by 2002 and 4.8% by 2012
WI: 2.2% by 2011

ME: 30% by 2000

MA: 11% by 2009

CT: 13% by 2009

NY: 25%

NJ: 6.5% by 2012

PA: varies by utility

CA: 20% by 2017

AZ: 1.1% by 2007, 60% solar

NM: 5% of standard offer

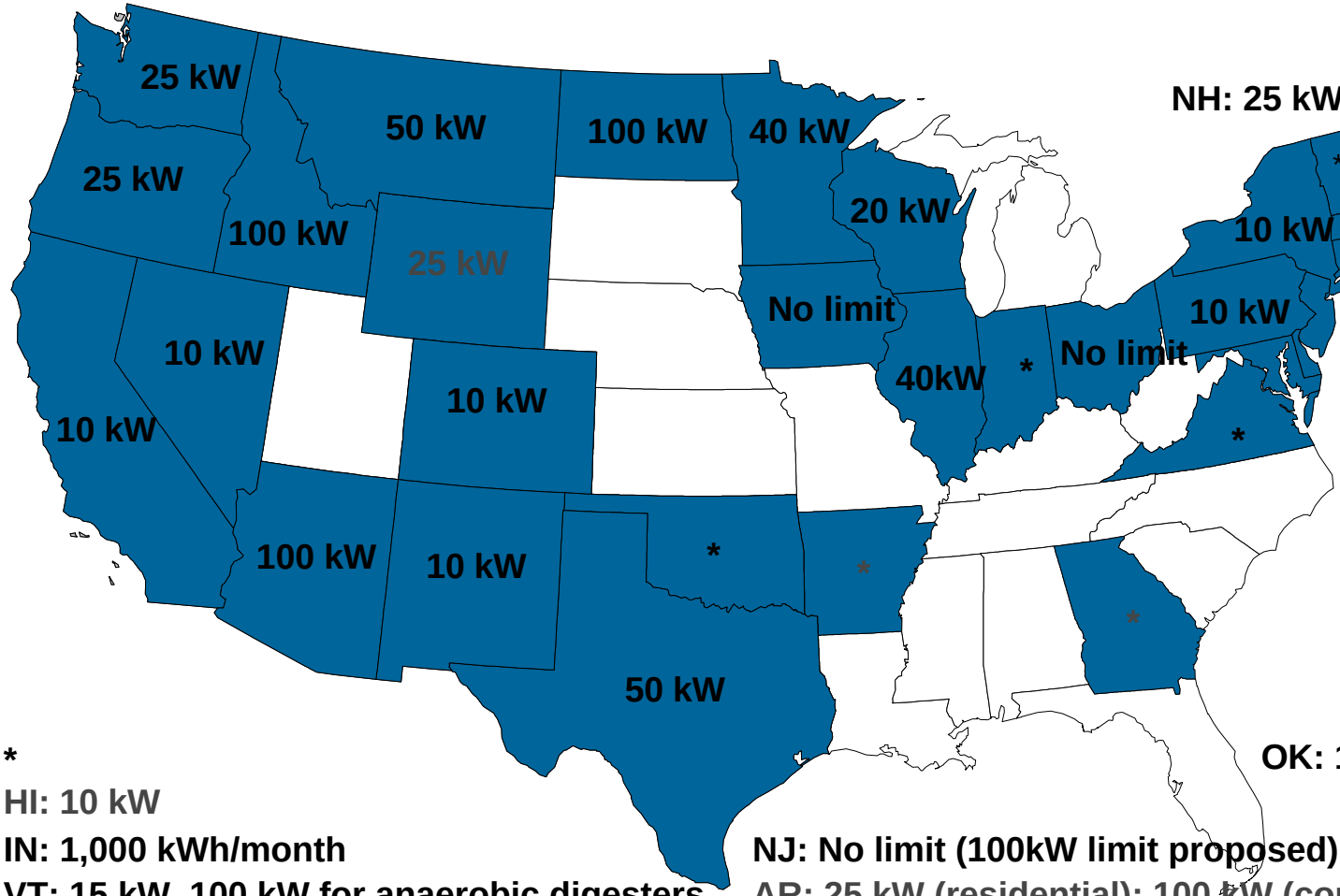
NV: 15% by 2013, 5% solar

TX: 2.2% by 2009

- 14 states

