

Role of Renewable Energy Analysis in Air Quality Policy Development and Regulatory Oversight

NREL Energy Analysis Forum
Sheraton Denver West

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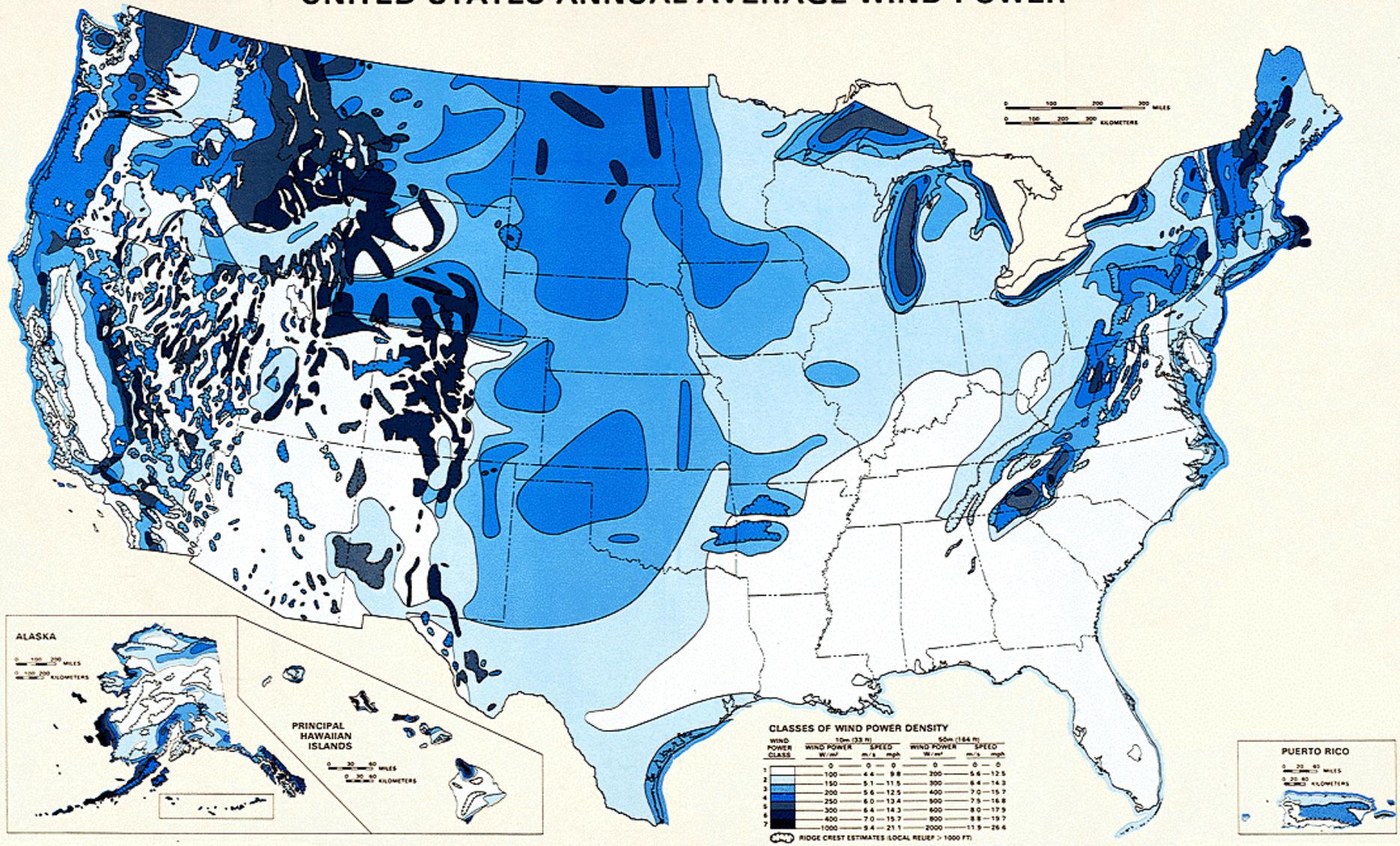
Why Renewables/Energy Efficiency?

- Why are Air Quality Planner's looking at renewable energy and energy efficiency?
 - Abundance
 - Increasing energy demand across country
 - Increasing air quality constraints
 - Increasing focus on Greenhouse Gas emissions
 - Improving Technologies

Abundance

- Wind
- Solar
- Hydroelectric Power
- Biomass
 - Wood
 - Landfill gas
 - Digester Gas
 - Energy Crops
- Waste (sometimes classified as renewable)

