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What Next for National Renewable Energy Policy?

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February 6, 2015
ITAM
Mexico City

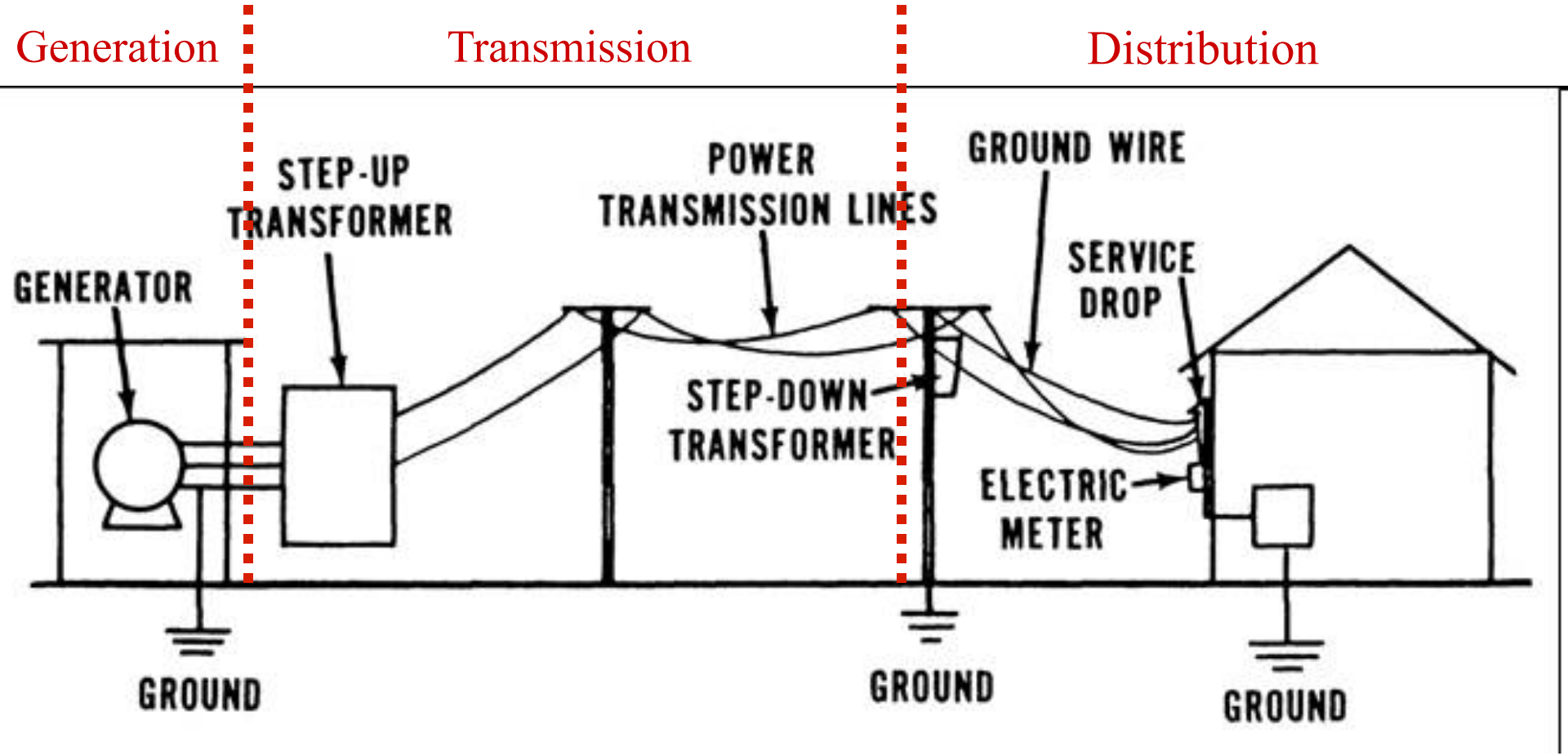
Introduction to Deregulation

Remember the Basics:

- Obligation to serve
- The regulatory compact
  - Monopoly territory in exchange for regulation to ensure that costs stay down, service remains reliable, and public policy goals can be supported
- Own and control transmission and distribution
- Own or purchase power

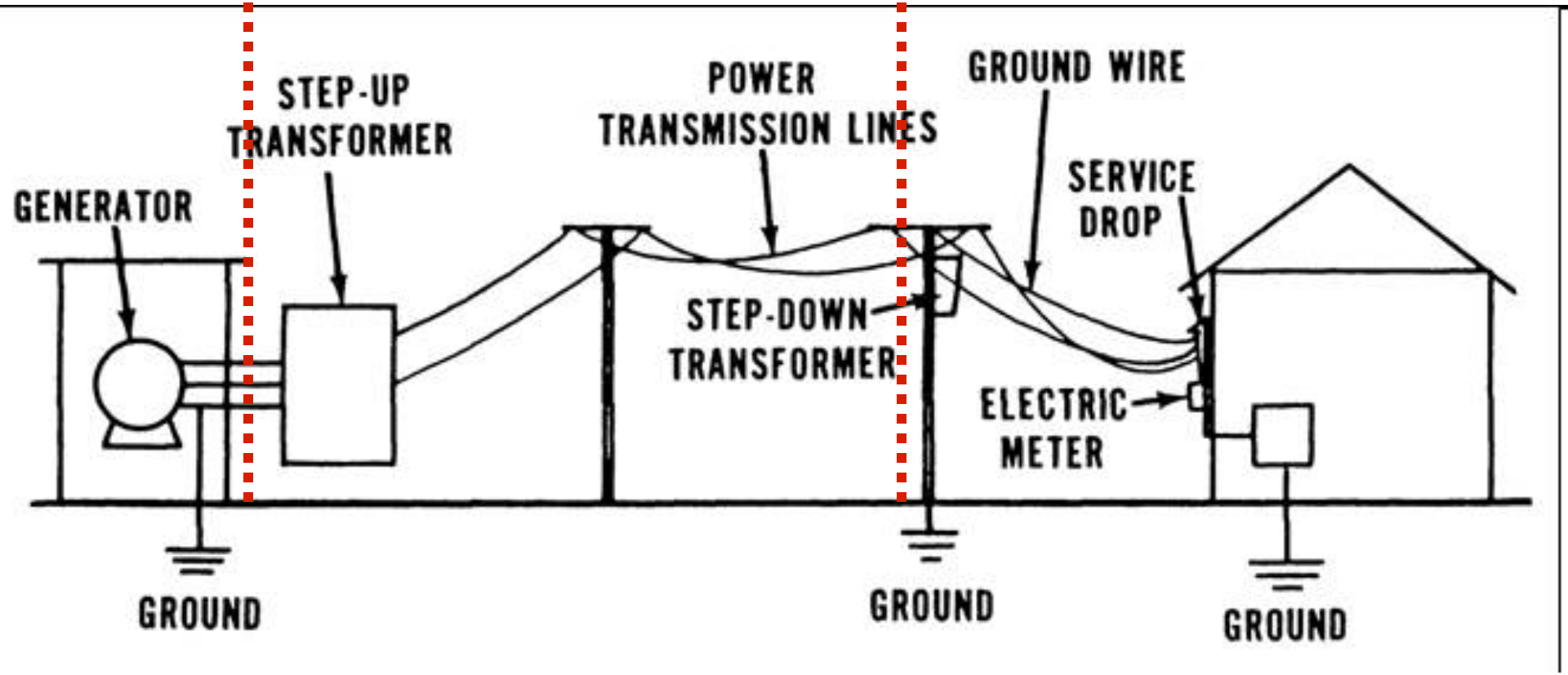

Wholesale


Retail


Generation
Transmission
Distribution
STEP-UP TRANSFORMER
POWER TRANSMISSION LINES
GROUND WIRE
GENERATOR
SERVICE DROP
STEP-DOWN TRANSFORMER
ELECTRIC METER
GROUND
GROUND
GROUND

Wholesale

Generation | Transmission | Distribution



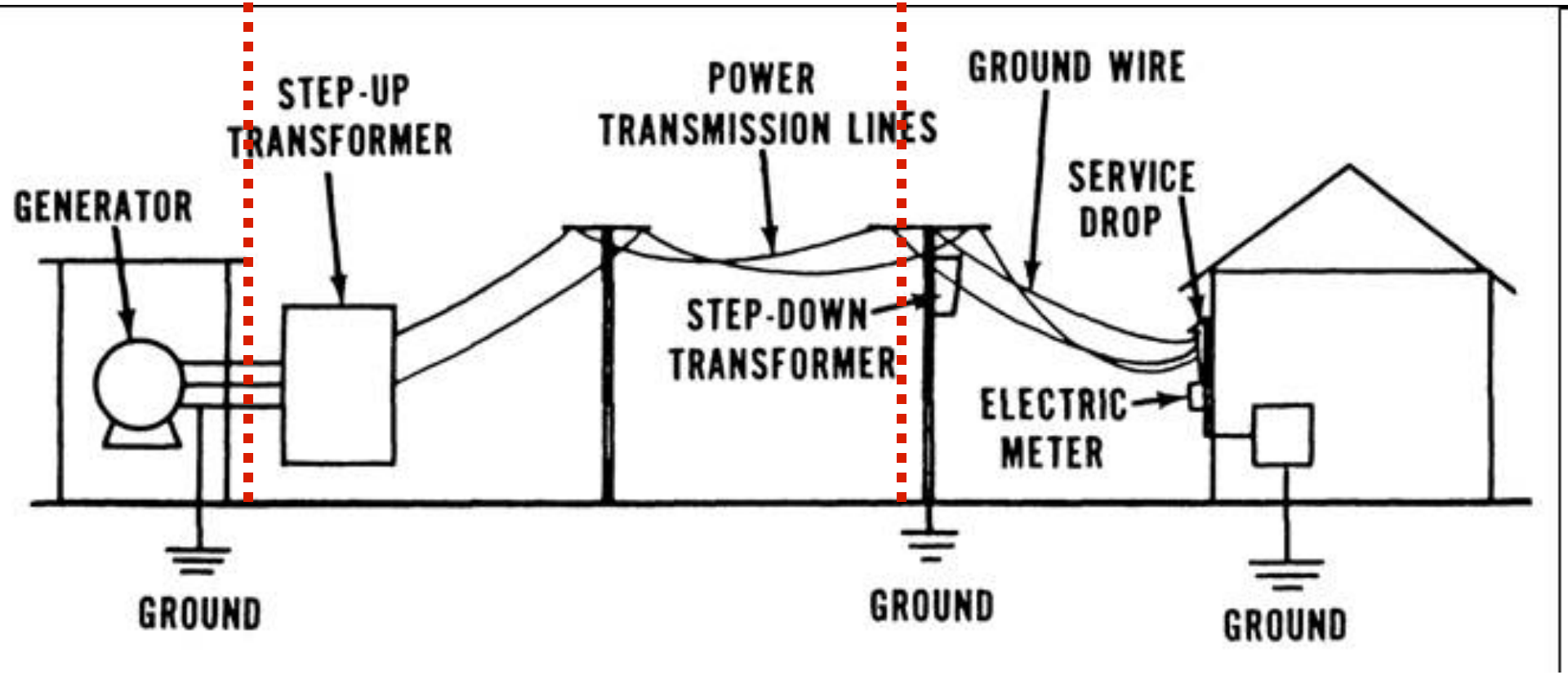
Wholesale

Retail

Generation

Transmission

Distribution



Wholesale

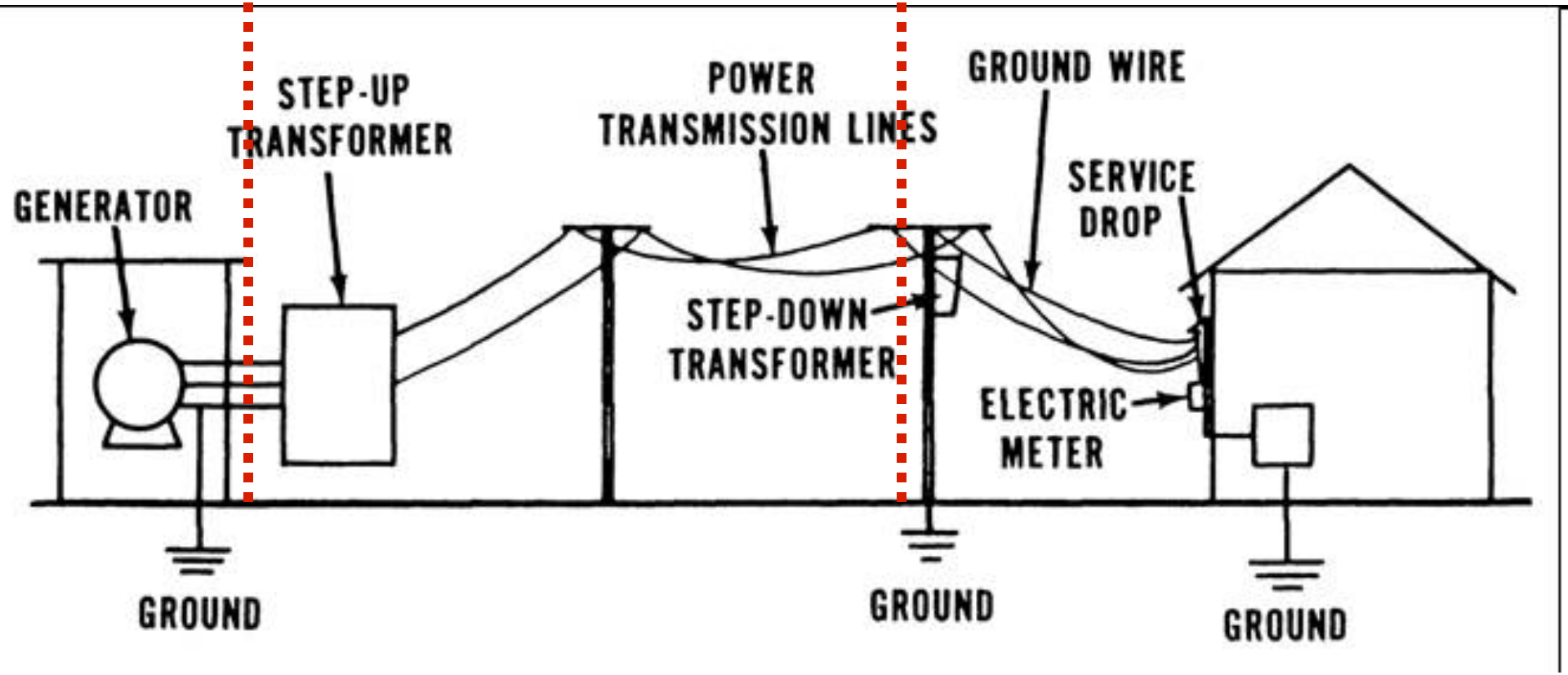
?

Retail

Generation

Transmission

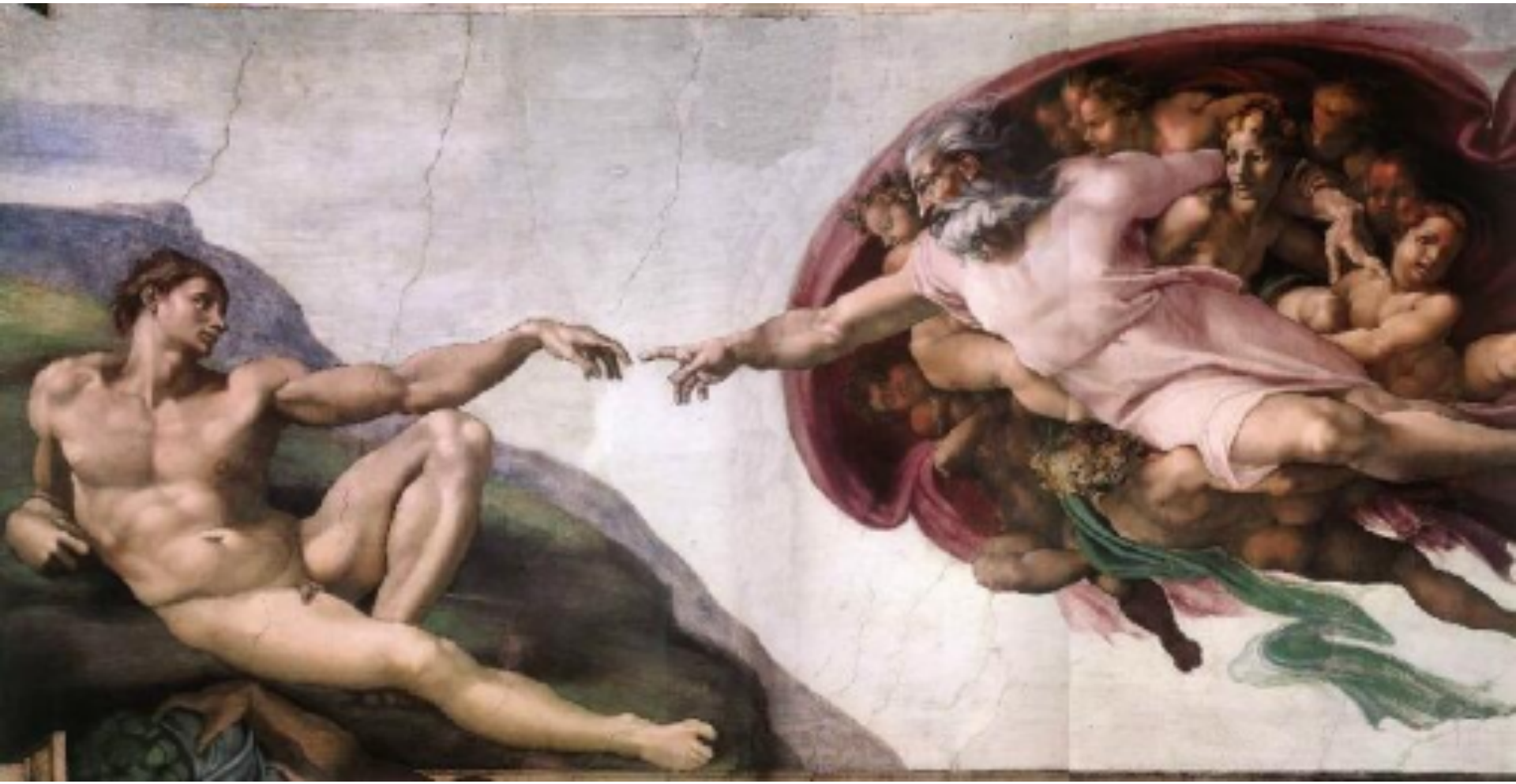
Distribution



What might change with deregulation?