States with Net Metering Laws

Source: Union of Concerned Scientists



NH: 25 kW

ME: 100 kW

MA: 60 kW

RI: 25 kW

CT: No limit

MD: 80 kW

34 states

OK: 100 kW and 25,000 kWh

*

HI: 10 kW

IN: 1,000 kWh/month

VT: 15 kW, 100 kW for anaerobic digesters

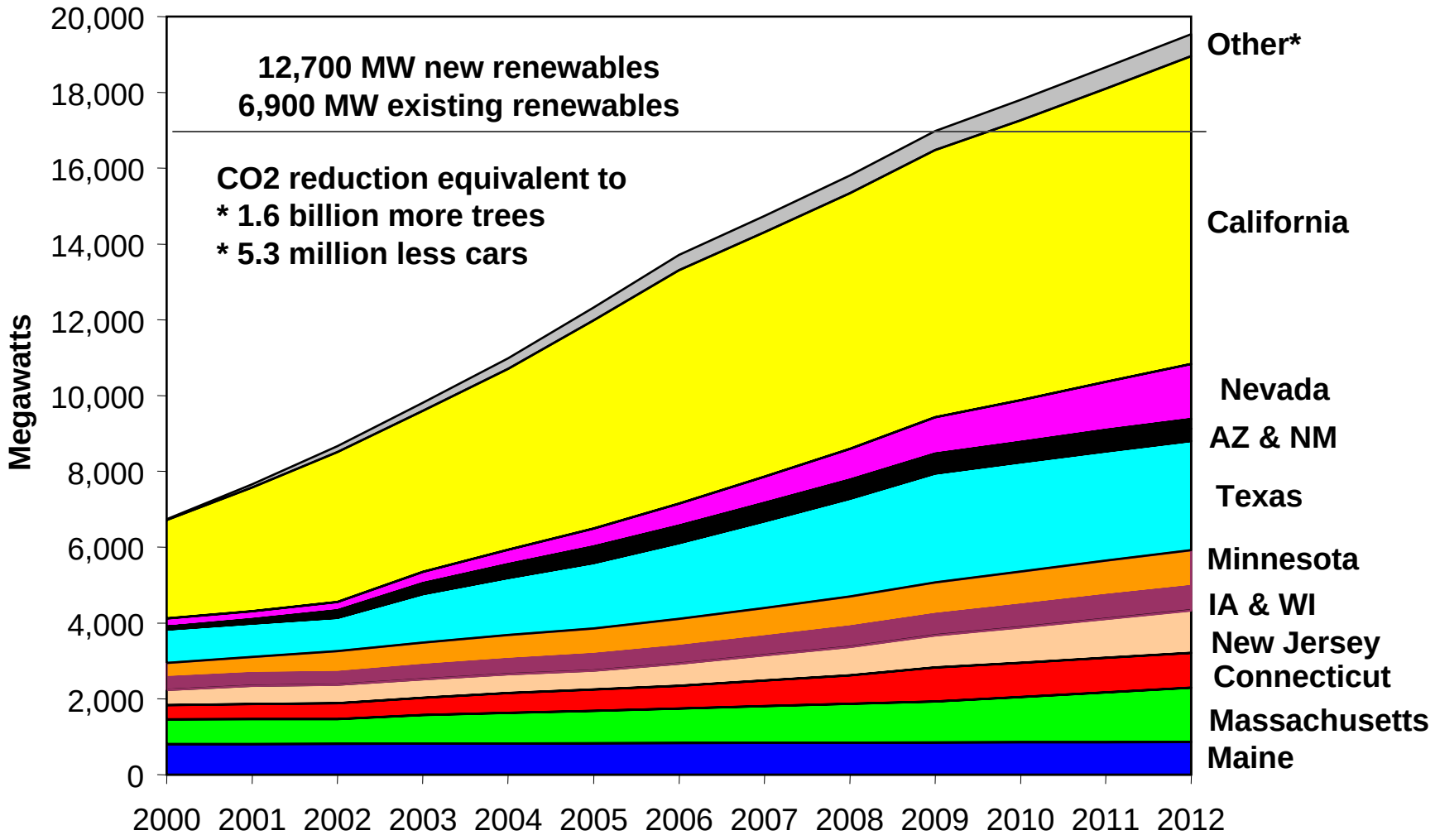
VA: 10 kW (residential);25 kW (commercial)