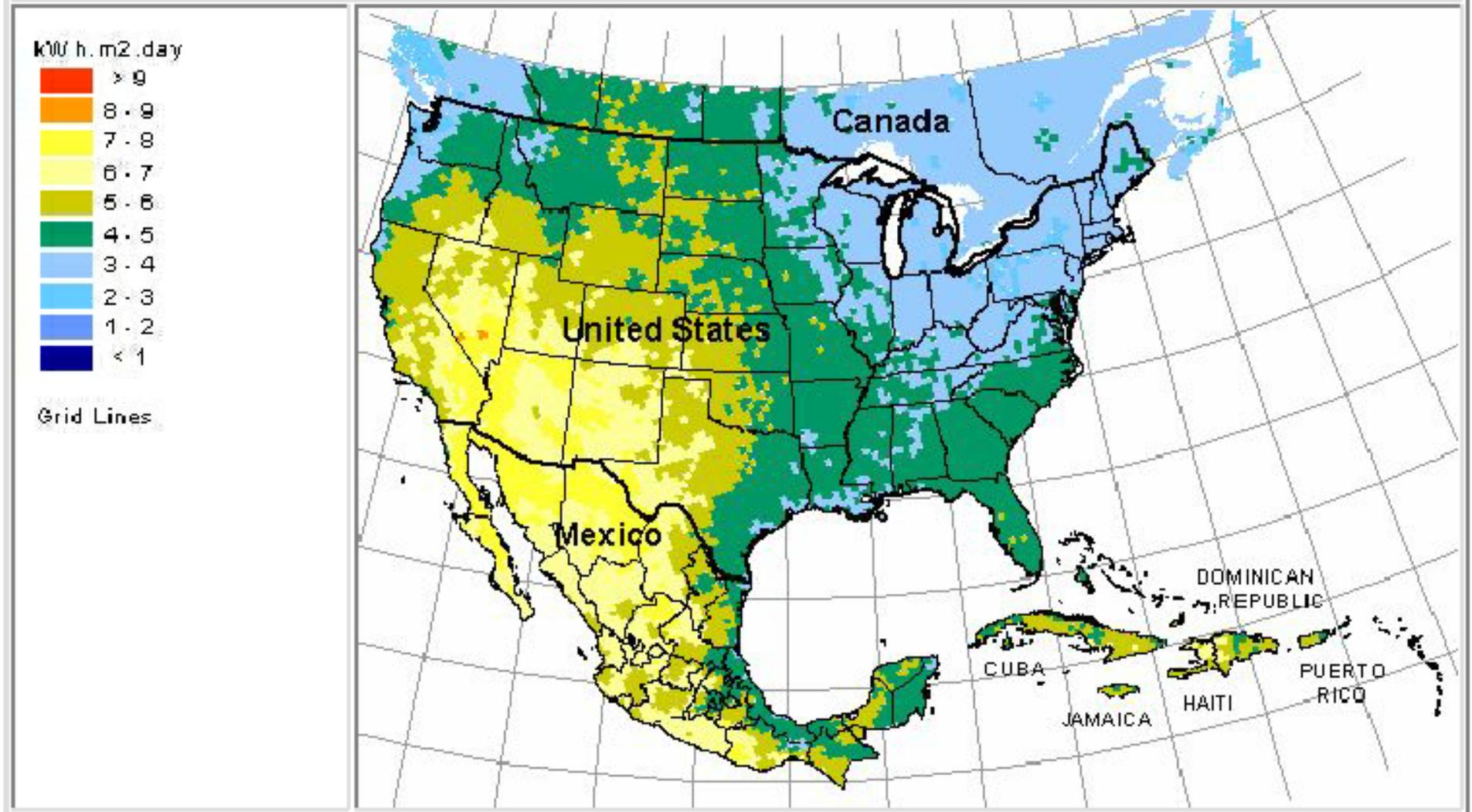
UNITED STATES ANNUAL AVERAGE WIND POWER



<http://rredc.nrel.gov/wind/pubs/atlas/maps/chap2/2-01m.html>

Solar Power Potential

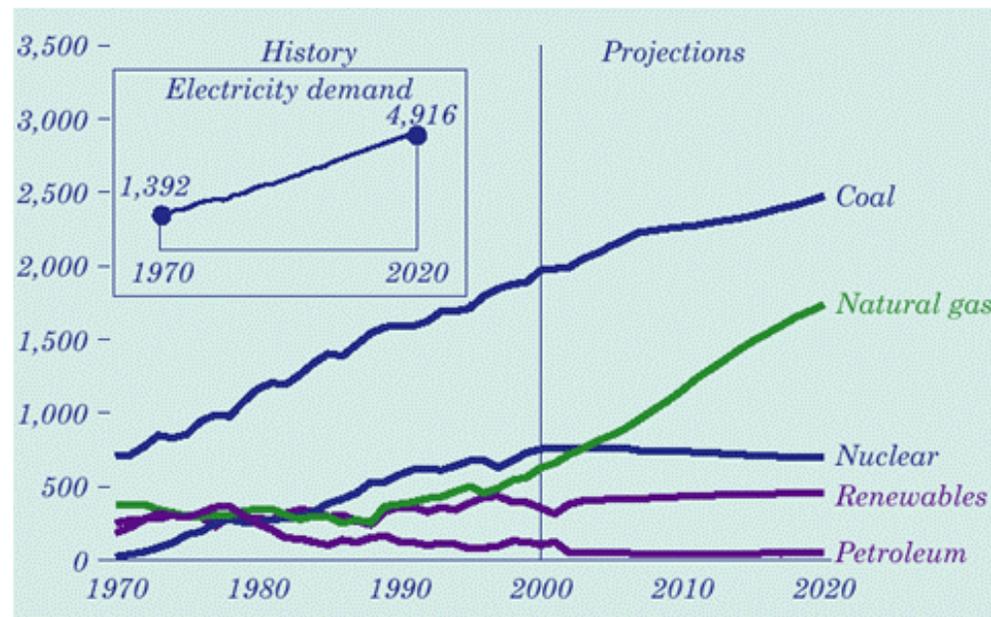
Annual



Source: NREL

Increasing Demand for Energy

*Figure 4. Electricity generation by fuel, 1970-2020
(billion kilowatthours)*



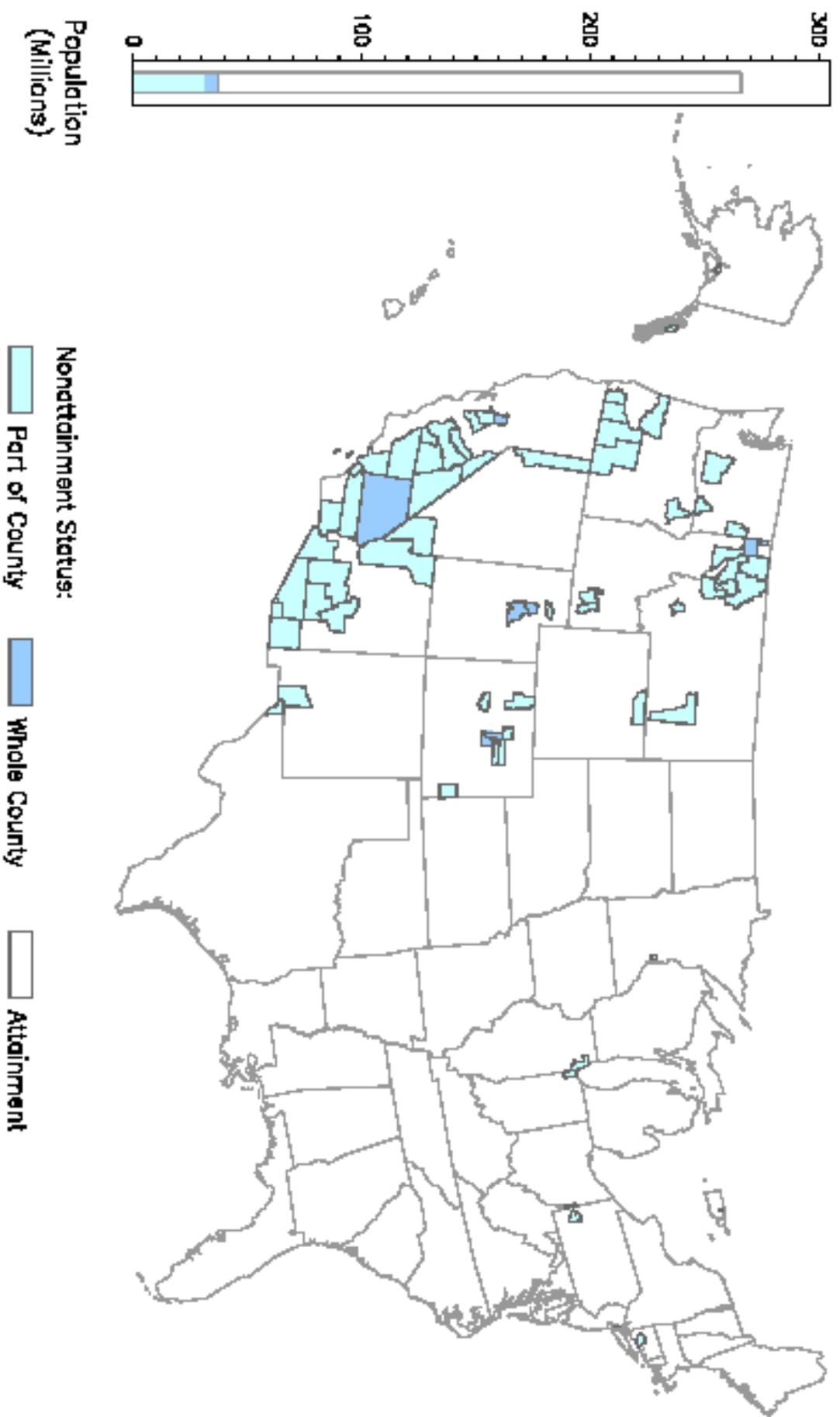
History: Energy Information Administration (EIA), Form EIA-860B, "Annual Electric Generator Report— Nonutility"; EIA, *Annual Energy Review 2000*, DOE/EIA- 0384(2000) (Washington, DC, August 2001); and Edison Electric Institute. **Projections:** Table A8.

http://www.eia.doe.gov/oiaf/aeo/images/figure_4.gif

Air Quality Constraints

UNITED STATES

Nonattainment Designations for Particulate Matter (PM10) as of January 2002



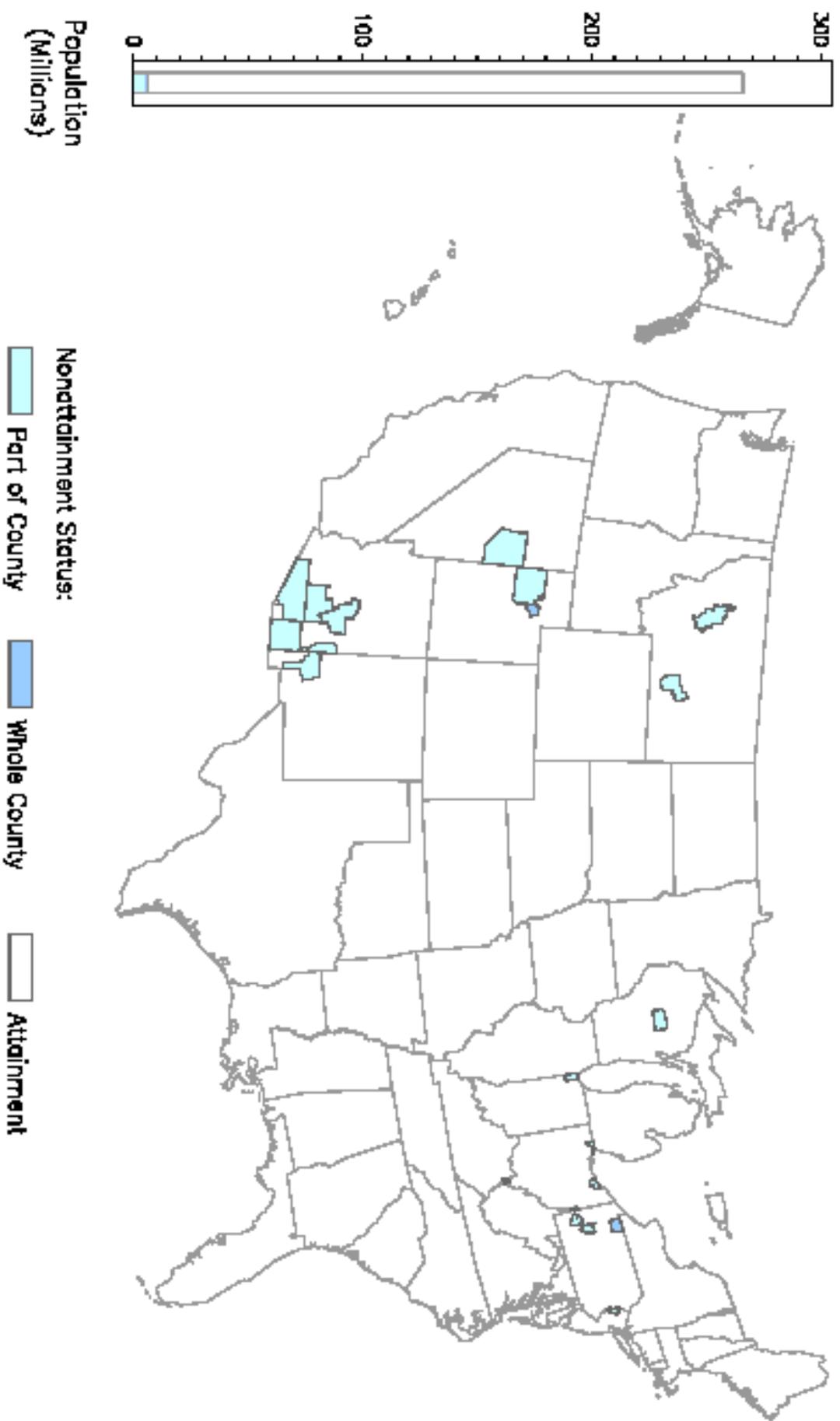
Source: US EPA Office of Air and Radiation, AIRS Database