- The obligation to serve by providing power disappears
- The regulatory compact does not apply to selling power
- The utility no longer is responsible to keep the system in balance
- The hope: price signals will motivate profit-seekers to build generation as needed

In the beginning…the states created the utilities.



The federal government can get involved where it finds a federal interest.

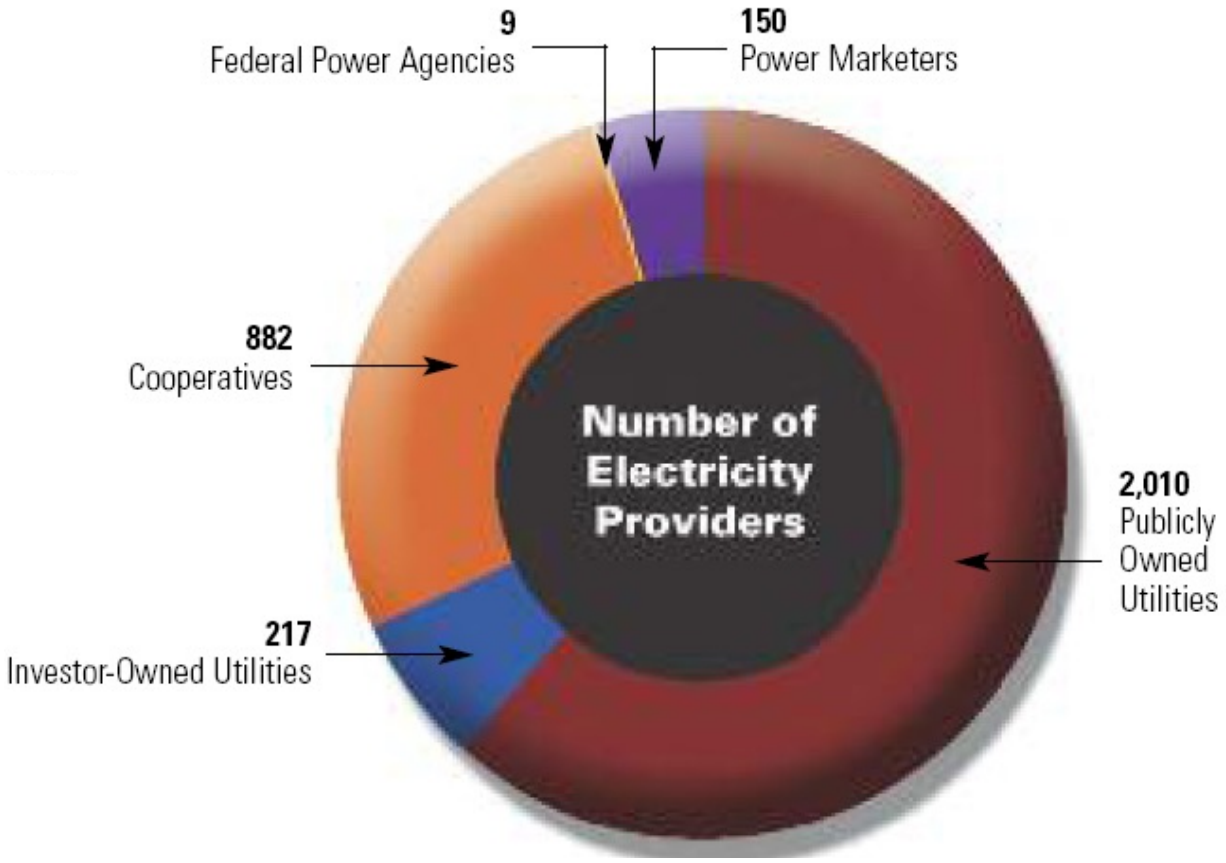
States

- Land Use
- Police Powers
- Infrastructure

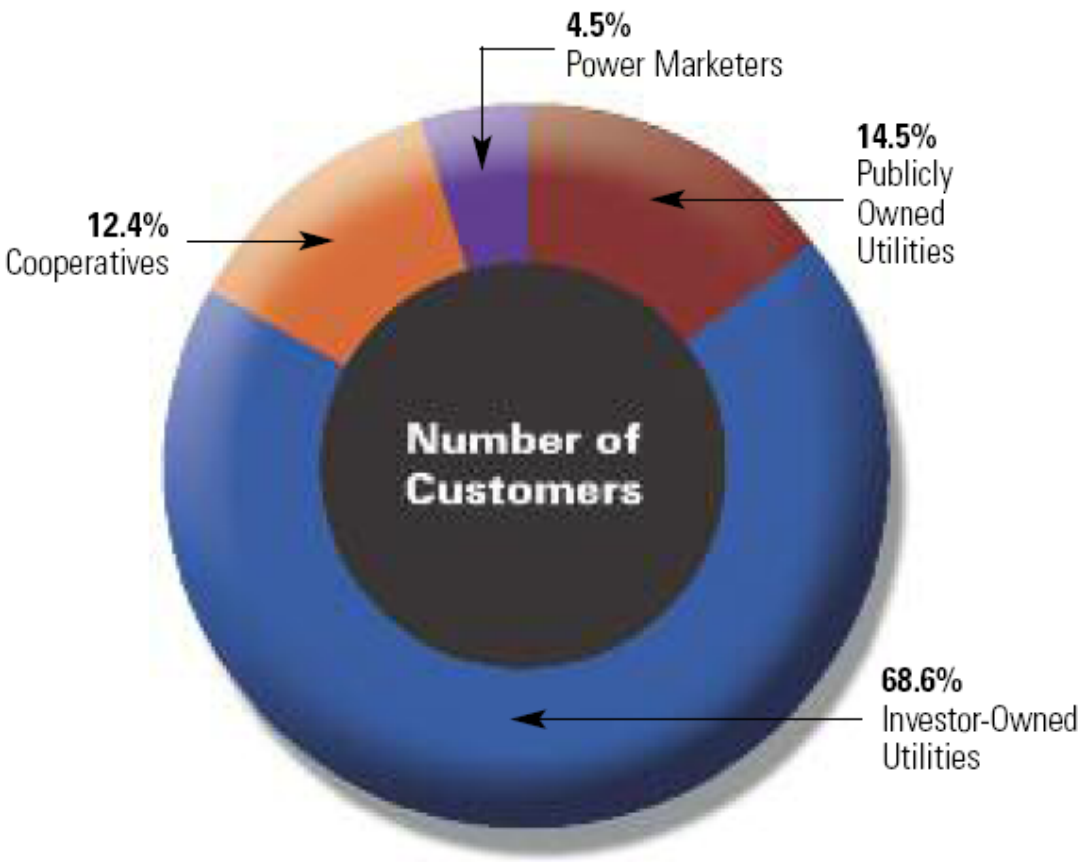
Feds

- Federal Lands
- International Projects
- Interstate Commerce

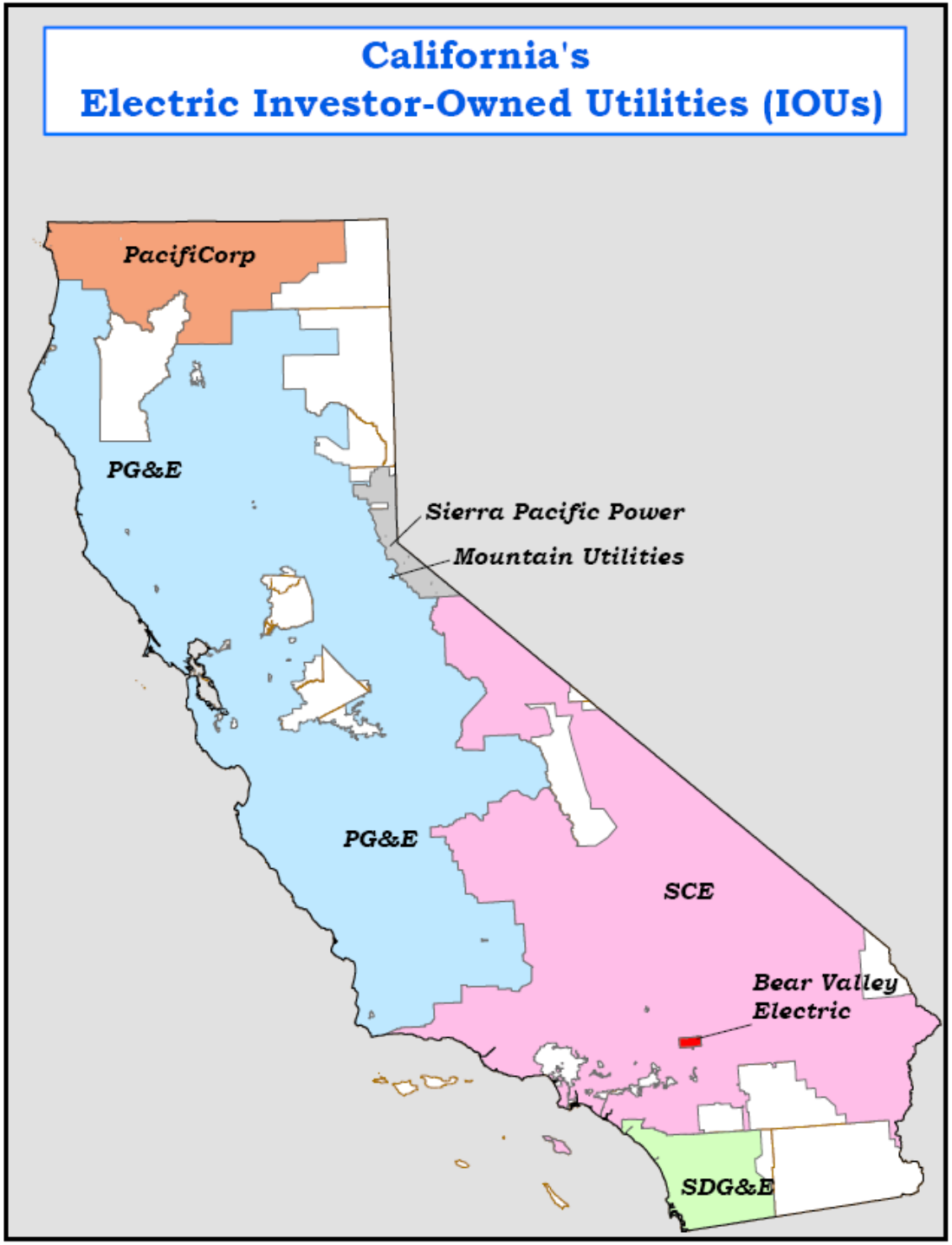
The Nature of Ownership



The Distribution of Customers



California's Electric Investor-Owned Utilities (IOUs)

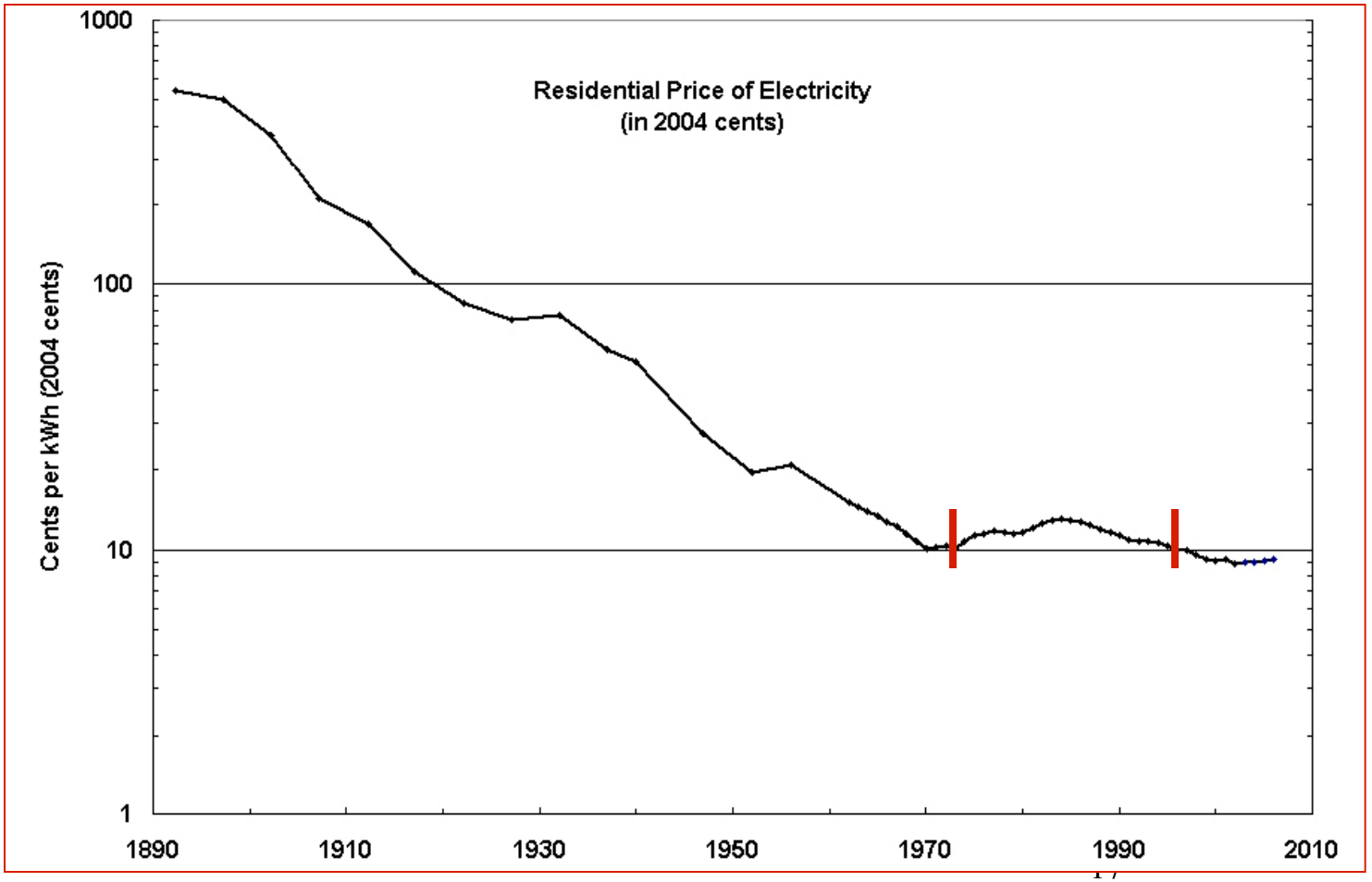


Deregulation Precursors

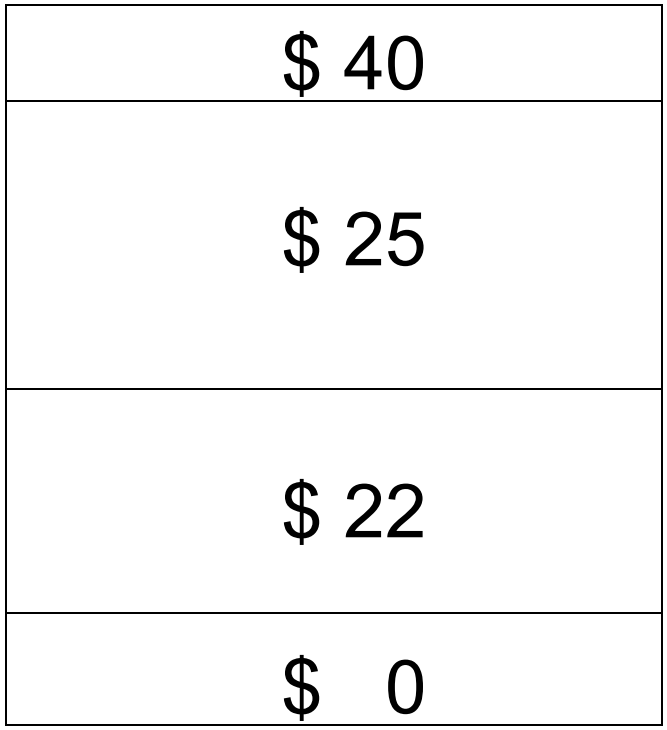
- Public Utilities Regulatory Policy Act 1978
- Energy Policy Act 1992
- High prices
  - Inflation
  - QFs
  - Nuclear Plants
- Change in power plant economics