NJ: No limit (100kW limit proposed)

AR: 25 kW (residential); 100 kW (commercial or agricultural)

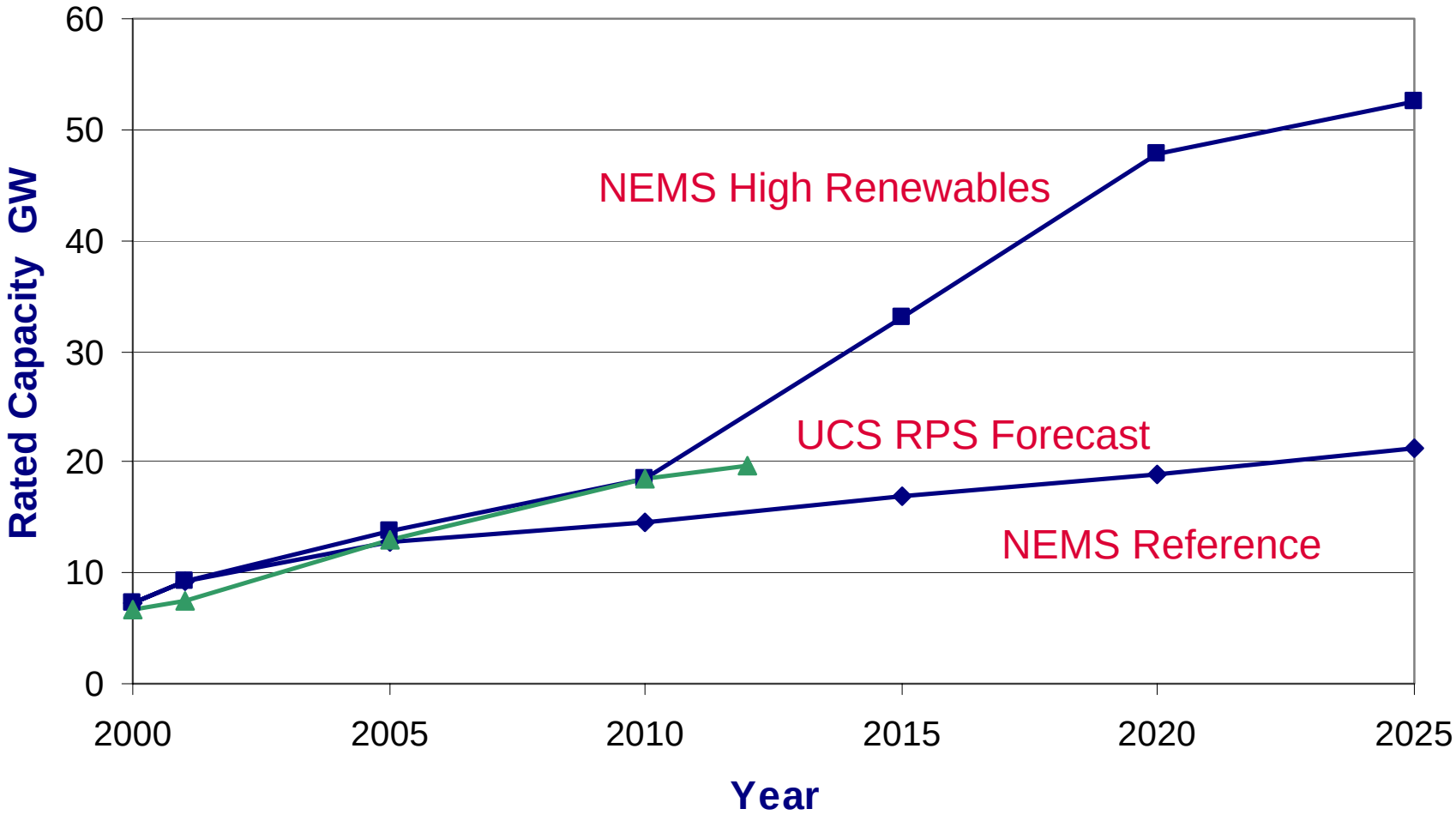
GA: 10 kW (residential); 100 kW (commercial)