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UNITED STATES

Nonattainment Designations for Sulfur Dioxide as of January 2002

Not shown: Piti and Tanguisson, Guam

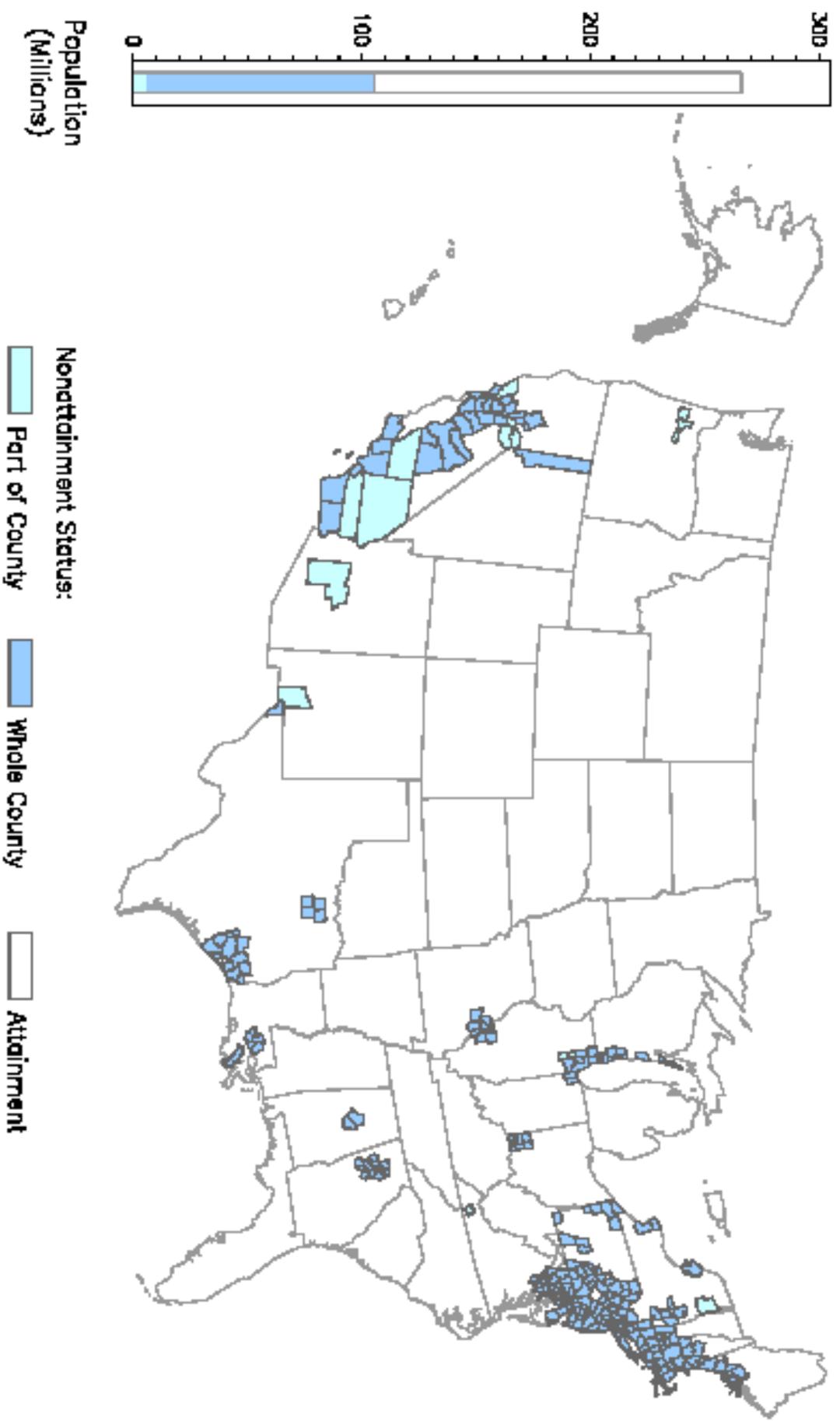


Source: US EPA, Office of Air and Radiation, AIRS Database

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UNITED STATES

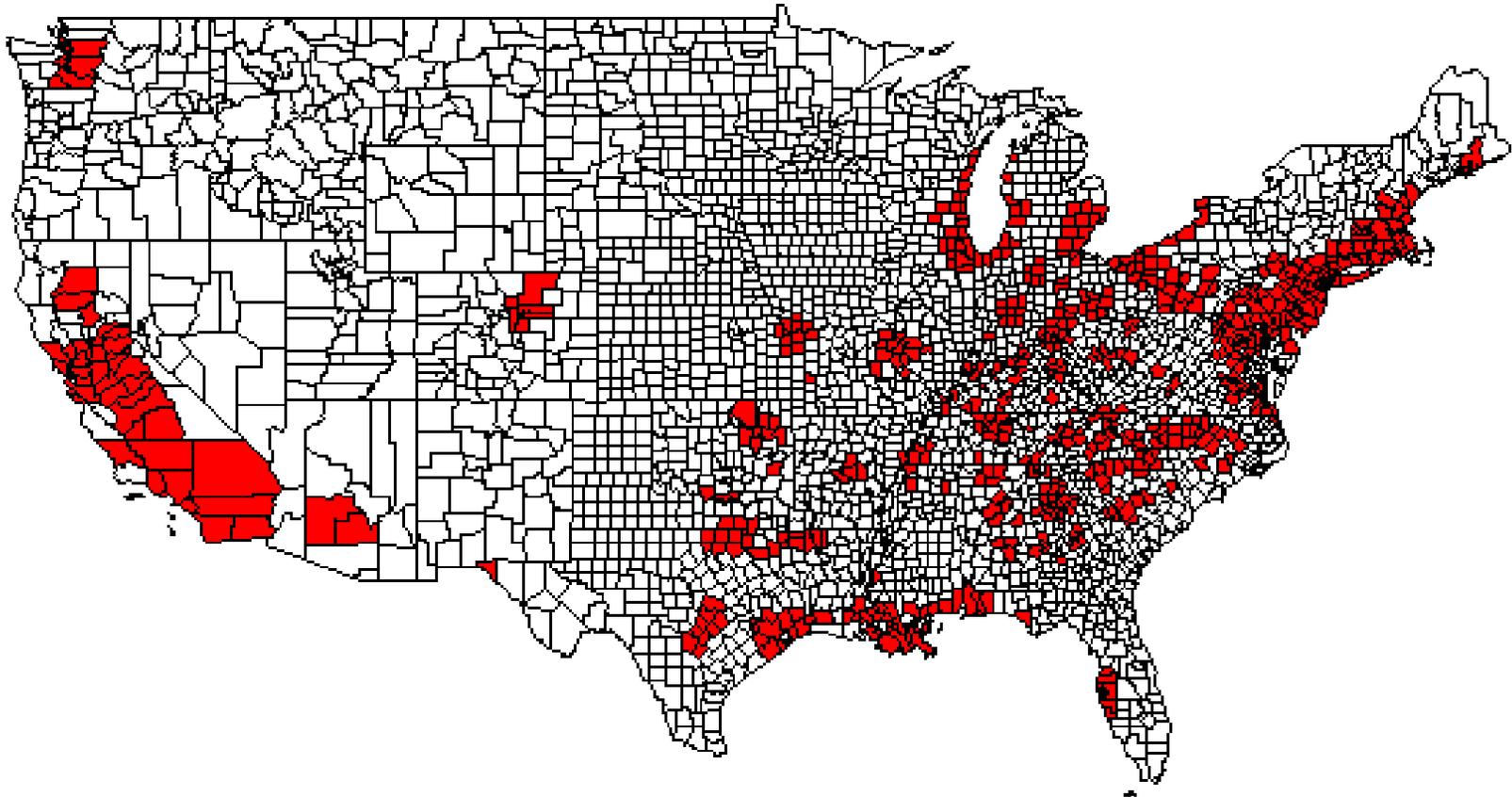
Nonattainment Designations for Ozone as of January 2002



Source: US EPA, Office of Air and Radiation, AIRS Database

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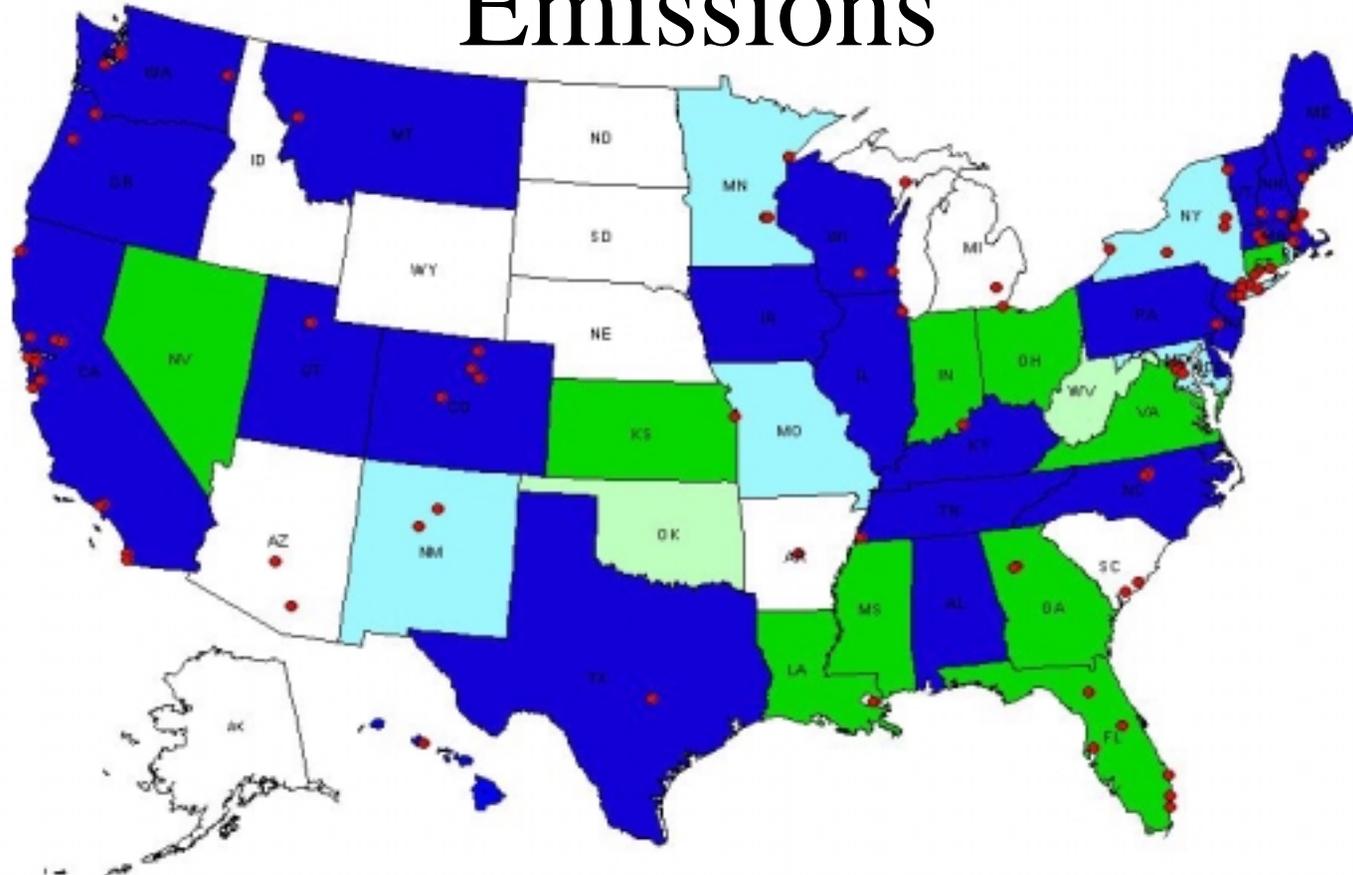
Identification of Counties that May Violate the 8-Hour Ozone Standard (Based on 1998-2000 Data)



Source: A.S.L. & Associates, Helena, Montana USA
<http://www.asl-associates.com/cb49800.htm>