Residential Electric Prices Over Time

Source: Carnegie Mellon 2005

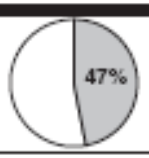
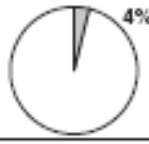


The Bid Stack



Market Clearing Price: $40/mwh

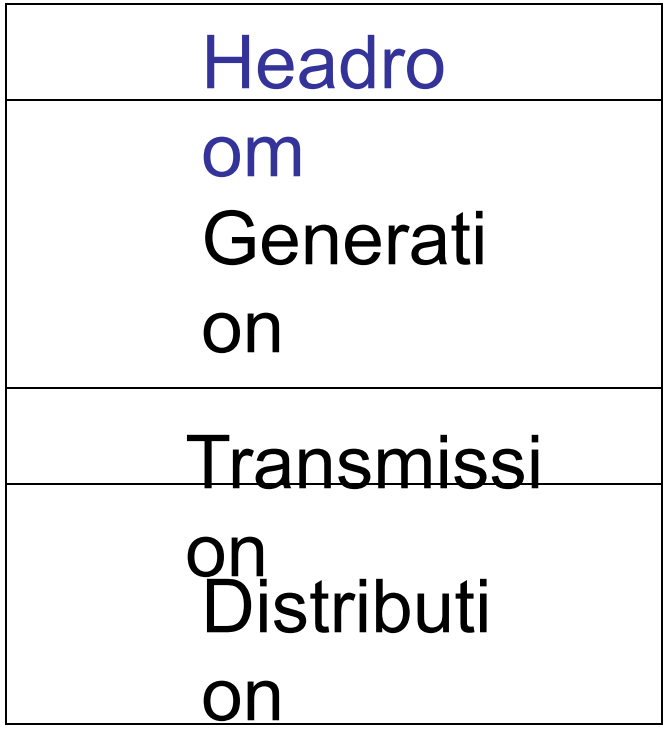
Typical Breakdown of Costs in New England

Distribution costs[a] ($68.90/MWh) Reflect the cost of building the distribution system, as well as operating and maintaining it	
Wholesale energy price[b] ($66.32/MWh) Reflects a market-determined price for energy (electricity) that includes an energy, congestion, and loss component	
Out-of-market payments (reliability payments)[b] ($5.41/MWh) Reflect nonmarket payments to generators that the RTO determines are needed for reliability	
Transmission costs[c] ($3.60/MWh) Reflect the cost of building the transmission system, as well as operating and maintaining it	
Capacity costs[b] ($1.44/MWh) Reflect a market-determined price for procuring power resources to satisfy the region's future needs	
Ancillary service costs[b] ($1.10/MWh) Reflect the costs associated with providing services to support the reliable operation of the electric grid	
RTO expenses[d] ($0.82/MWh) Reflect the administrative rate charged to ISO New England market participants in 2006 to recover operating and investment expenses	

Source: GAO analysis of information provided by ISO New England.