Union of Concerned Scientists Forecast of R. E. Expected From State Standards and Funds



*Includes Illinois, Montana, New York, Oregon, Pennsylvania and Rhode Island.

NEMS 2003 vs. UCS Renewable Energy Capacity Forecasts



Renewable Energy Positives and Negatives

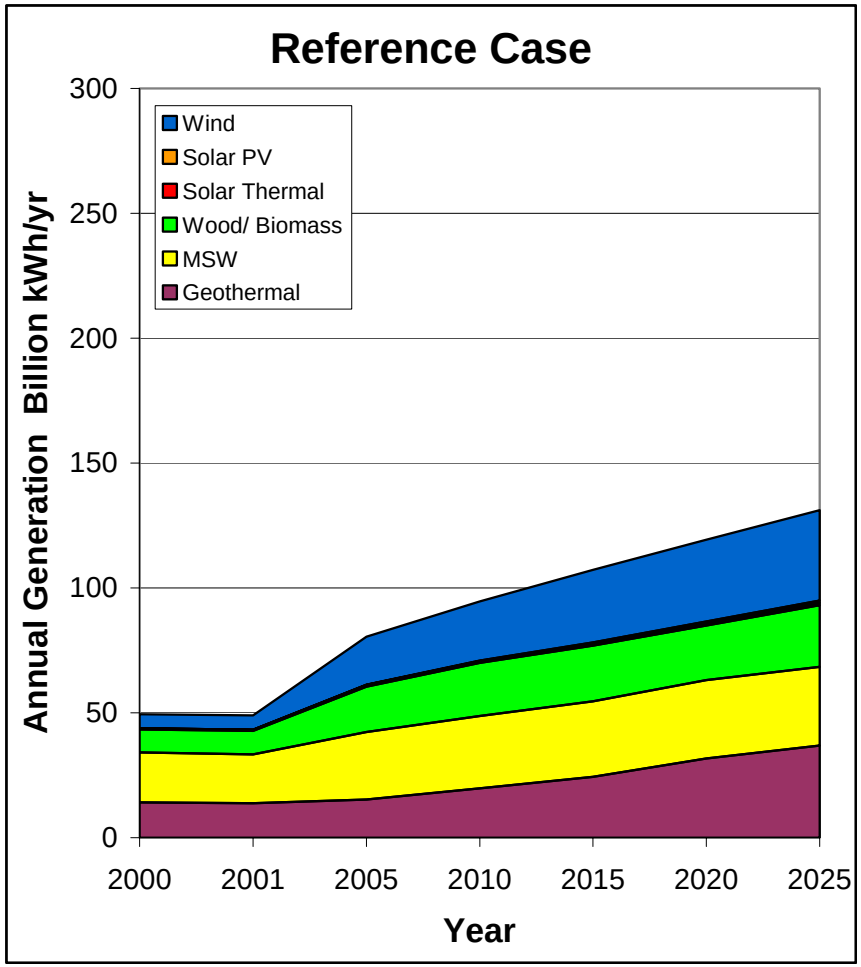
Positive Factors

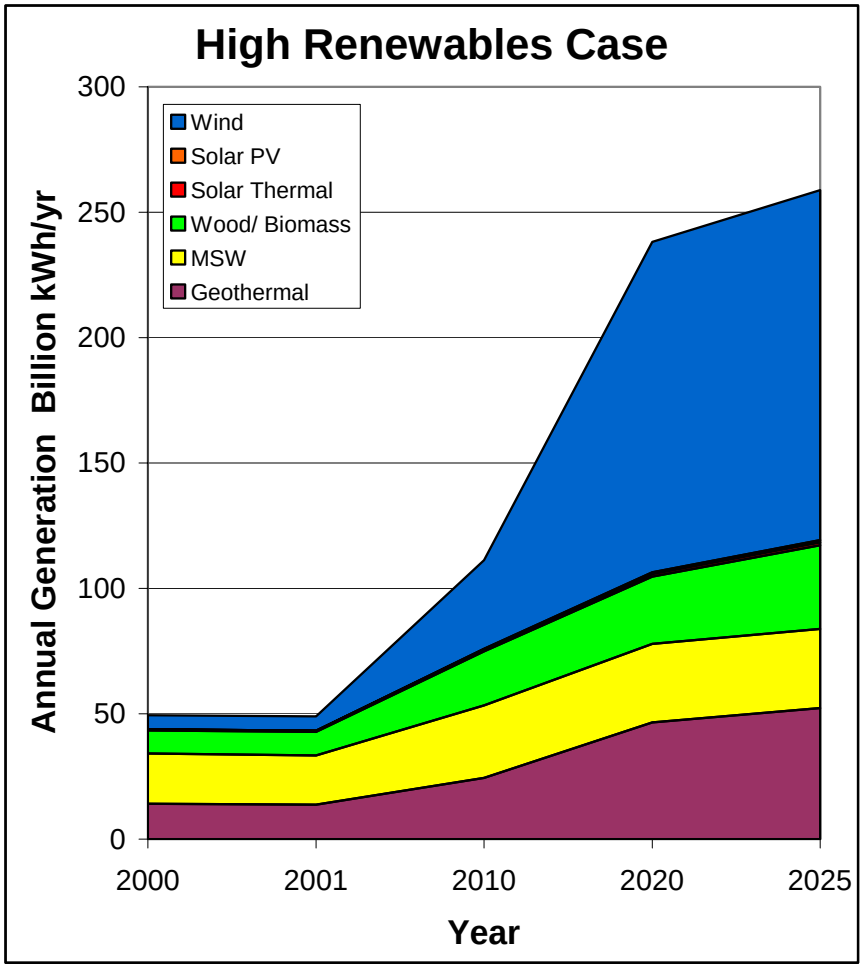
- Renewable energy can potentially supply 100% of world electricity needs
- Growing public awareness, support
- Efficiencies rising, costs falling—no economic showstoppers in sight for leading approaches
- Farming, ranching can continue on wind project land, farming is biomass land use
- Untapped potential for large-scale central-station solar-thermal and residential/commercial photovoltaics and solar-thermal
- Ocean tidal and wave current energy has large potential

Negative Factors

- Gap between public support and interest in 'premium' energy—energy lacks consumer priority
- Wind, solar are intermittent sources—better storage needed!
- Large new wind, solar, biomass facilities require significant land (but not as much as some think)
- Public opposition to large renewables projects will be similar to other generation—NIMBY
- Biomass combustion (at first?) less acceptable than other renewables
- Popular solar technologies are farthest from economic parity

NEMS 2003 Renewable Energy Generation Forecasts





NEMS 2003 Renewable Energy Capacity Forecasts