Increasing Focus on GHG emissions

Increasing Focus on GHG Emissions

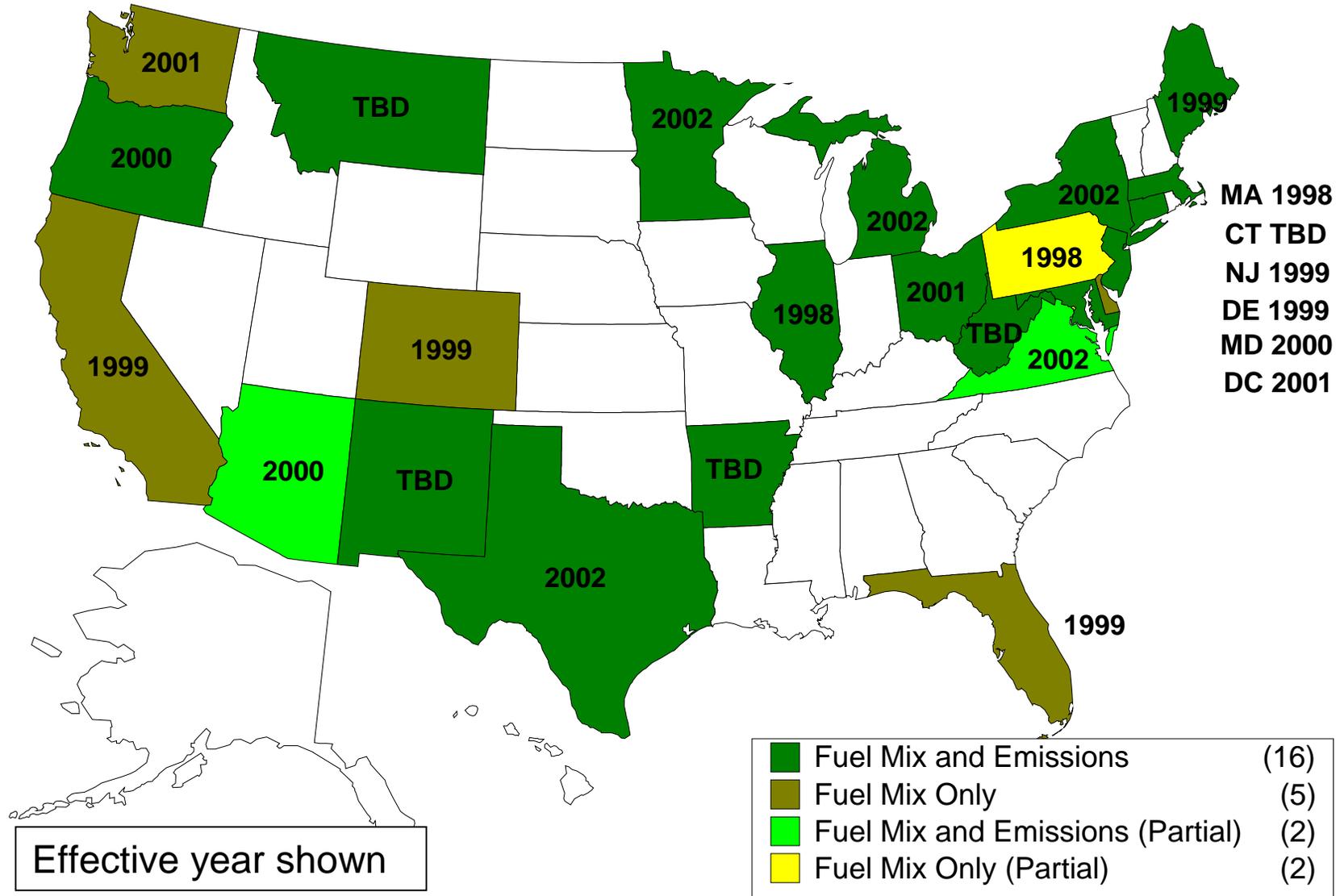


Light Green State Inventory In Progress **Cyan** State Inventory Complete and Action Plan In Progress
Dark Green State Inventory Complete **Blue** State Inventory and Action Plan Complete
EPA State and Local Capacity Building Branch **Red Dot** City or County with GHG Reduction Goal
May 2002

What are the policies?

- Environmental provisions associated with Electricity Restructuring legislation
 - Renewable Portfolio Standards
 - Environmental Disclosure
 - Emission Portfolio Standards
 - Public Benefit Funds (a.k.a. System Benefits Charges)
 - “Green Power” purchasing requirements
 - Net metering provisions
- Tax Incentives

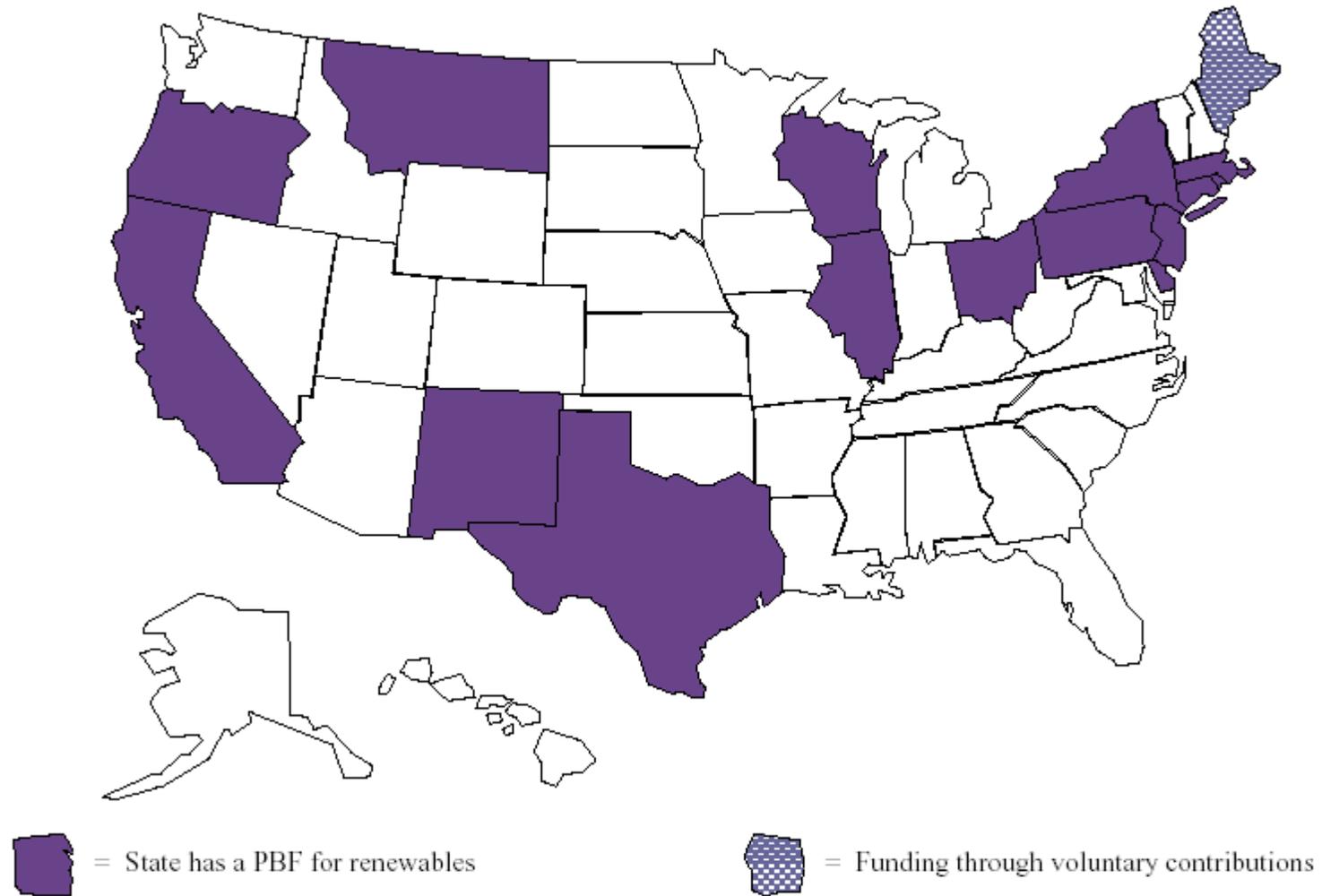
Environmental Disclosure



States with System Benefit Charge (SBC) Programs

<u>EE</u>	<u>RE</u>	<u>Both</u>	<u>TBD</u>
ME NH	NM	AZ CA	DC MD
NY OH		CT IL MA	MI NV
TX VT		MT NJ	
		OR PA RI	
		WI	

SBC Renewables Funding



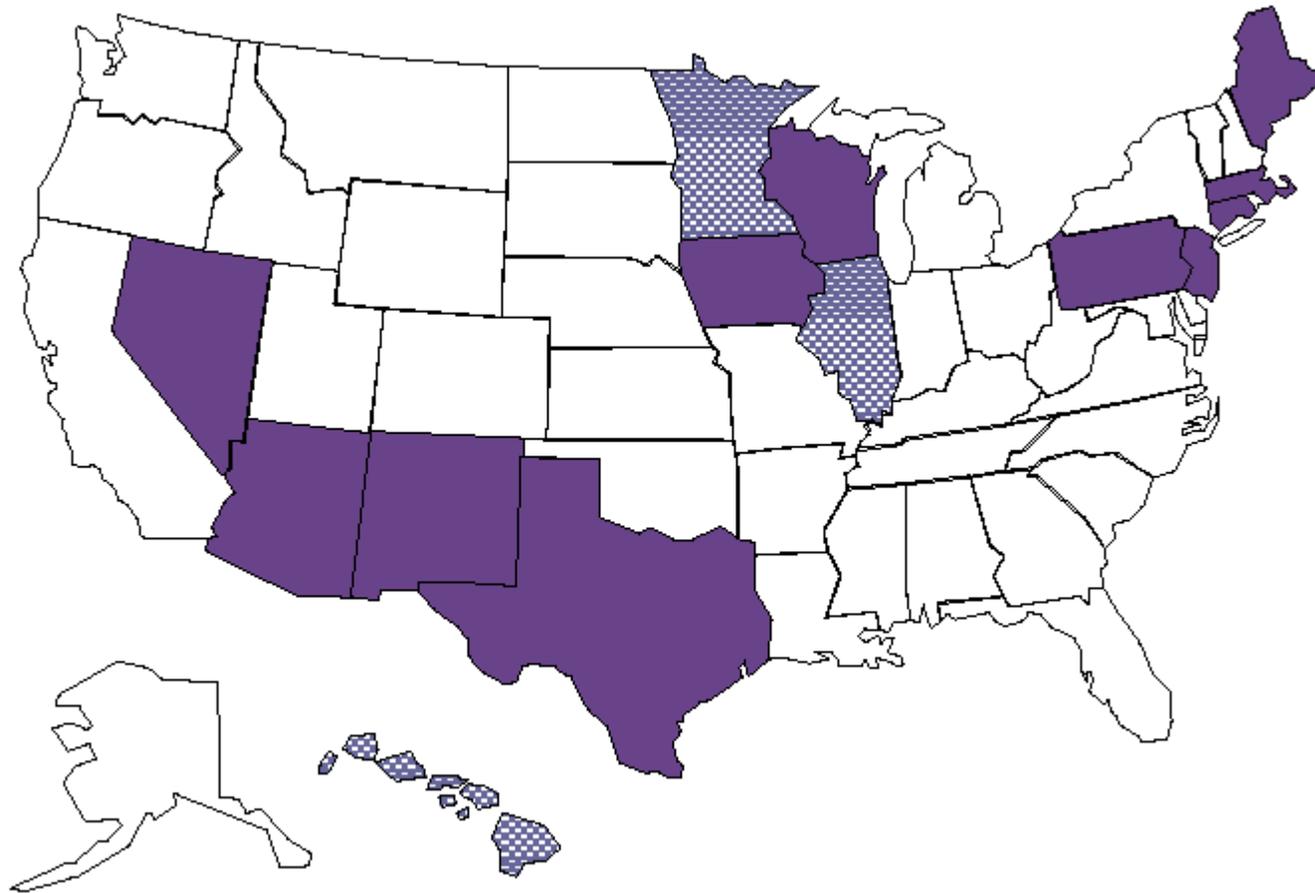
http://www.ies.ncsu.edu/dsire/library/docs/PBF_Map.pdf

States with RPS

State	Standard
Connecticut	New Renewables: 0.5% by 7/1/2000 increasing by 0.25% each year through 7/2009. Existing renewables increase from 5.5 percent to 7% by 2009.
Maine	30% standard. (including hydro)
Massachusetts	1% starting in 2003, increasing by 0.5% through 2009, and an additional 1% per year thereafter.
Nevada	0.2% and increasing to 1% by 2010, half of which is to come from solar power.
New Jersey	2.5% in 2000 increasing to 6.5% by 2012.
Pennsylvania	2% increasing by 0.5% annually subject to cost limitations.
Texas	2000 megawatts new renewable generating capacity by 2009 with 400 MW to be installed by 2003.

http://www.eren.doe.gov/state_energy/policy_content.cfm?policyid=27#states

States with RPS



 = State has a Renewables Portfolio Standard

 = State has a Renewables Portfolio Goal

http://www.ies.ncsu.edu/dsire/library/docs/RPS_Map.pdf

What are the policies?