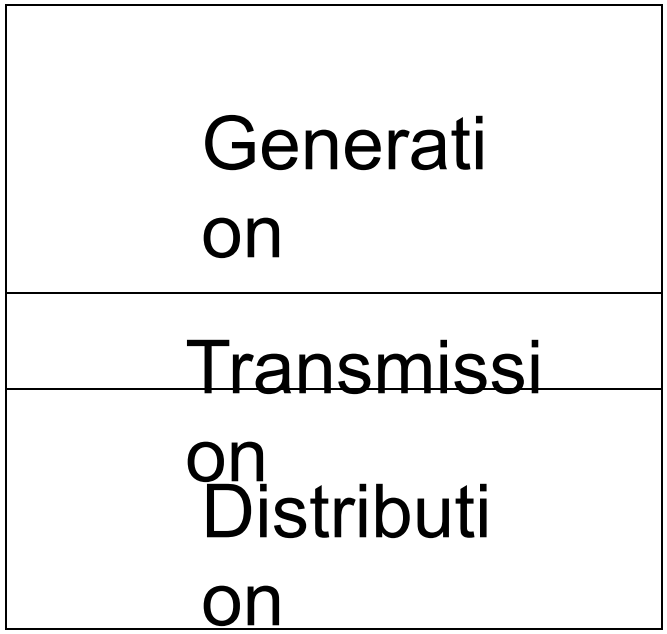
The California Model

Frozen Rate



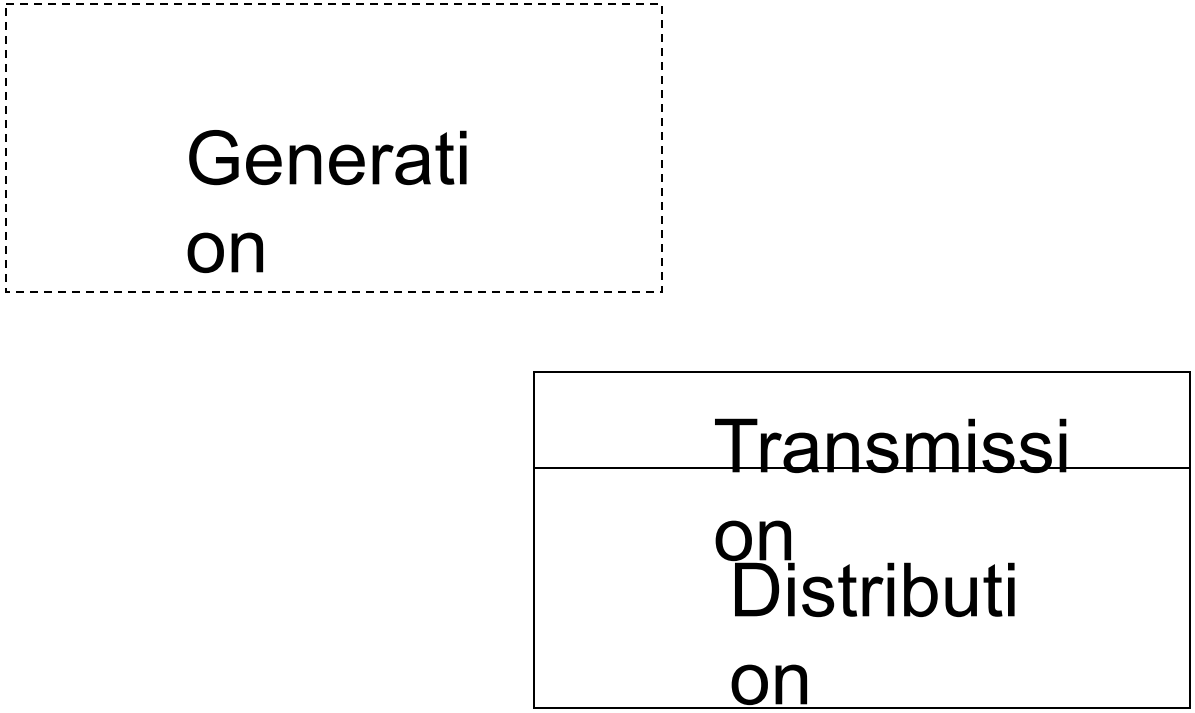
The California Model

After the Freeze

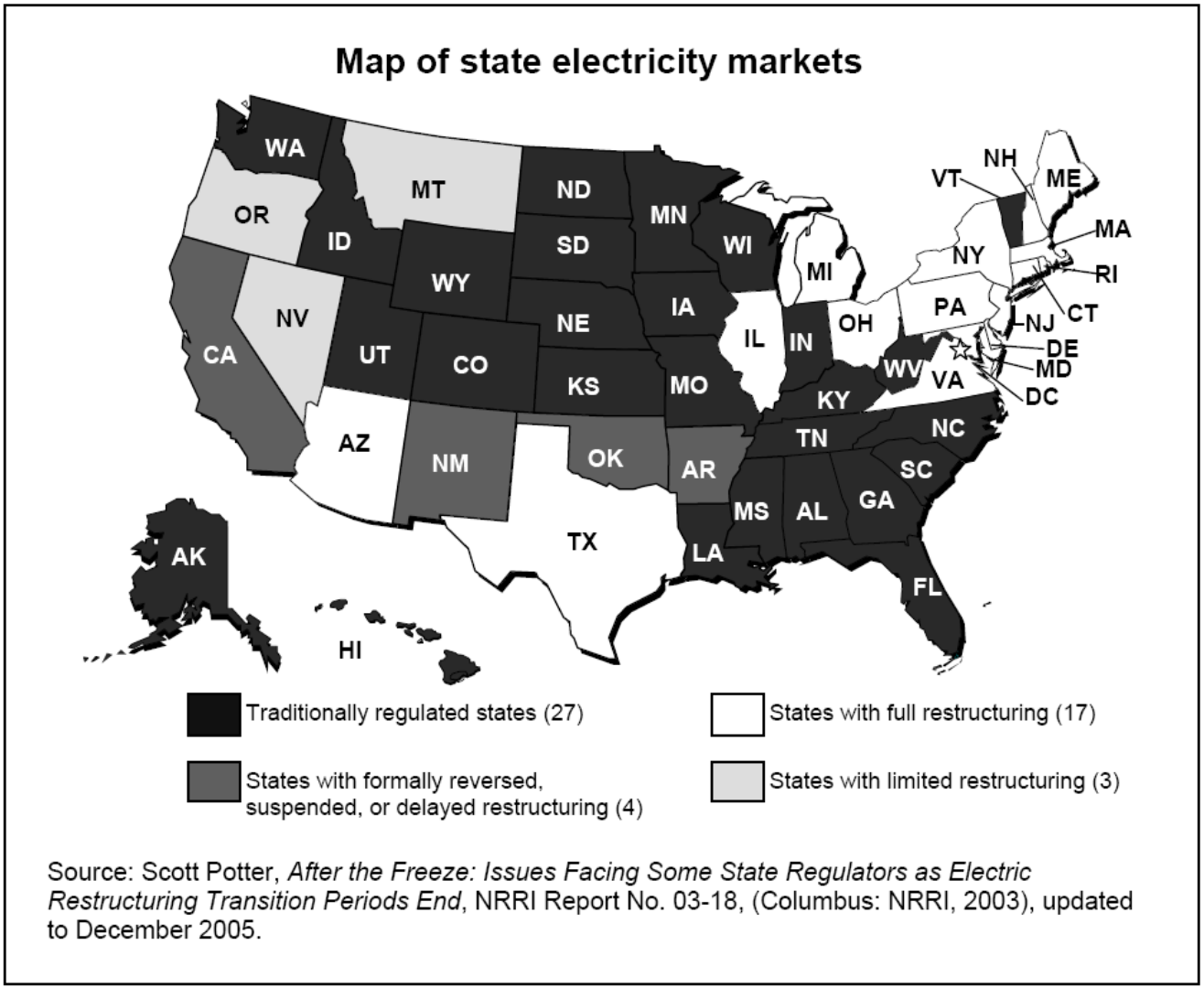


The California Model

Retail Competition

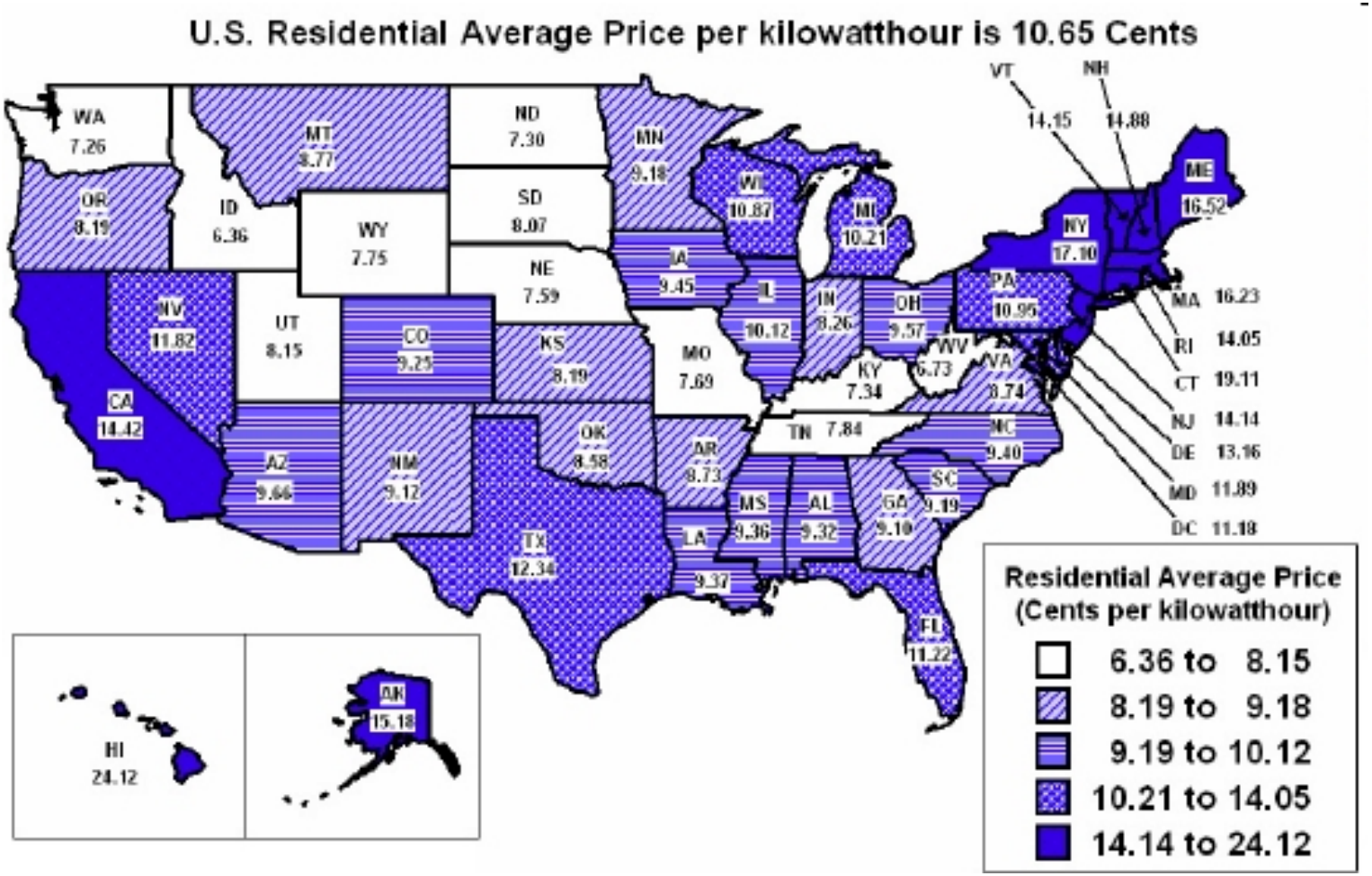


The Status of Deregulation

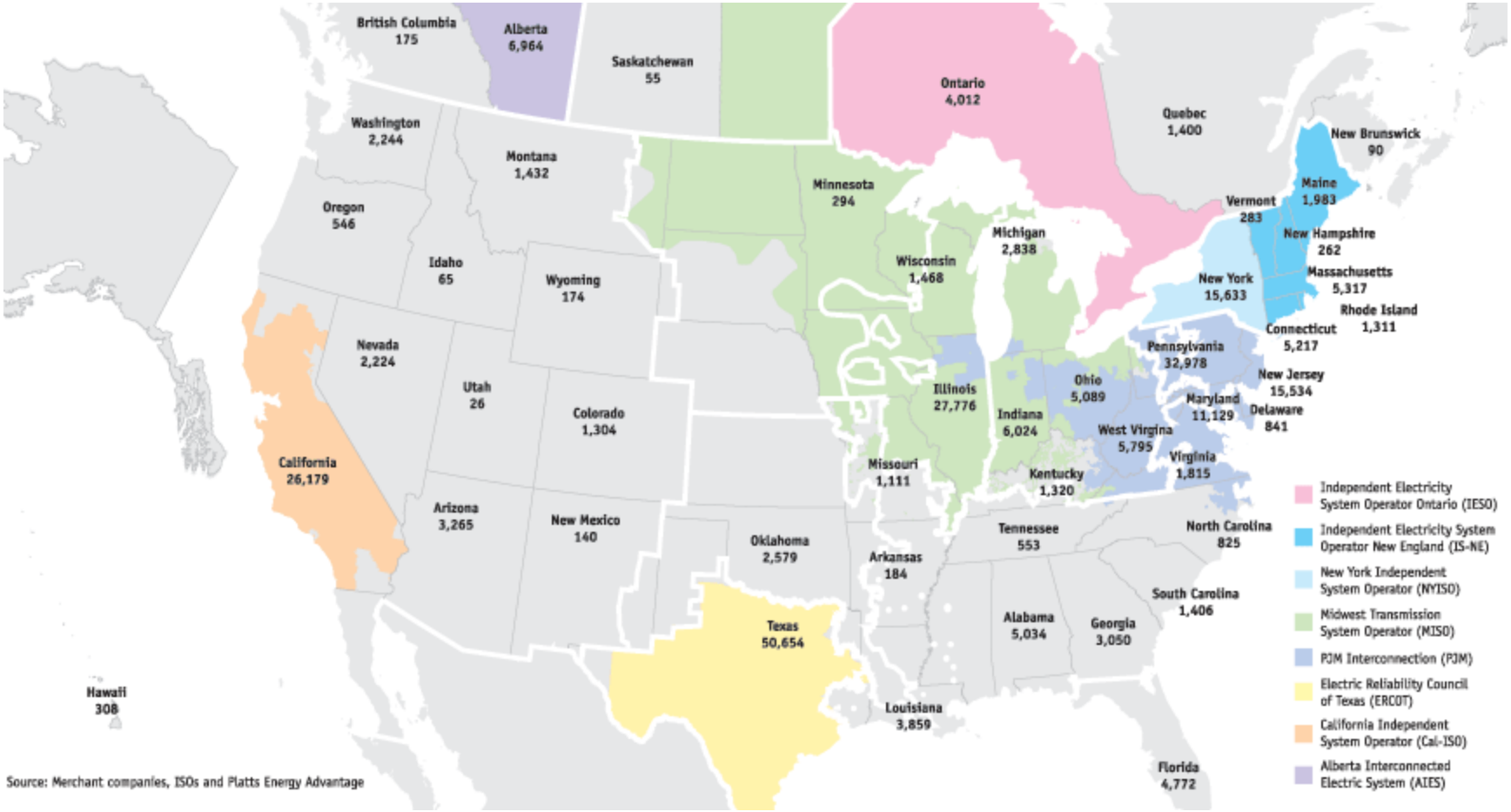


Source: Scott Potter, *After the Freeze: Issues Facing Some State Regulators as Electric Restructuring Transition Periods End*, NRRI Report No. 03-18, (Columbus: NRRI, 2003), updated to December 2005.

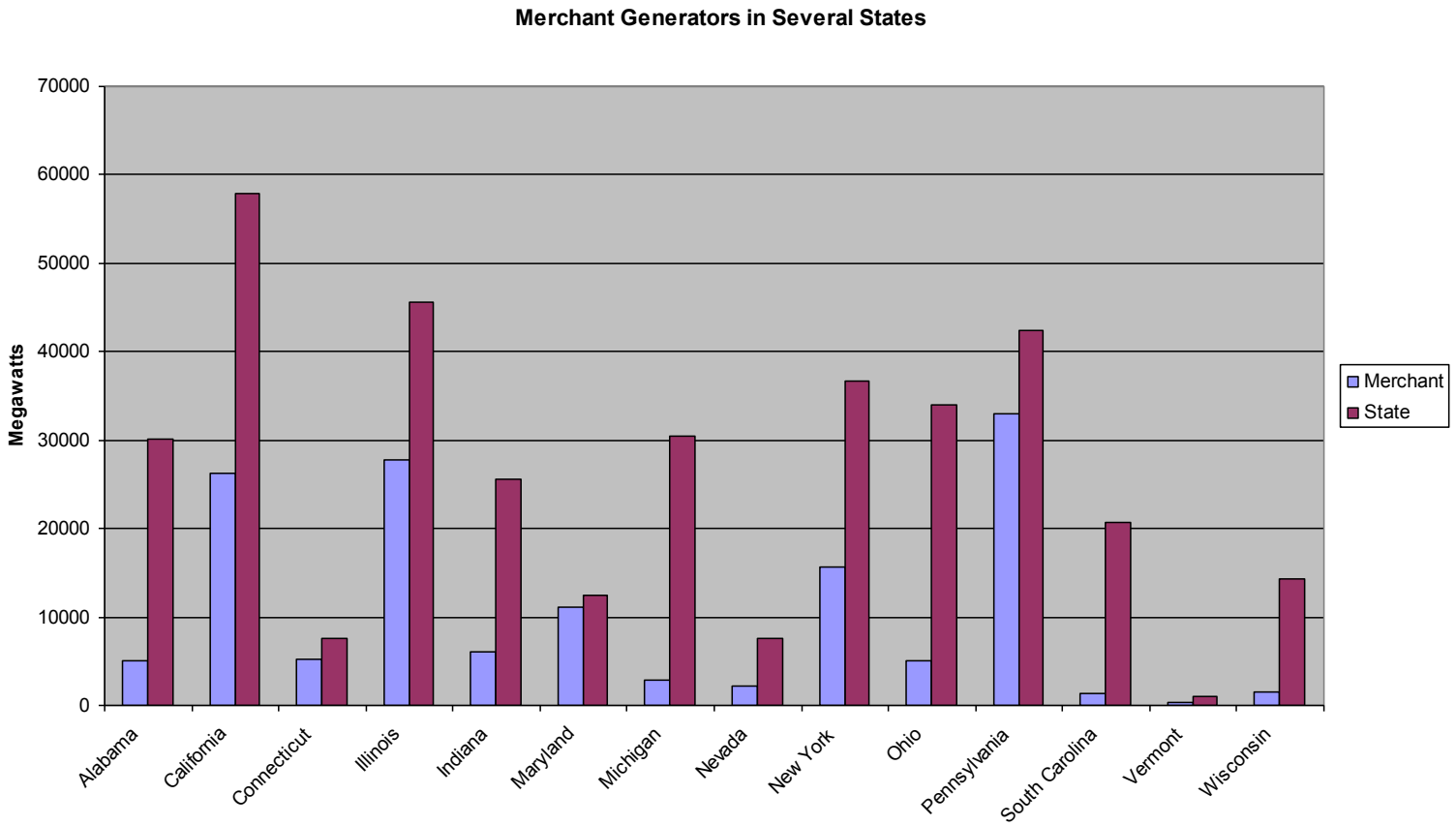
Average Price of Electricity By State



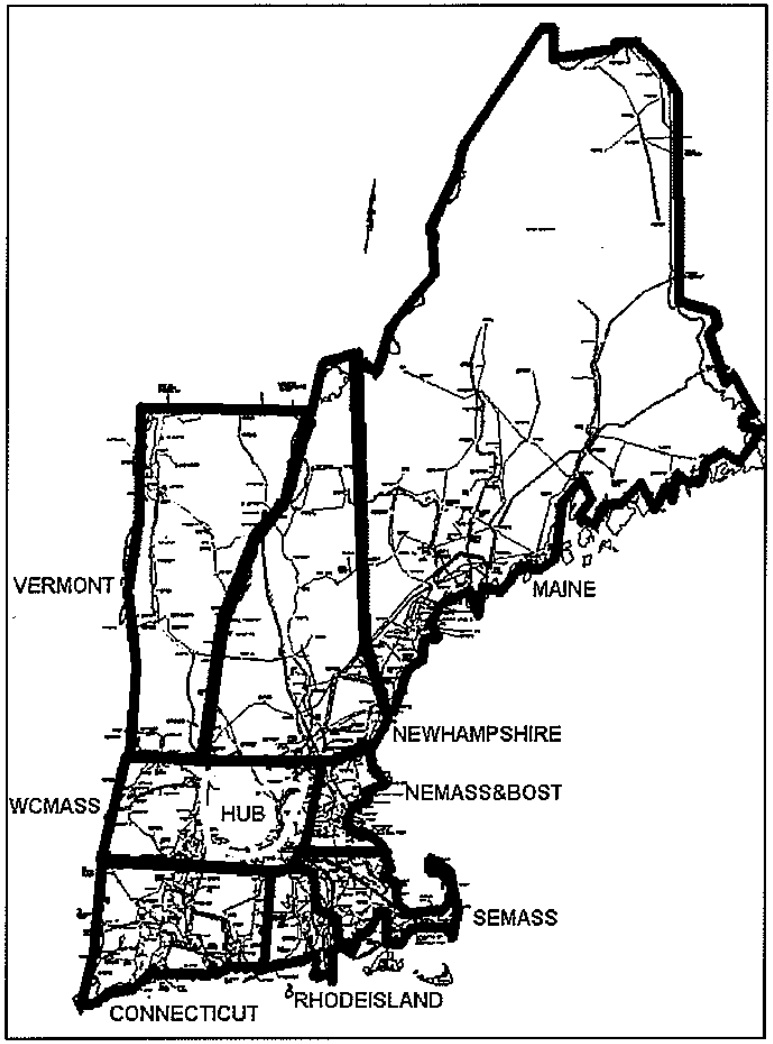
Merchant Power By State and Province



Merchant Generators in Some States



Nodal Zones & Hubs



Why is market power a problem in electricity market?

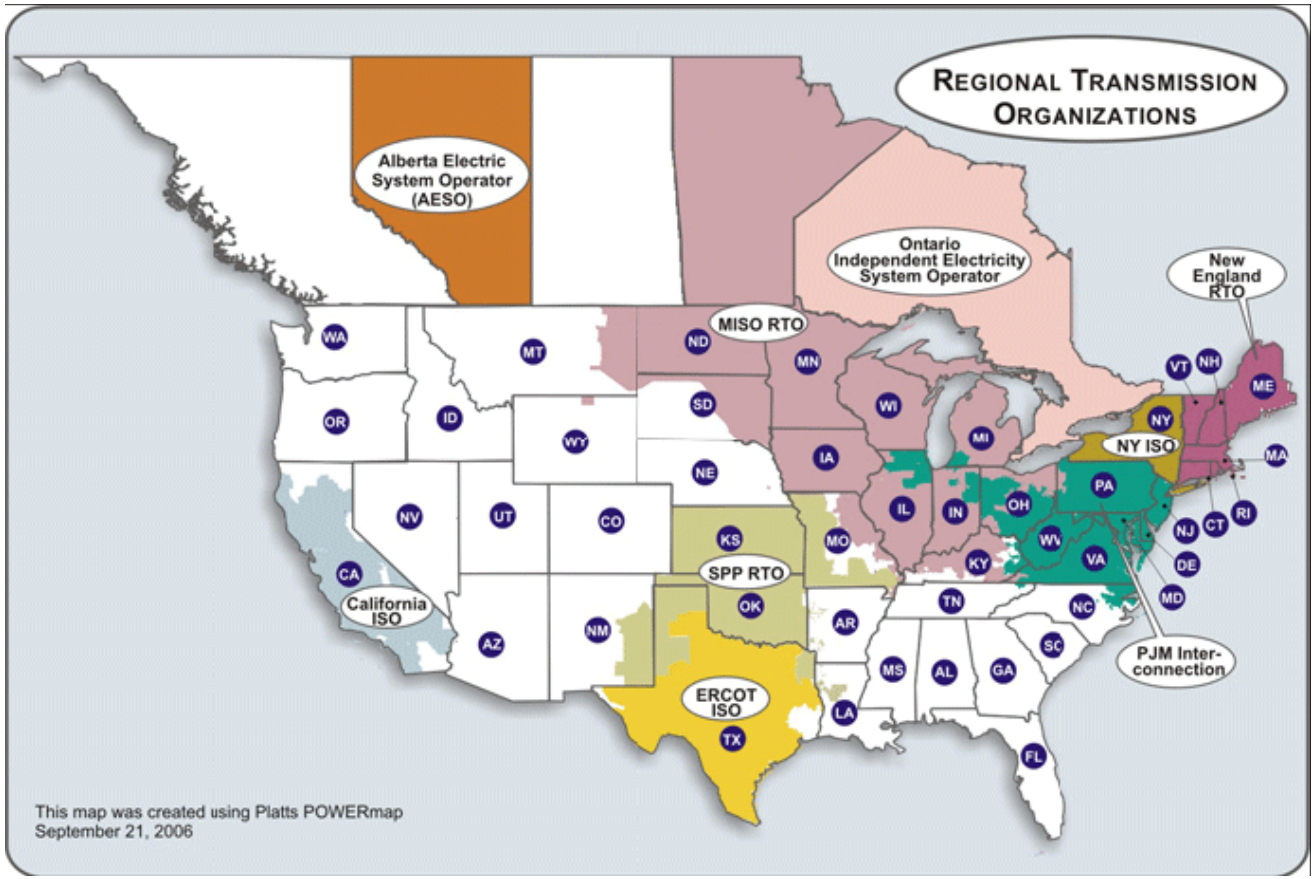
1. Transition from an era when cooperation was appropriate
2. Electricity is a fundamental element of society
3. Physical characteristics:
    - Constrained transmission
    - Requires instantaneous balancing
    - Virtually no storage opportunity

Why is market power a problem in electricity market? (2)

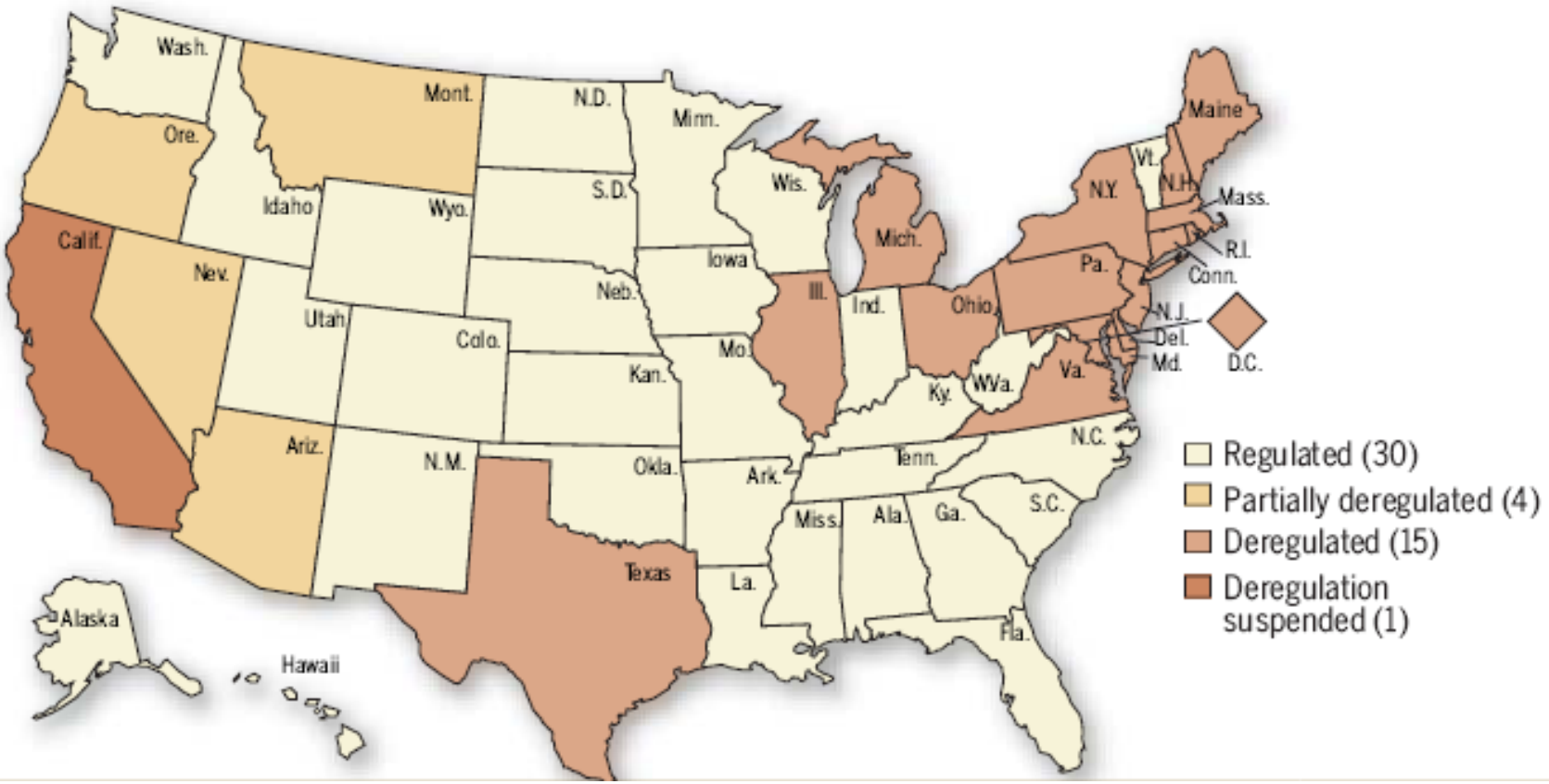
4. A game function, repeated every day, is subject to collusion
5. High barriers to entry
6. Short-run inelasticity of demand