- Renewable Energy/Energy Efficiency Set-aside within Cap and Trade Programs
- Energy Codes
- Equipment Standards
- Multi-pollutant Programs (e.g. NH)
- Voluntary and Market Transformation Programs (e.g. Energy Star)
- Regional Haze Renewable goal for Grand Canyon Visibility Transport Commission States (10% by 2005, 20% by 2015)

How can analysis help?

- Translating policies into projected environmental impacts, especially relating to air emissions:
 - How much will renewable energy and energy efficiency be utilized in the future?
 - How will the policies affect the use?
 - What are the emissions from the renewable sources (especially important for various biomass applications)?

How can analysis help?

- What sources of energy are being supplanted by the increase in energy efficiency or renewable energy?
- What are the emission reductions?
- Where are these emission reductions occurring?
- Are there other important impacts to consider?

Current analytic tools

- Economic modeling
 - E.g. NEMS, IPM
- Electricity Dispatch Modeling
- Energy/Emissions Databases
 - EIA data, EPA data (E-GRID)

Challenges for improved analysis

- Up-to-date assessments of renewable energy technologies within economic models
- Improved “displaced emission rate” factors for various efficiency and renewable technologies (different technologies have different load profiles)
- Locational component of displaced emissions
- Consideration of Cap and Trade Programs

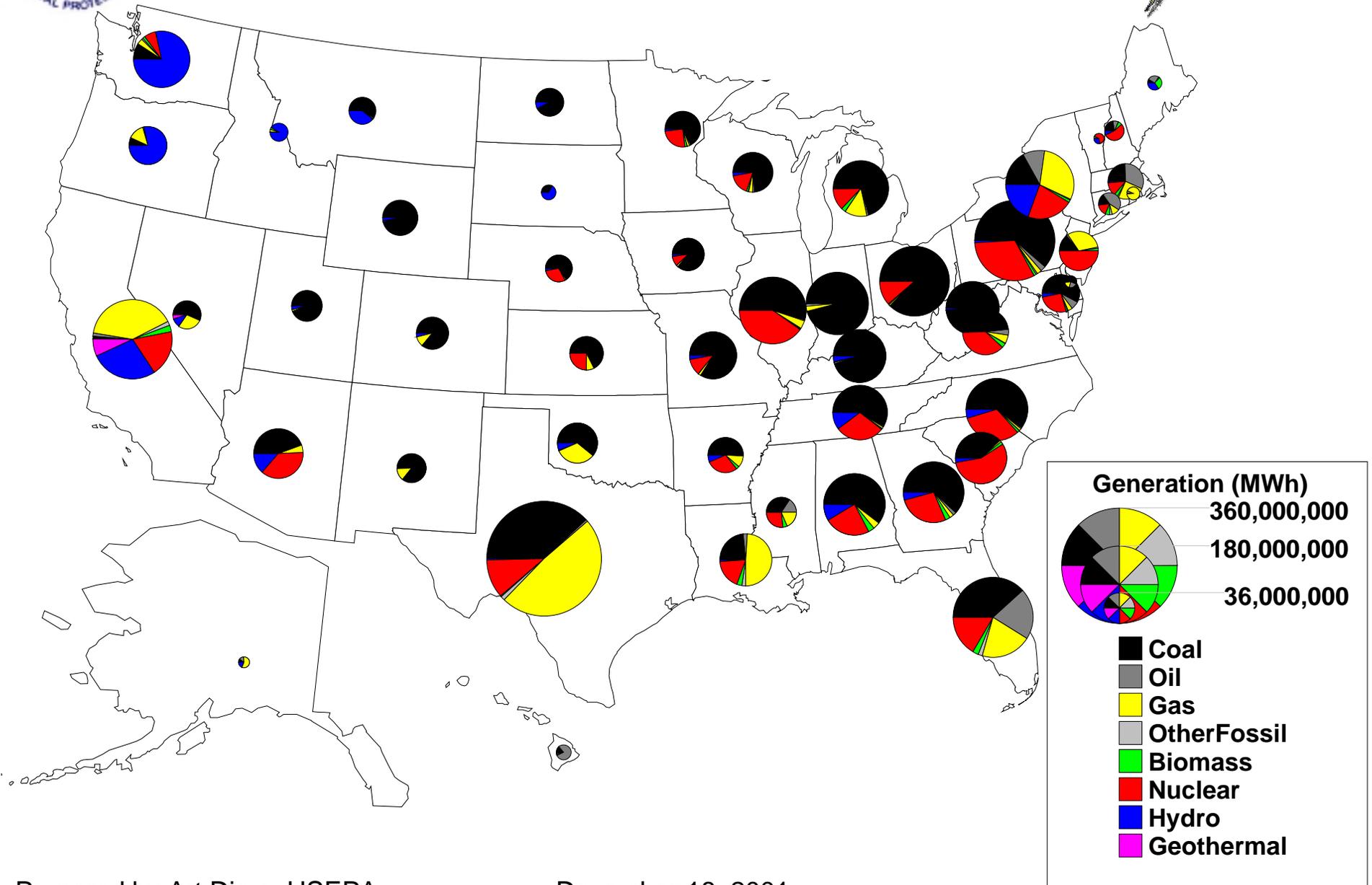
Snapshots of Energy Use, Emissions, and Renewables

1998 Electricity Generation Snapshot

- EGRID Data: compellation of dozens of EIA/EPA/FERC databases
- <http://www.epa.gov/airmarkets/egrid>
 - all US electricity generators of 1 MW and greater
 - emissions
 - generation
 - locational information
 - affiliation/ownership
- Year 2000 data coming soon

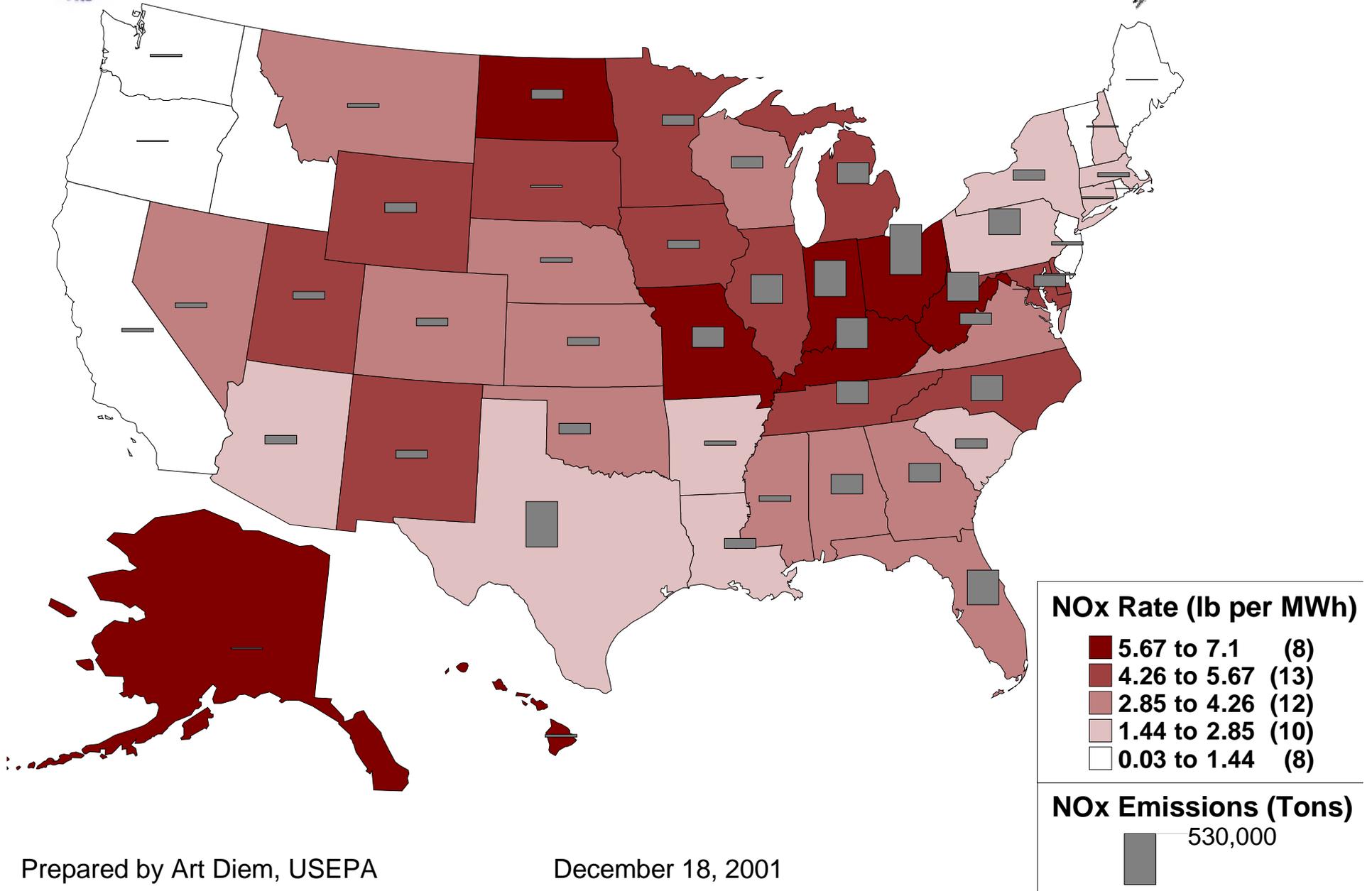


1998 Fuel Mix





1998 NO_x Emissions/Rates

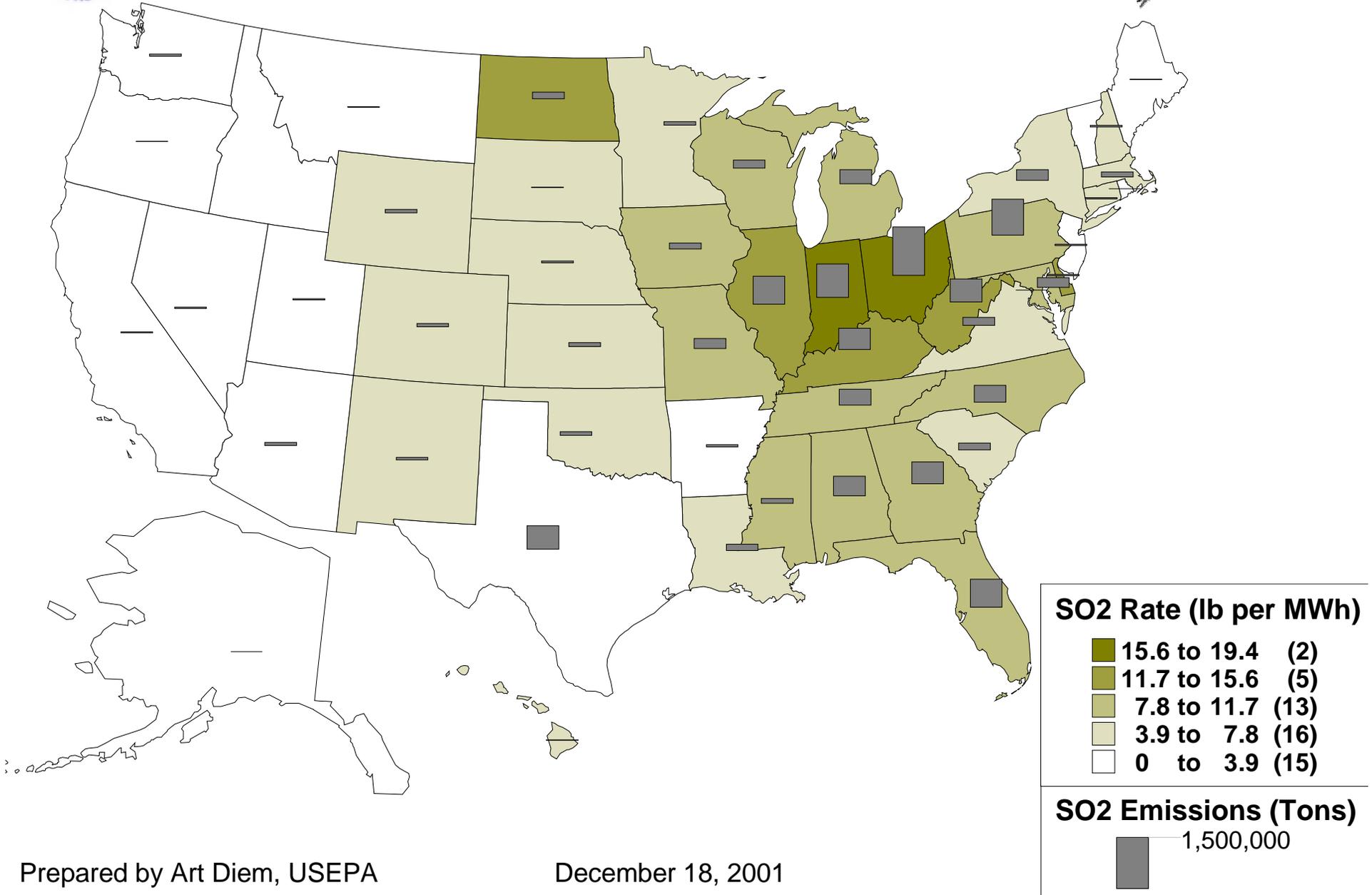


Prepared by Art Diem, USEPA

December 18, 2001

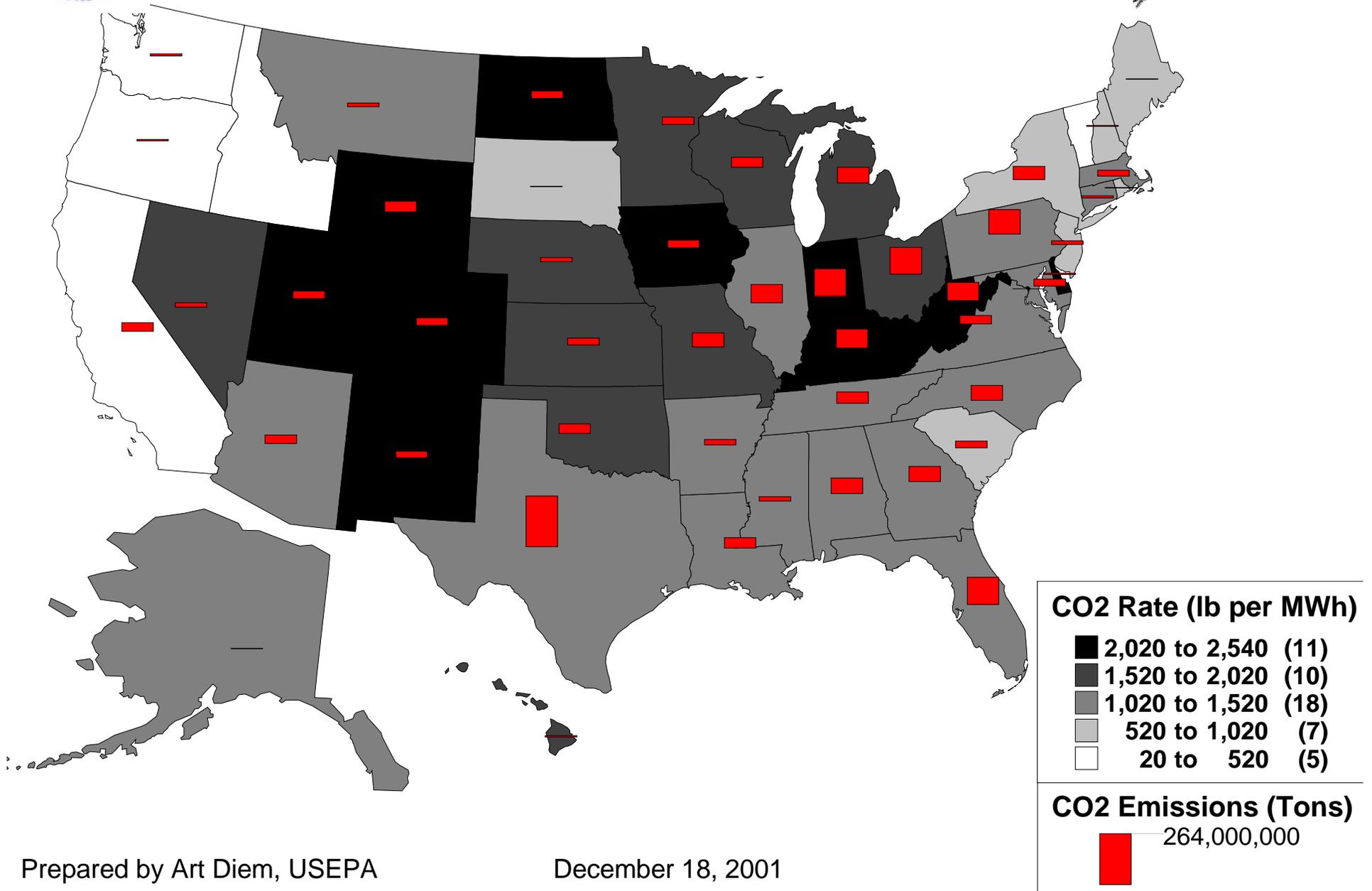


1998 SO₂ Emissions/Rates





1998 CO₂ Emissions & Rates **E[⚡]GRID**

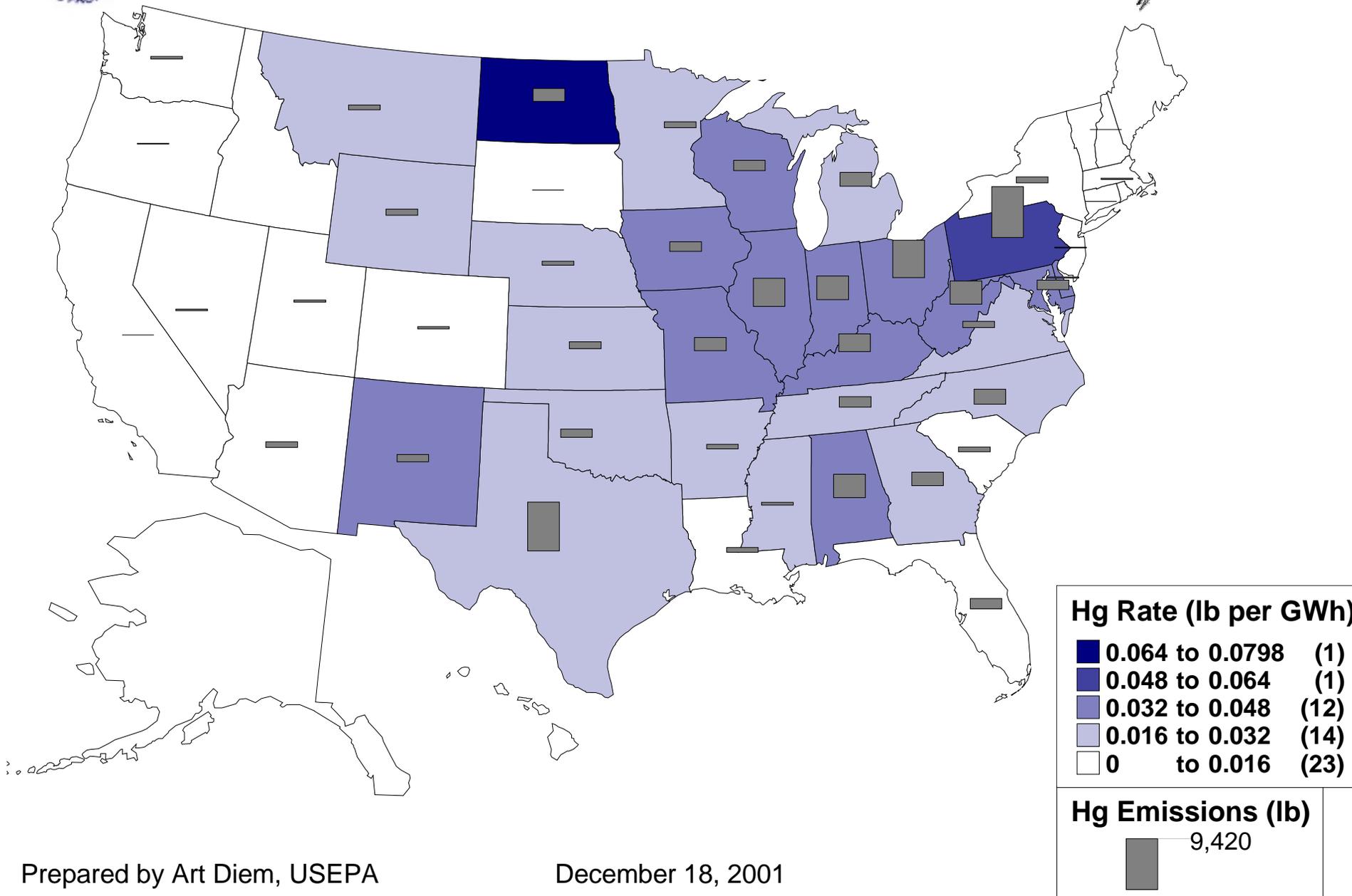


Prepared by Art Diem, USEPA