Regional Transmission Organizations

Source: FERC



Status of Deregulation 2006

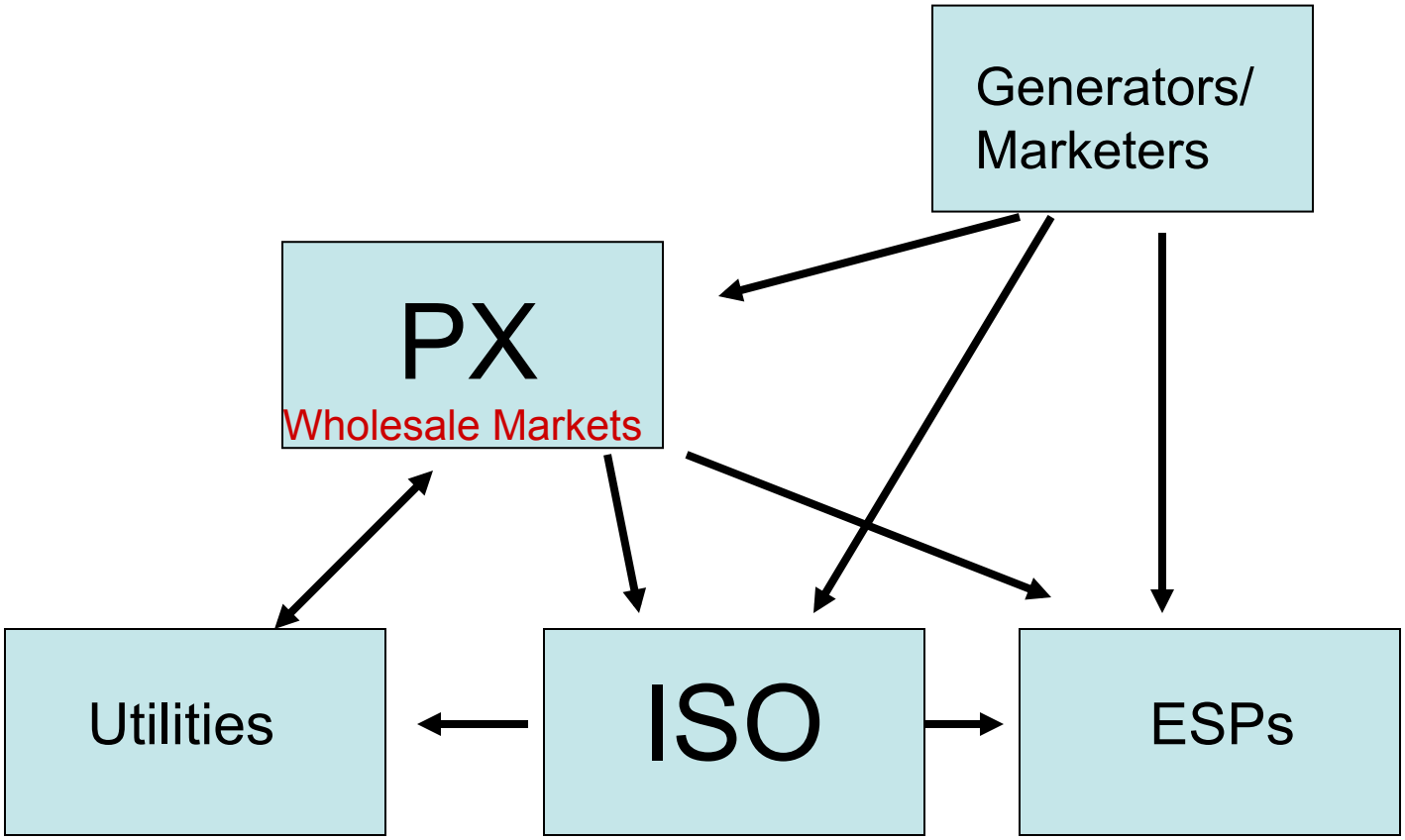


California Deregulation and the Crisis of 2000-2001

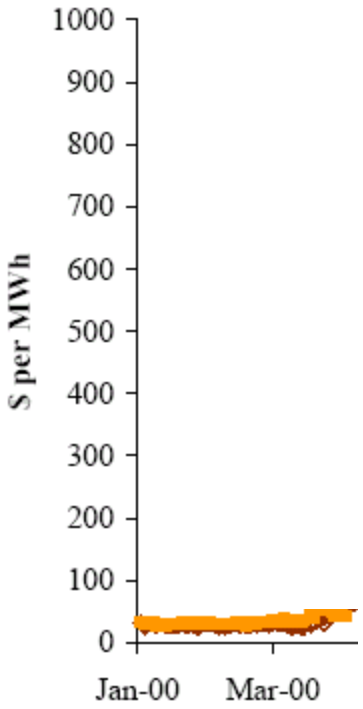
- Utilities sold all gas-fired generating plants
- All generation and retail service open to competition as of March 31, 1998
- All utility power sold into Power Exchange
- All utility load served from Power Exchange
- All purchases day-ahead or hour-ahead
- No long-term contracts
- Retail rates frozen for up to 4 years to allow for recovery of stranded cost

The California Model

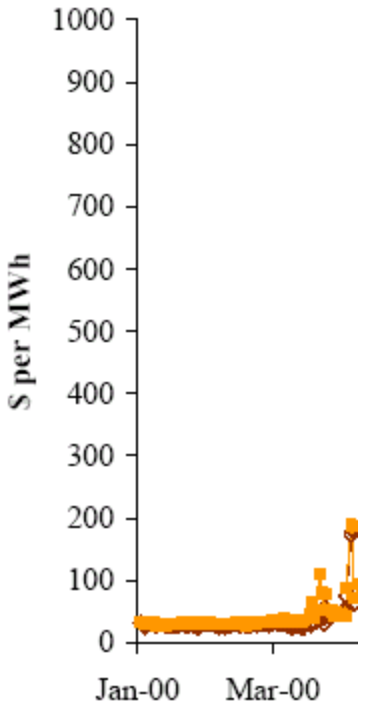
Initial Design



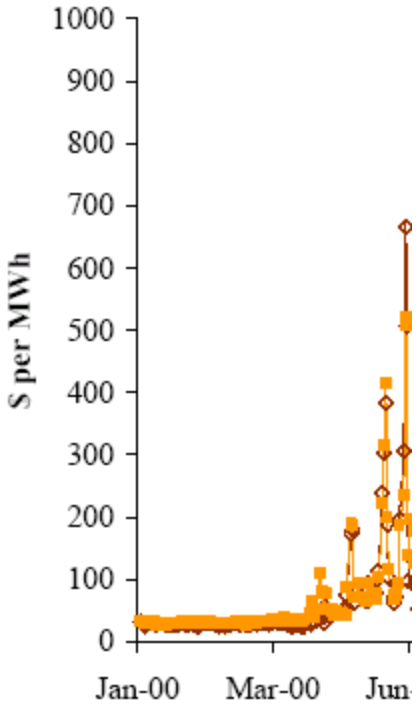
Pretty Cool, Huh?