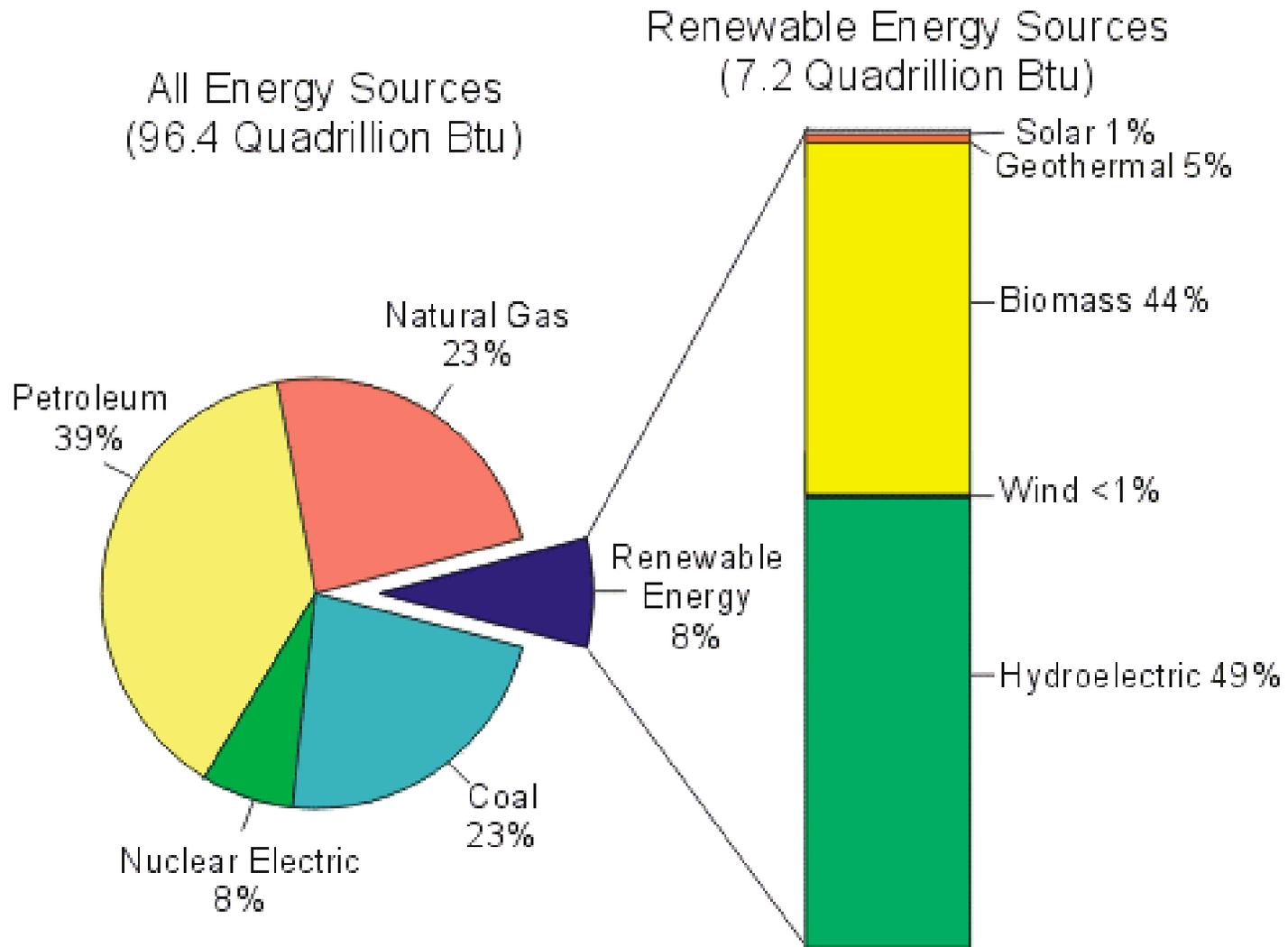
December 18, 2001



1998 Hg Emissions/Rates



U.S. Energy Consumption by Source, 1999

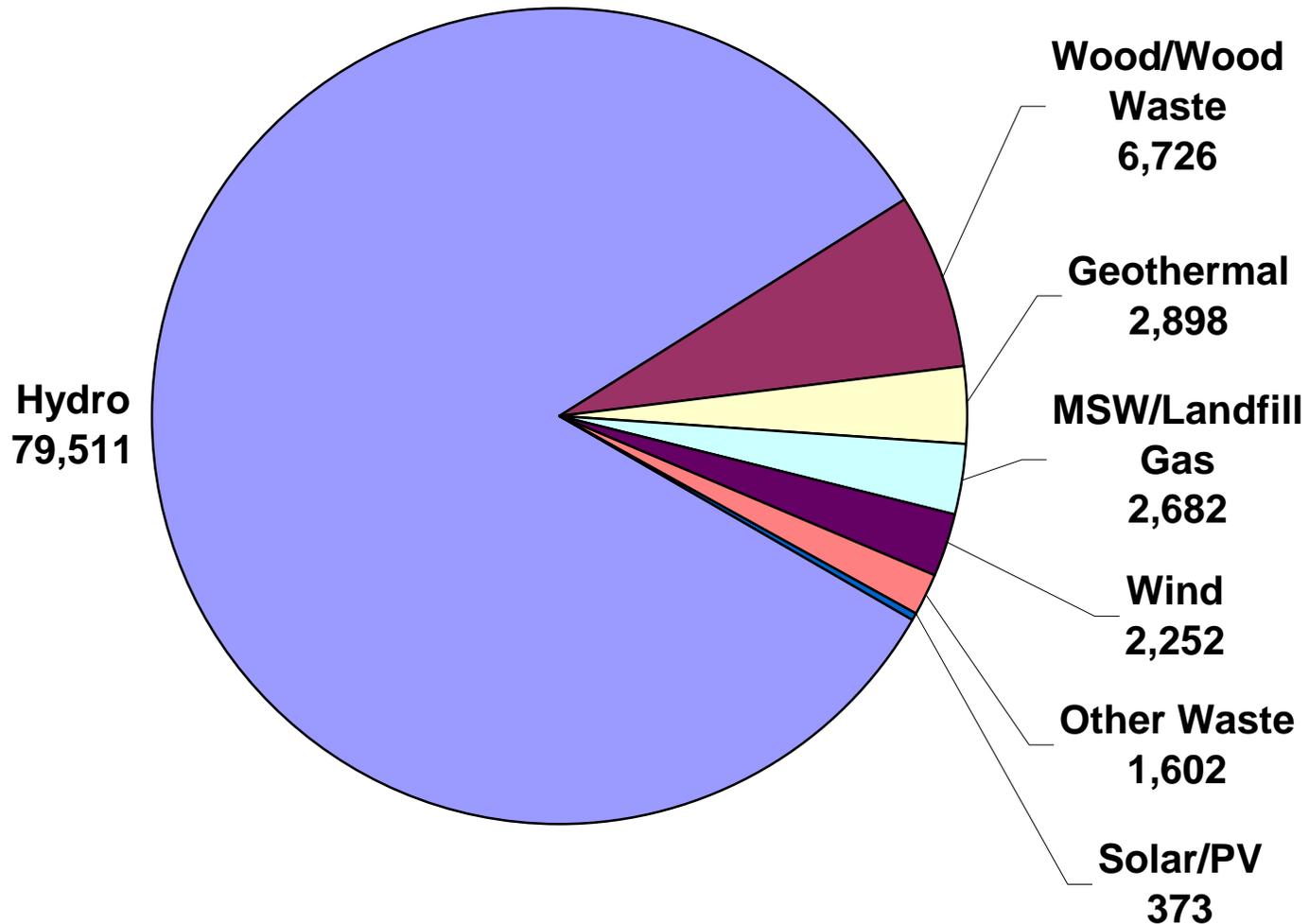


Totals may not equal sum of components due to independent rounding.

Source: EIA

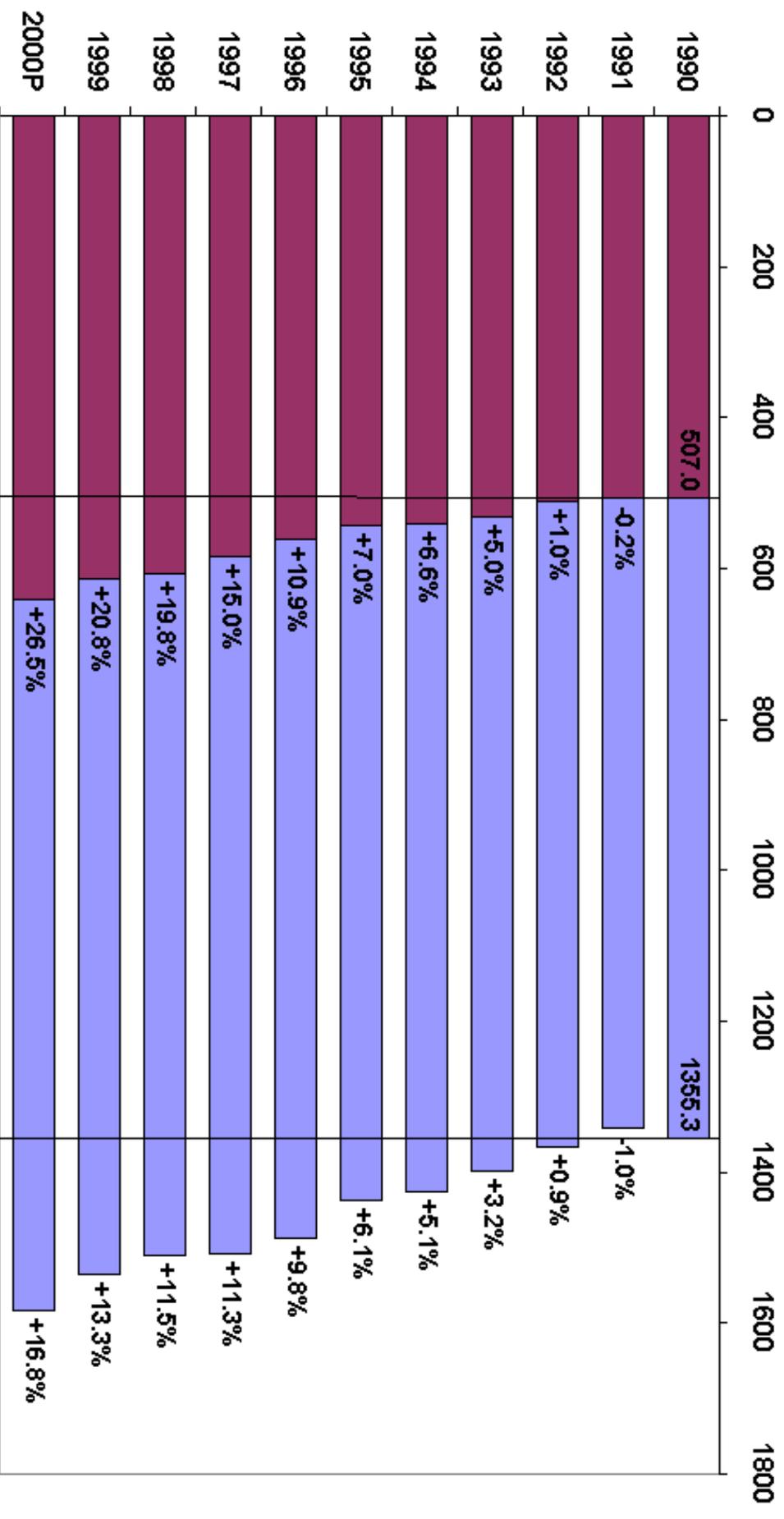
http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/fig1.gif

1999 Renewable Electric Power Net Summer Capability (Megawatts)



Source: http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/tablec14.html

Million Metric Tons of Carbon Equivalent



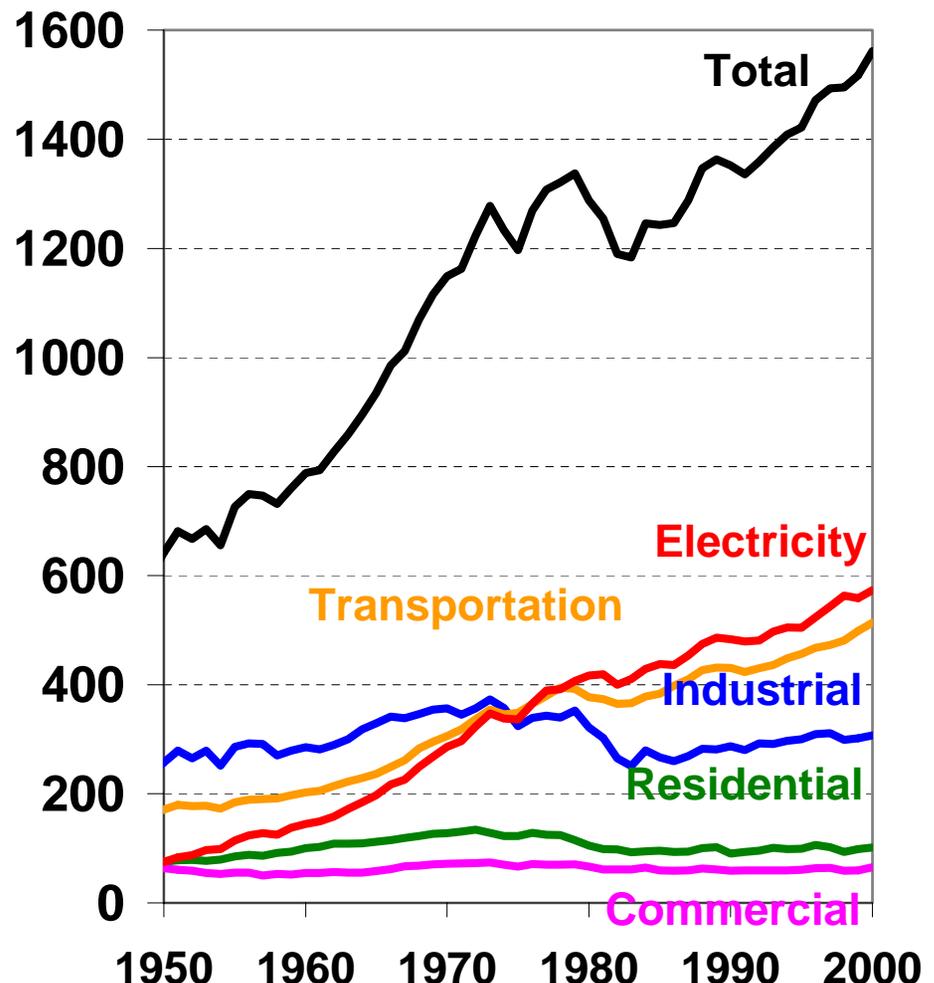
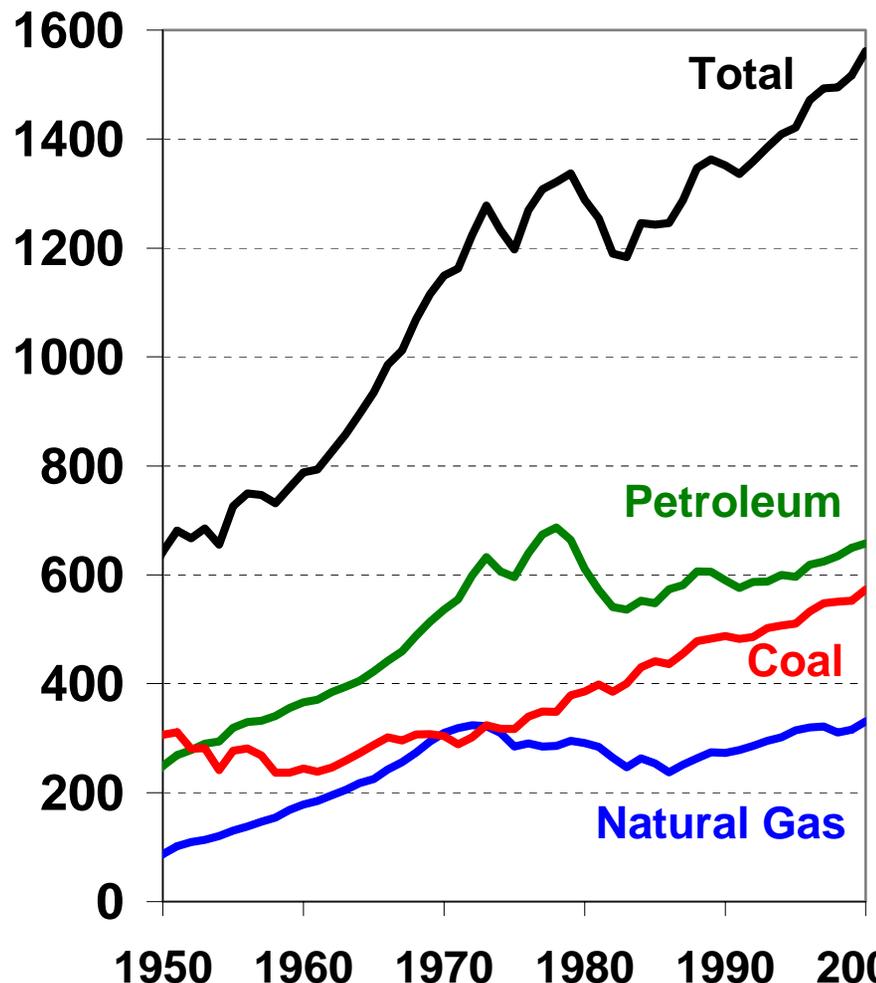
- Total U.S. CO2 Emissions from Energy and Industry
- U.S. CO2 Emissions from Electric Power Sector Consumption

Source: <http://ftp.eia.doe.gov/pub/oiat/1605/cdrom/pdf/ggrpt/057300.pdf>

Prepared by Art Diem 11/13/2001

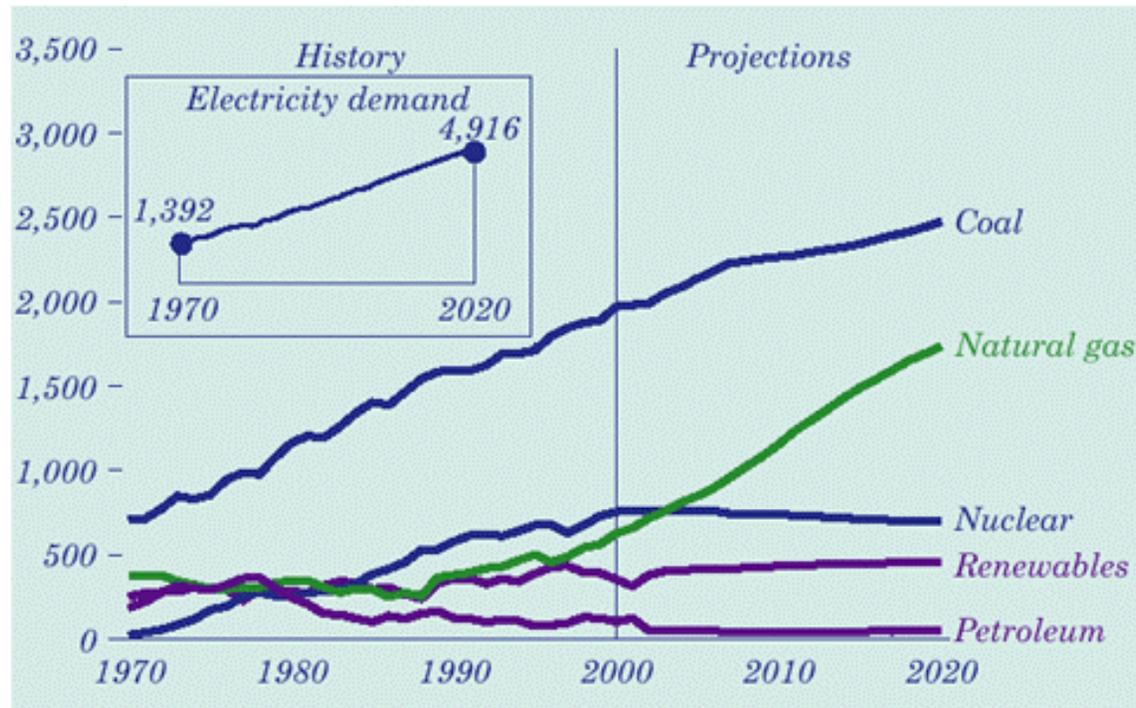
U.S. Carbon Dioxide Emissions from Fossil Fuel Combustion

Million Metric Tons of Carbon Equivalent



Source: Energy Information Administration/Emissions of Greenhouse Gases in the United States 2000
<http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/appendixe.pdf>

**Figure 4. Electricity generation by fuel, 1970-2020
(billion kilowatthours)**



History: Energy Information Administration (EIA), Form EIA-860B, "Annual Electric Generator Report— Nonutility"; EIA, *Annual Energy Review 2000*, DOE/EIA- 0384(2000) (Washington, DC, August 2001); and Edison Electric Institute. **Projections:** Table A8.

Conclusion

Innovative Policies + Innovative Analysis =
Better Planning for Air Quality and
Greenhouse Gas emissions

Considerable momentum is occurring:
technologies, policies and analysis