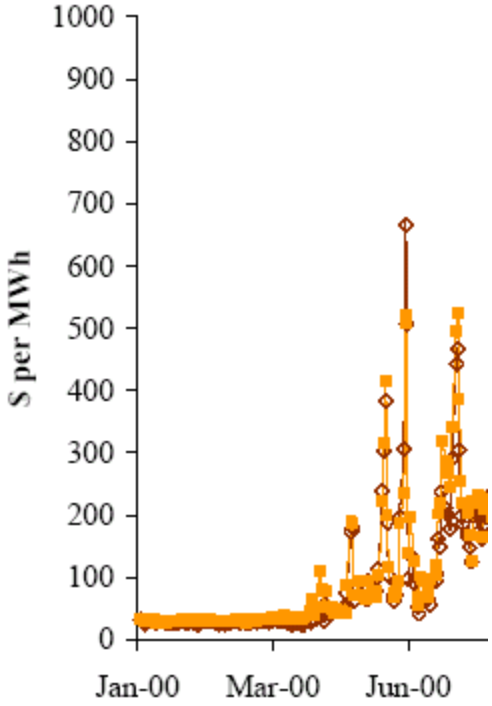
The May Surprise



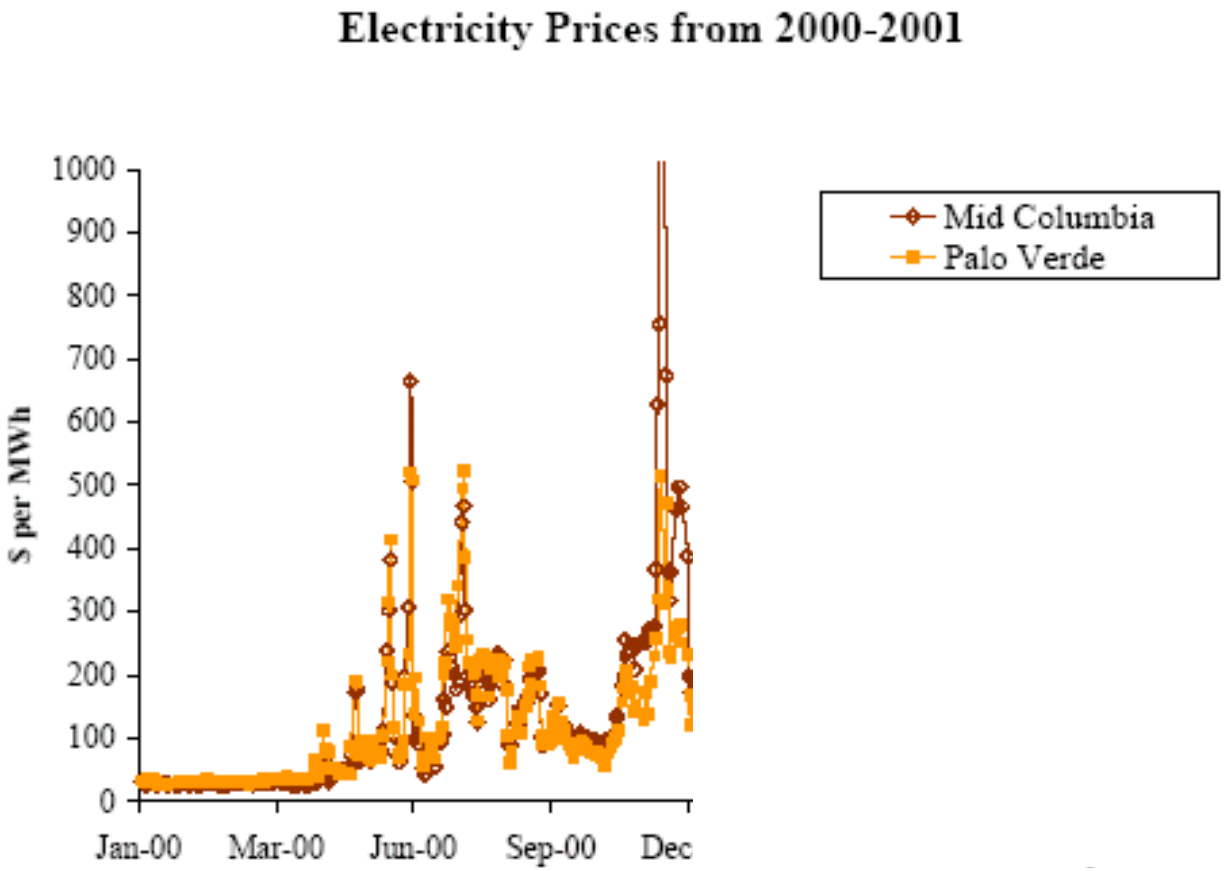
Soaring in June



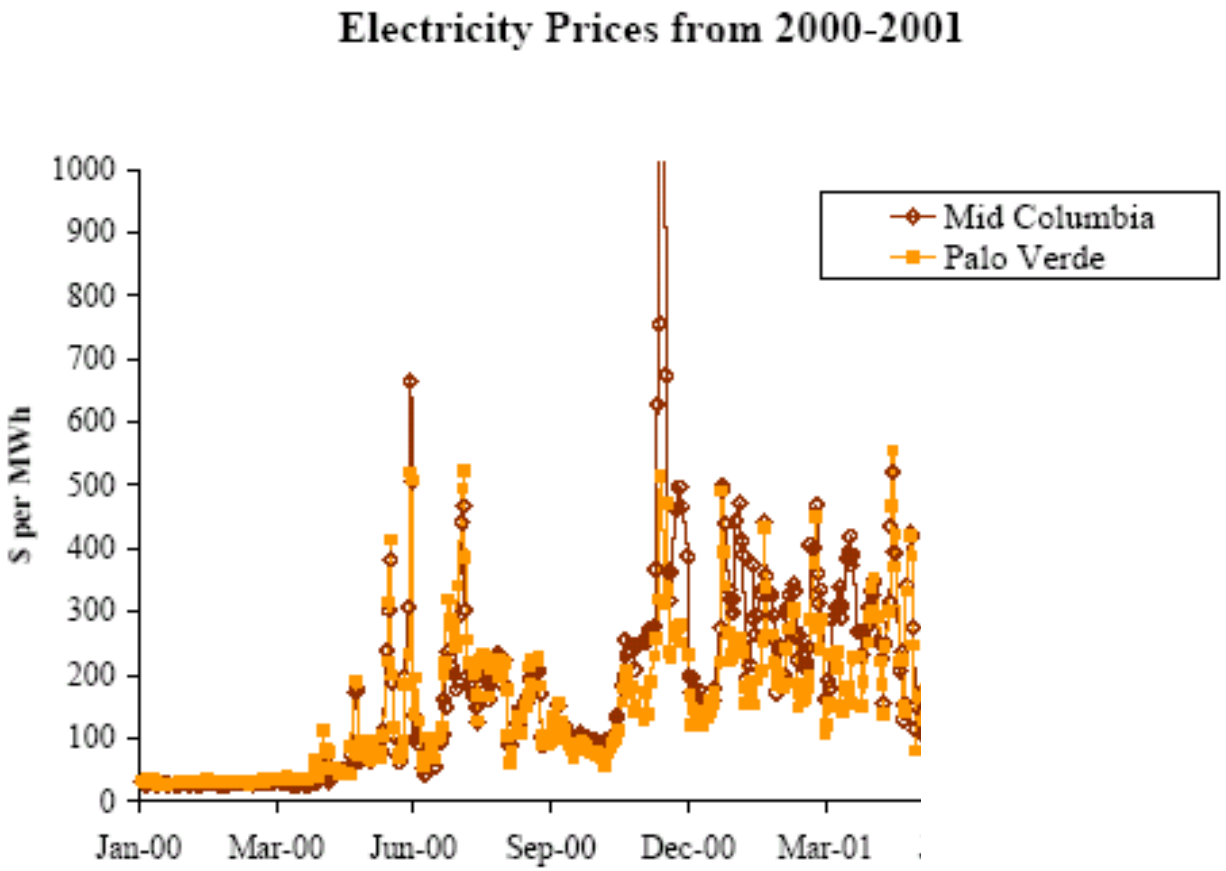
July: We've Got A Problem



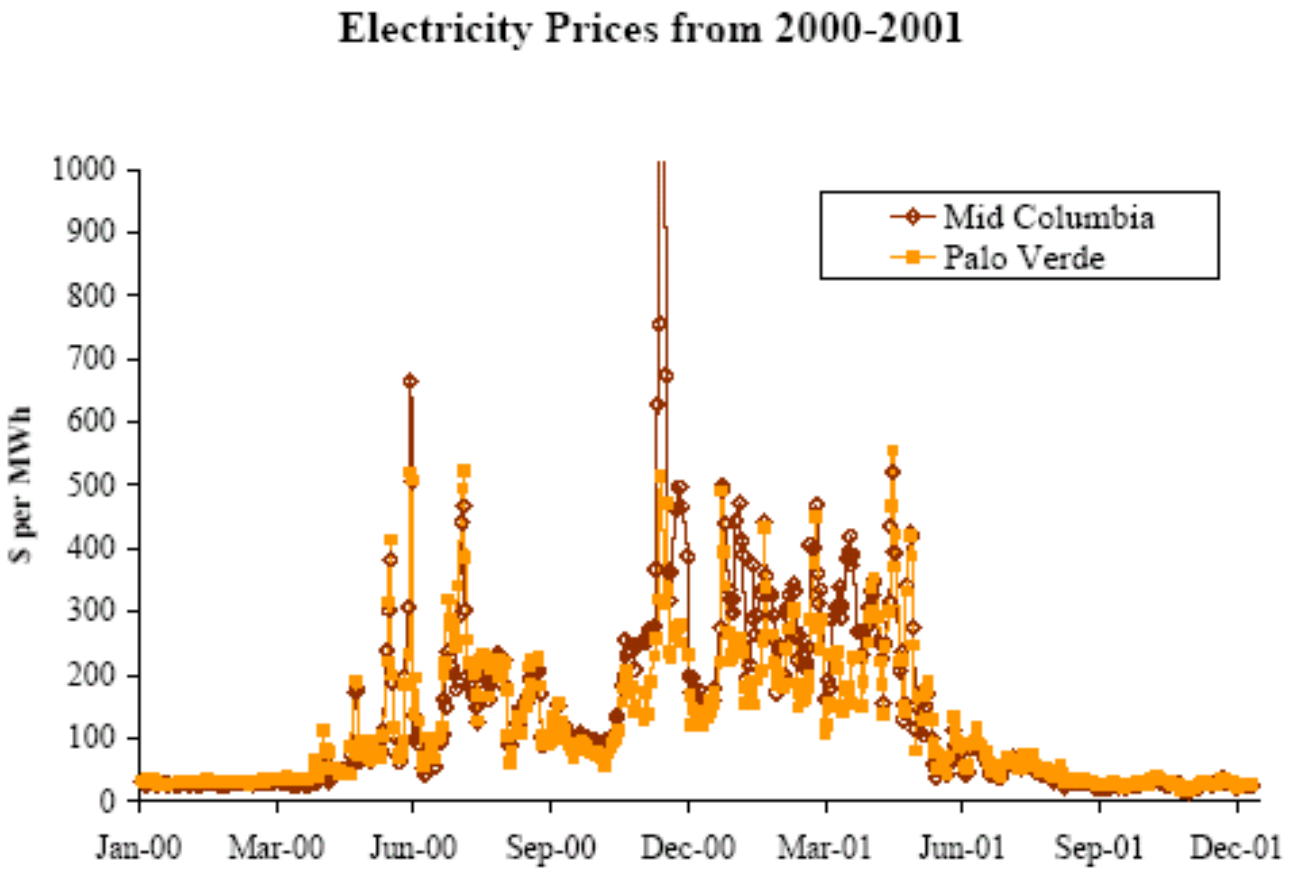
It Gets Worse



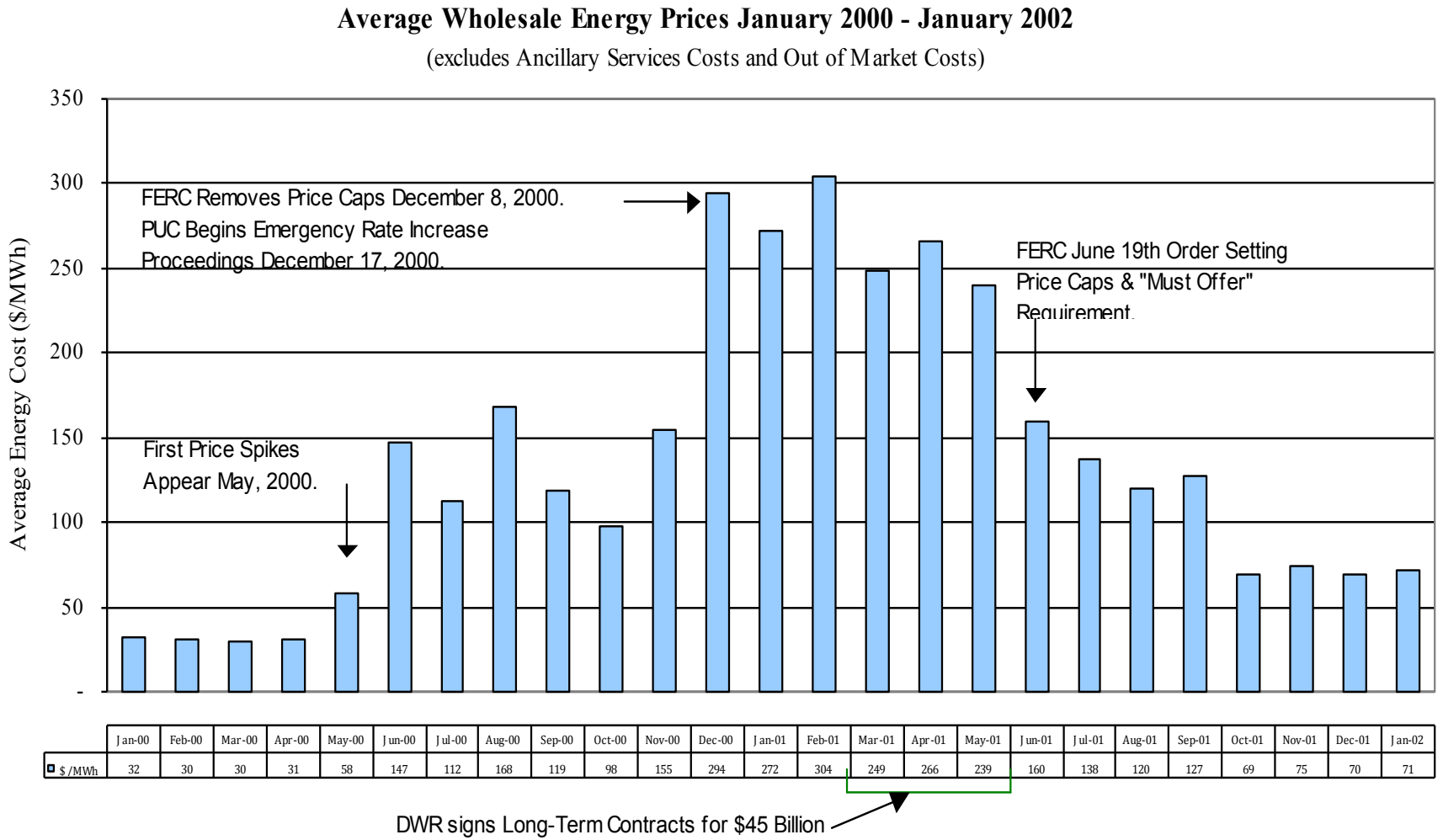
The Crisis: Prices In The West



The Crisis: Prices In The West



Energy Prices Stabilized With Price Caps



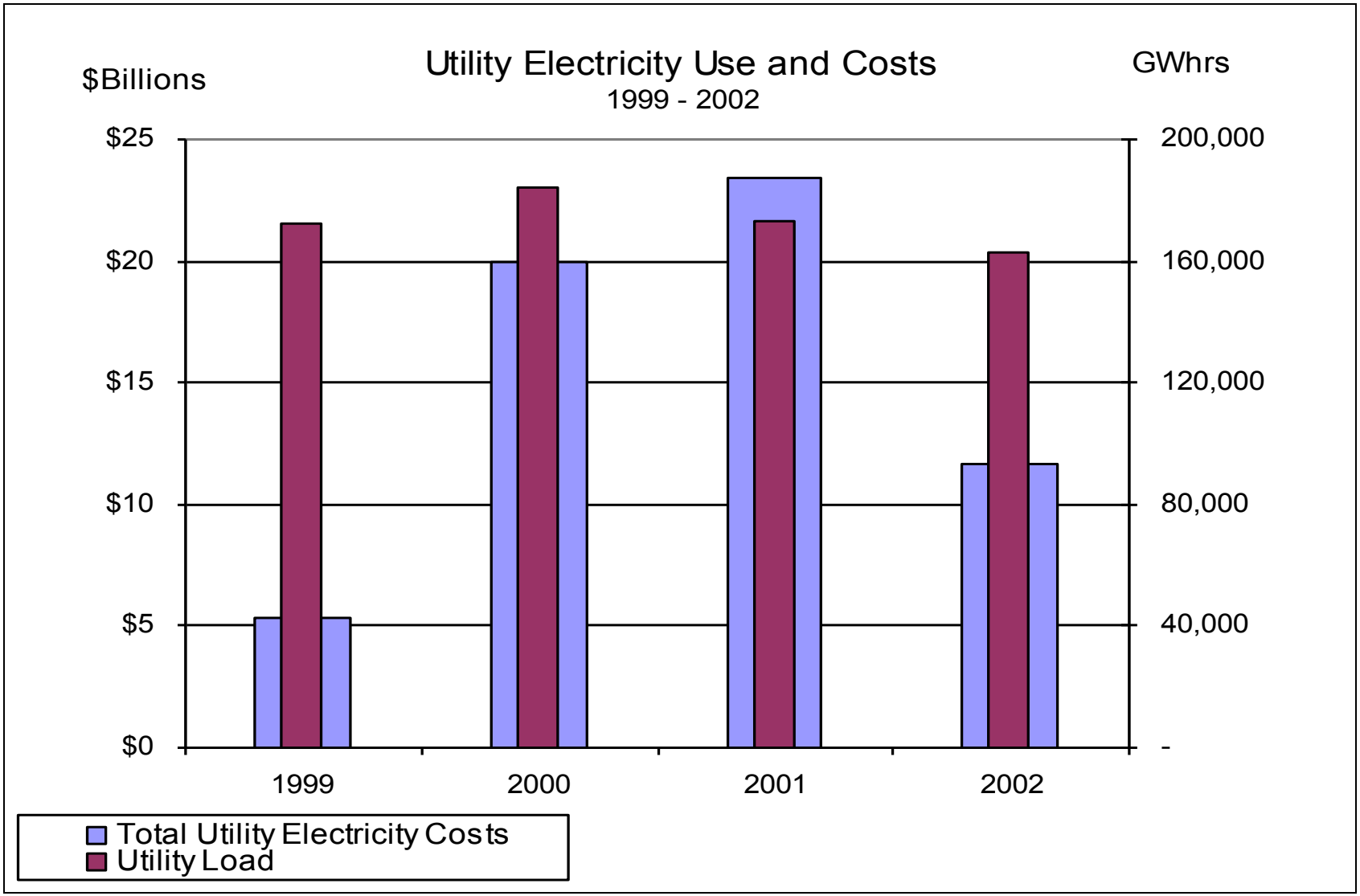
	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02
$/MWh	32	30	30	31	58	147	112	168	119	98	155	294	272	304	249	266	239	160	138	120	127	69	75	70	71

Source: Chart prepared by CPUC Energy Division. Data from CAISO (http://www.caiso.com/docs/2001/03/22/2001032214552322811.pdf) and DWR Revenue Requirement Filings

The Conventional Explanations

- Supply and Demand Imbalances
- High fuel costs
- High pollution costs
- California is unfriendly to business
- Wholesale price constraints
- Retail price controls
- Lack of real-time pricing

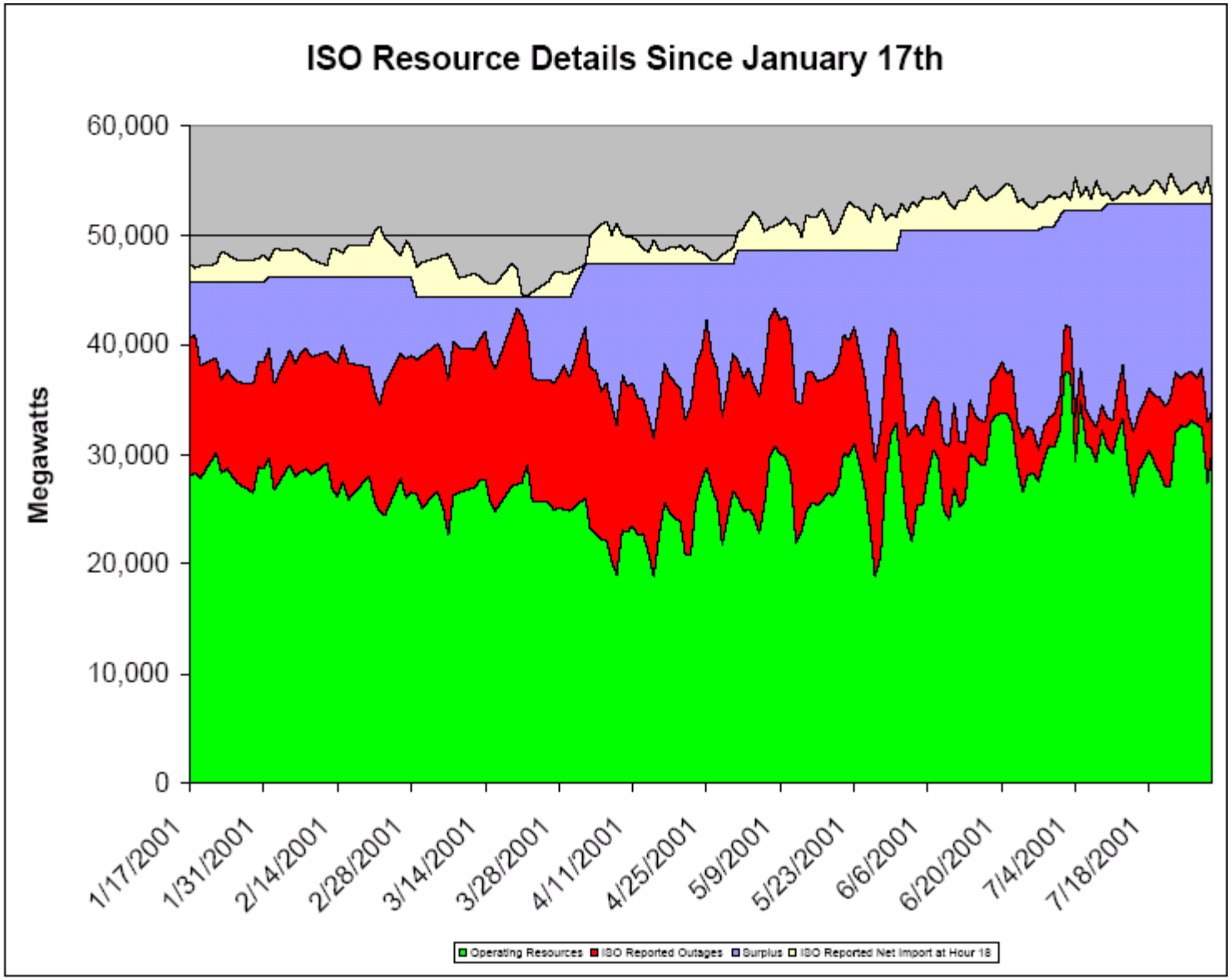
Cost vs.Load During Crisis



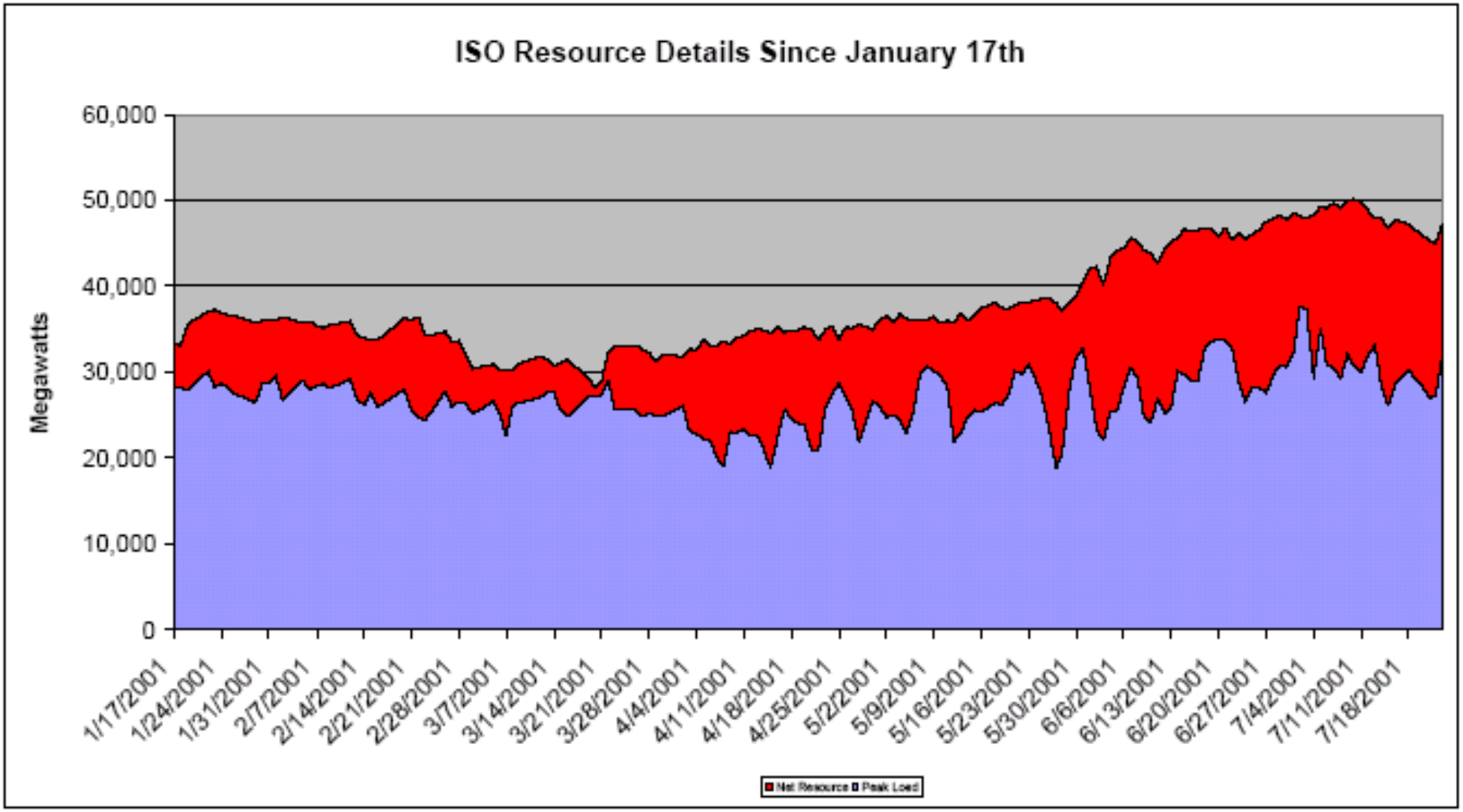
The Conventional Explanations (2)

- The design of the auction process
- Lack of long-term contracts
- Various forms of market manipulation
  - Pinging
  - Out of market calls
  - Physical withholding
  - Economic withholding
  - Waiting for the real-time market

Supplies and Outages in 2001



Peak Demand and Reserves in 2001



What Tim Duane Saw

- Little retail competition
- The changing markets inhibited long term investment by utilities
- Low spot prices discourage new generation
- No buy-back requirement at divestiture
- Gas price manipulation
- Normal hydro in Northwest
- Rapid growth in Southwest

"The acute phase is over, and the chronic phase has begun."

CPUC Executive Director
Paul Clanon, Summer 2001

The Unraveling (1)

- Rolling blackouts
- End of mandatory buy/sell
- Utilities cease purchasing
- Department of Water Resources drains the General Fund surplus
- Punitive long-term contracts
- SCE cuts a deal
- PG&E stages a “jail break”

The Unraveling (2)

- PG&E reaches a deal to end bankruptcy
- State sells bonds to reimburse the General Fund
- Direct Access is frozen in place
- Enron is bankrupt
- PG&E's competitive generation affiliate is bankrupt

The Unraveling (3)

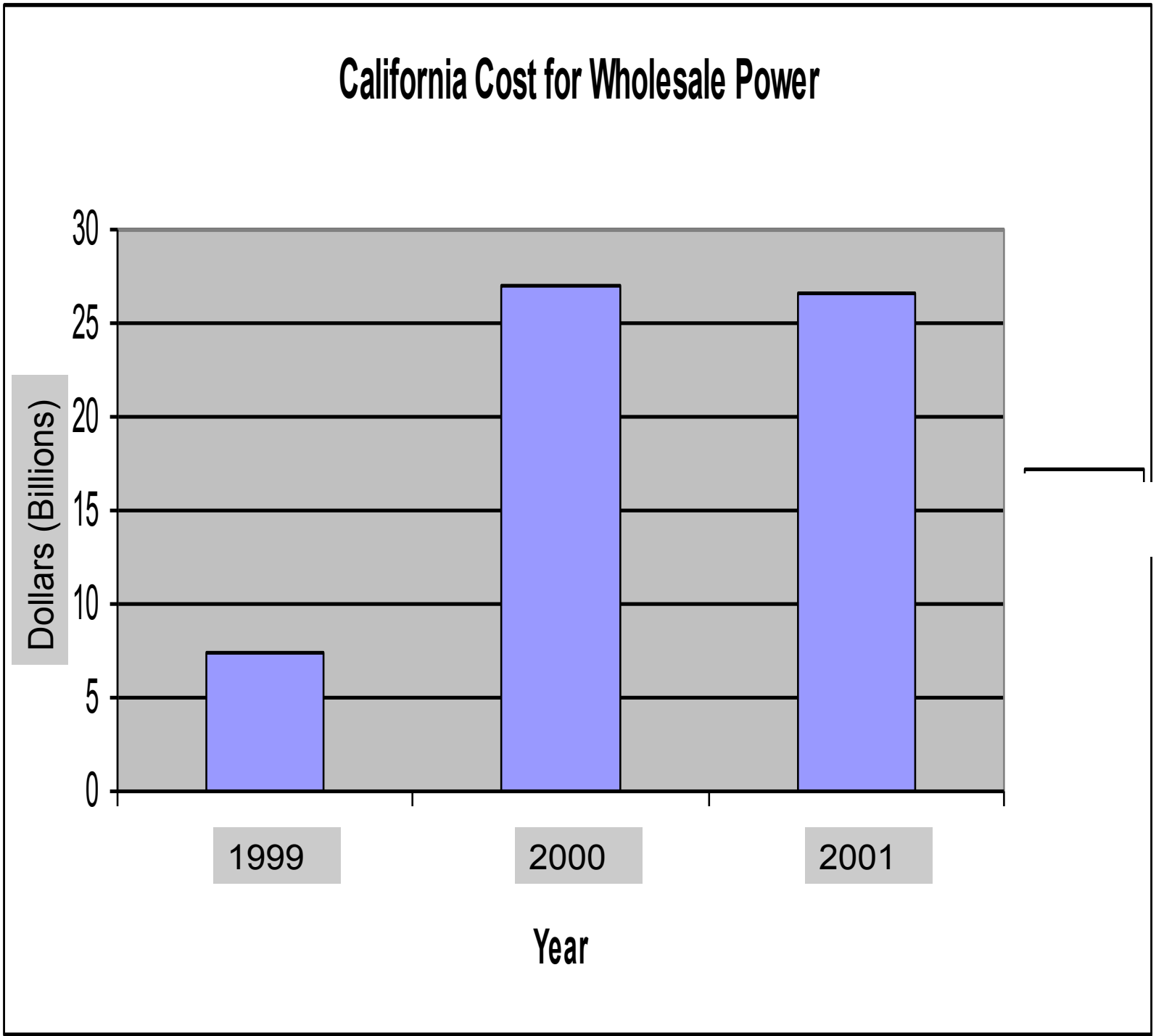
- The State (and then the utilities) stuck with overpriced power purchase contracts
- Lawsuits on parade (almost every one is settled, relatively little cash changes hands)
- California without organized wholesale markets for several years
- Commission embraces “hybrid” markets

The Unraveling (4)

- California Power Authority created and dissolved
- Governor Davis is recalled
- PG&E declares war on muni expansion and community choice aggregation
- FERC staffs up enforcement division
- The California ISO re-establishes formal markets

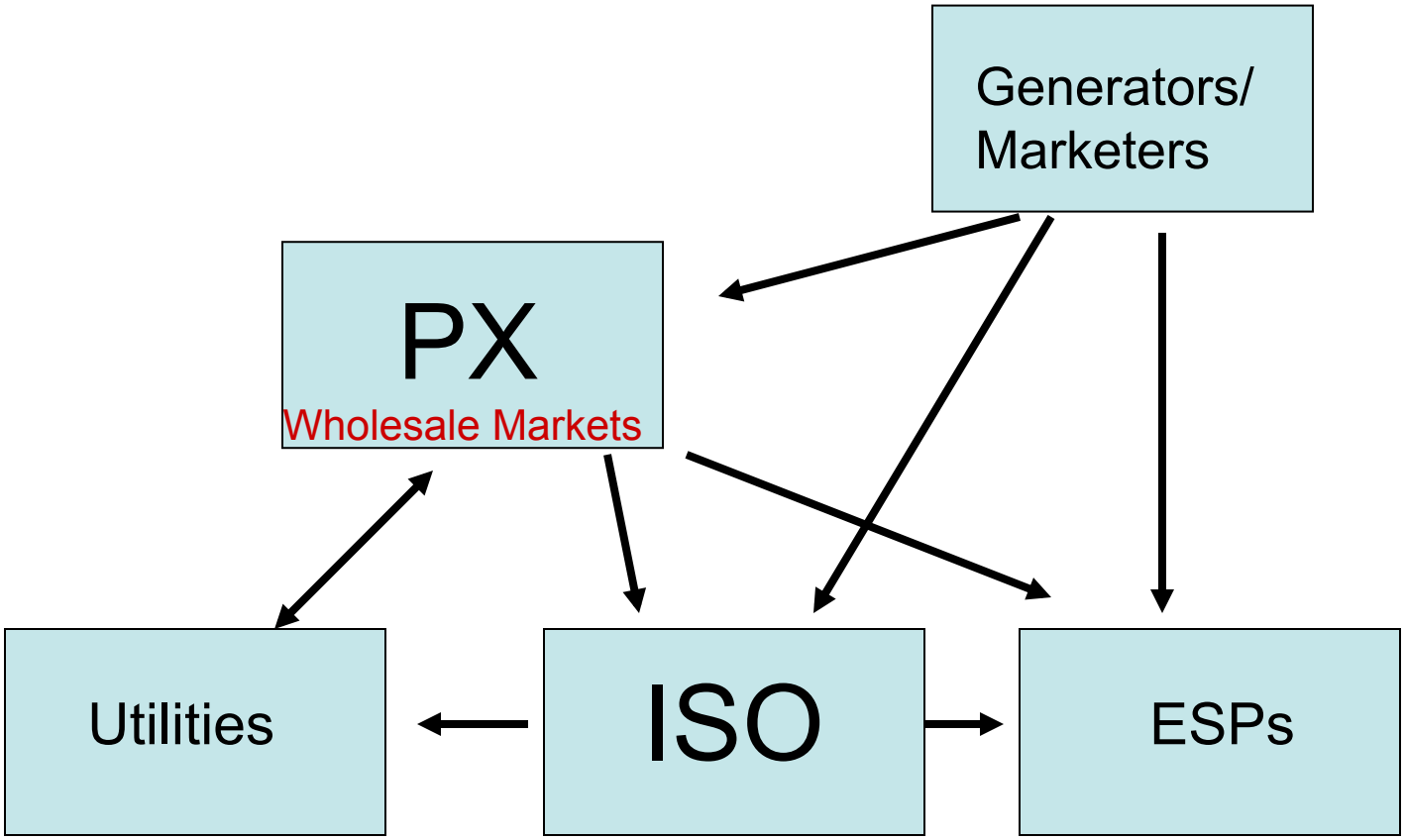
The Unraveling (5)

- Utilities buy more fossil-fueled plants
- Legislature resets the suspension of Direct Access
- Cap and trade rules informed by the Western energy crisis
- Community choice aggregation begins to take hold
- A new generation of utility executives and regulators think in terms of competitive markets


California Cost for Wholesale Power
30
25
20
15
10
5
0
Dollars (Billions)
1999
2000
2001
Year

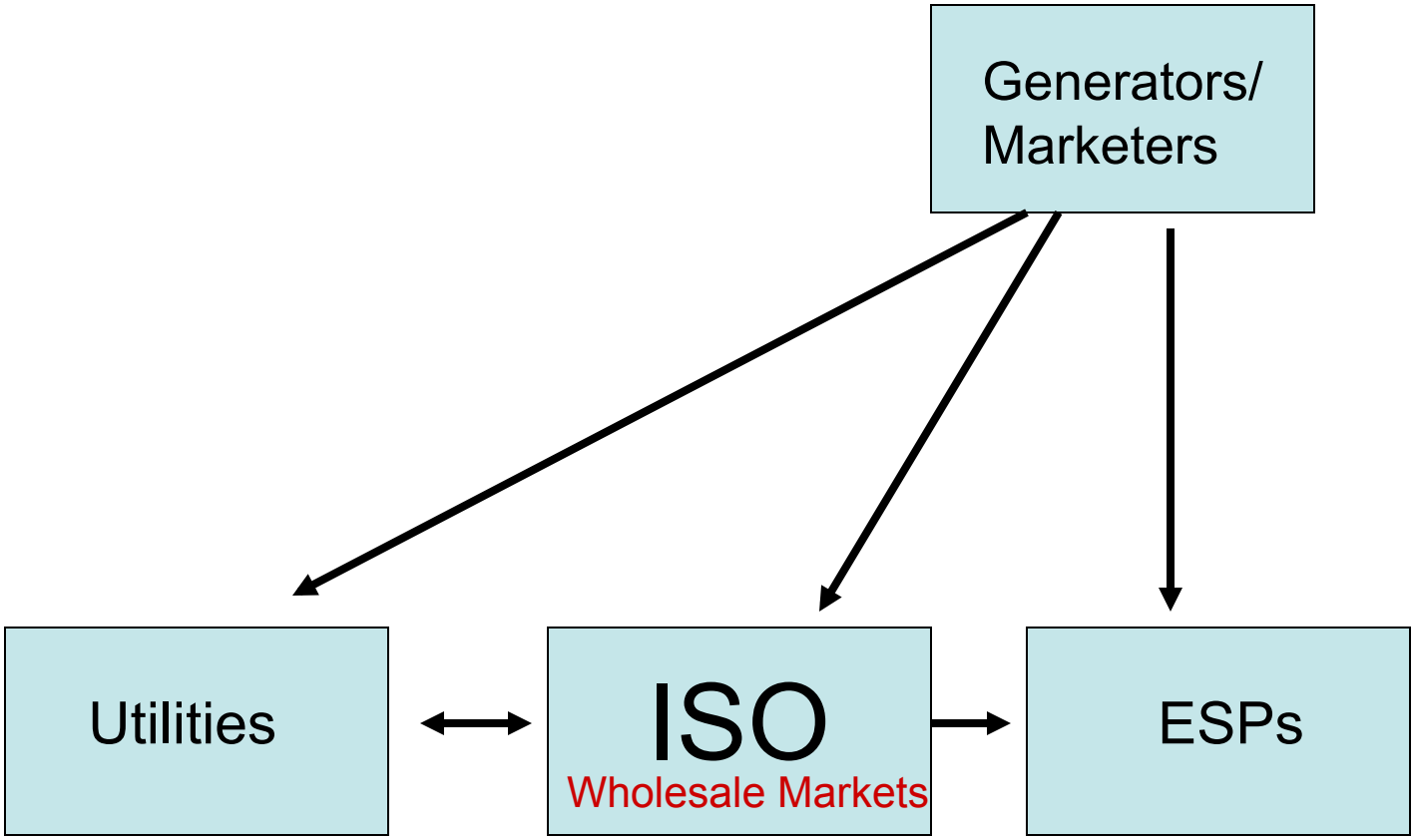
The California Model

Initial Design



The California Model

Current Design



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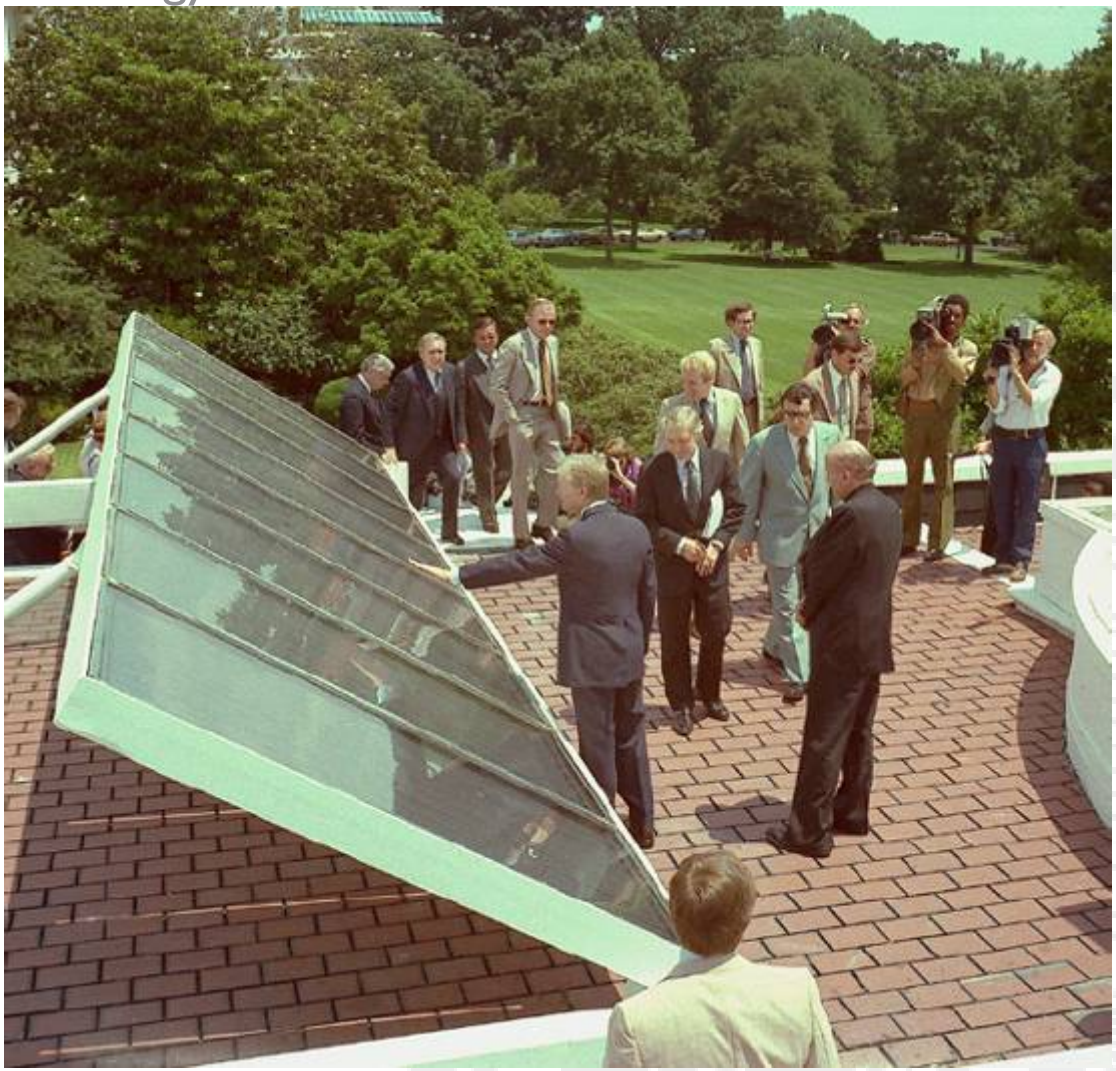


Mandatory Reading:

As the World Burns

by Ryan Lizza

New Yorker

October 11, 2010

DSIRE™
Database of State Incentives for Renewables & Efficiency

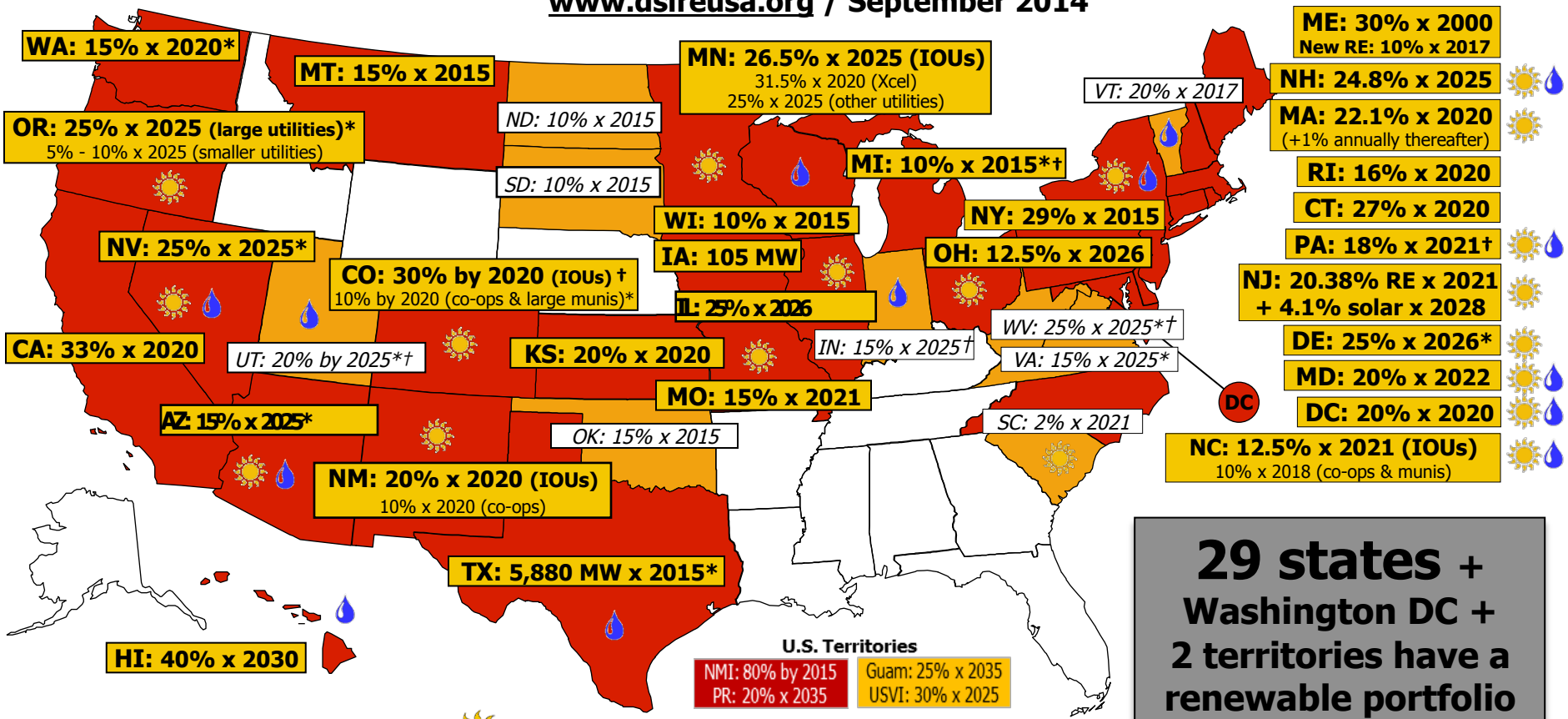
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IREC Interstate Renewable Energy Council

North Carolina Solar Center

Renewable Portfolio Standard Policies

www.dsireusa.org / September 2014



29 states + Washington DC + 2 territories have a renewable portfolio standard

(9 states and 2 territories have renewable portfolio goals)

Renewable portfolio standard

Renewable portfolio goal

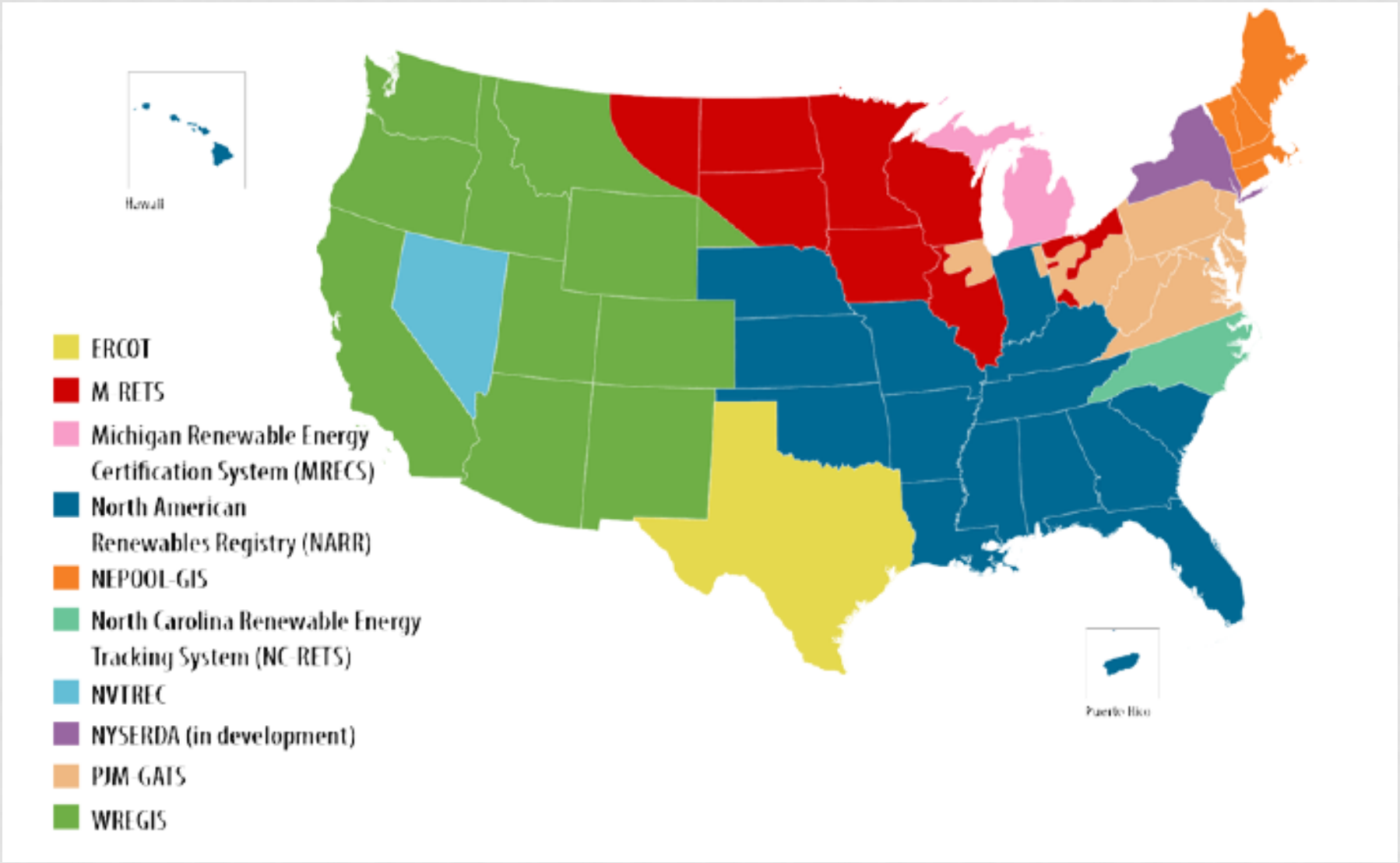
Solar water heating eligible

Minimum solar or customer-sited requirement

* Extra credit for solar or customer-sited renewables

† Includes non-renewable alternative resources

Regional Tracking Systems in the U.S.



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Need for Congressional Resolve

It's OK for the Pentagon – why not everyone else?

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Senators Bingaman and L. Graham Play with a National Standard

- Bingaman Introduces S.3813
- Graham Counters with a Clean Energy Standard

Renewable Energy Standard Total Demand

Renewable Energy Standard
33% by 2020

Renewable Energy Standard Bingaman (15% by 2020)

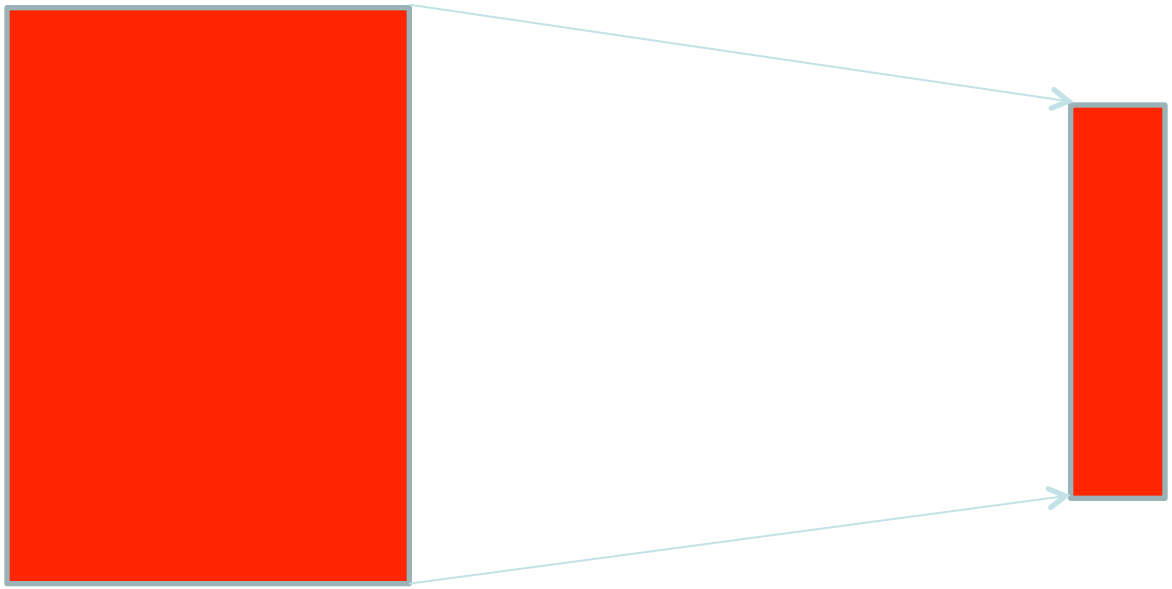
Renewable Energy Standard
15% of What?

Renewable Energy Standard Credit Bonuses

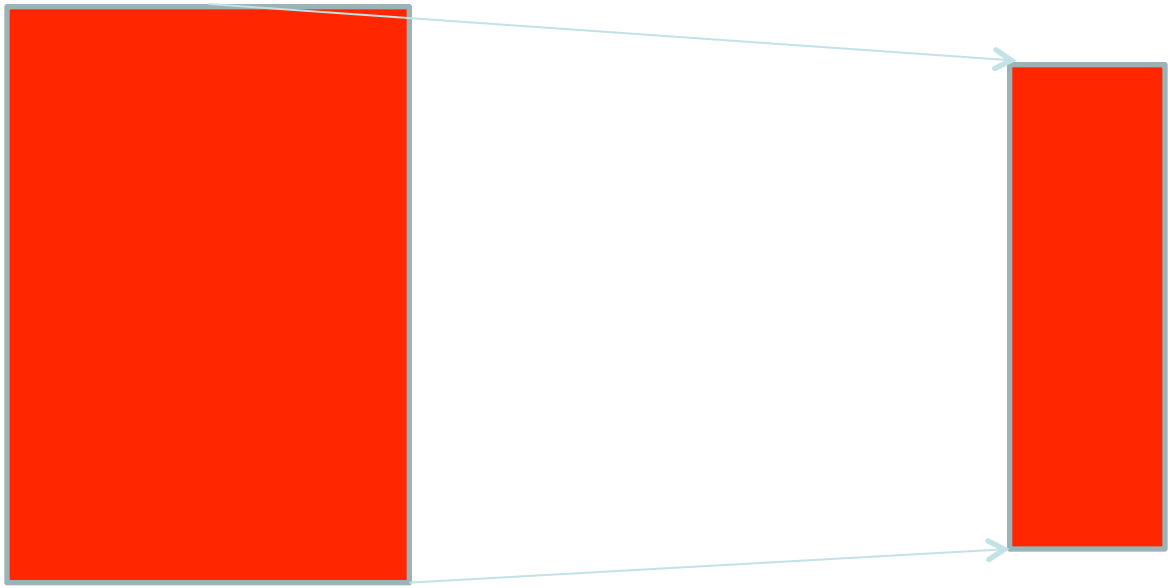
Renewable Energy Standard
Energy Efficiency First Effect

Renewable Energy Standard
Energy Efficiency Second Effect

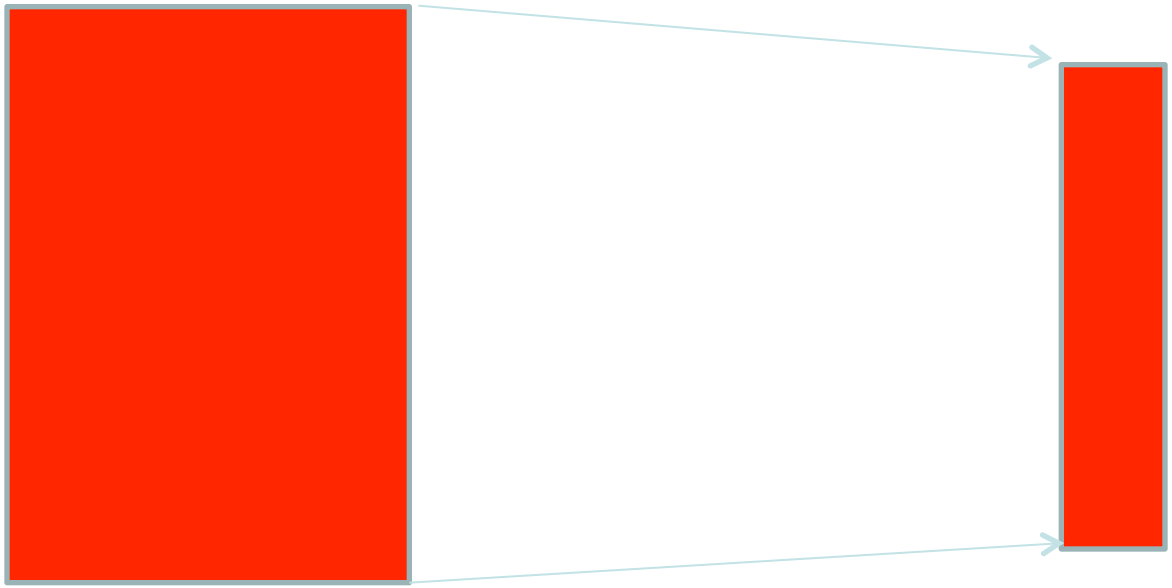
Renewable Energy Standard
From 33% to Bingaman



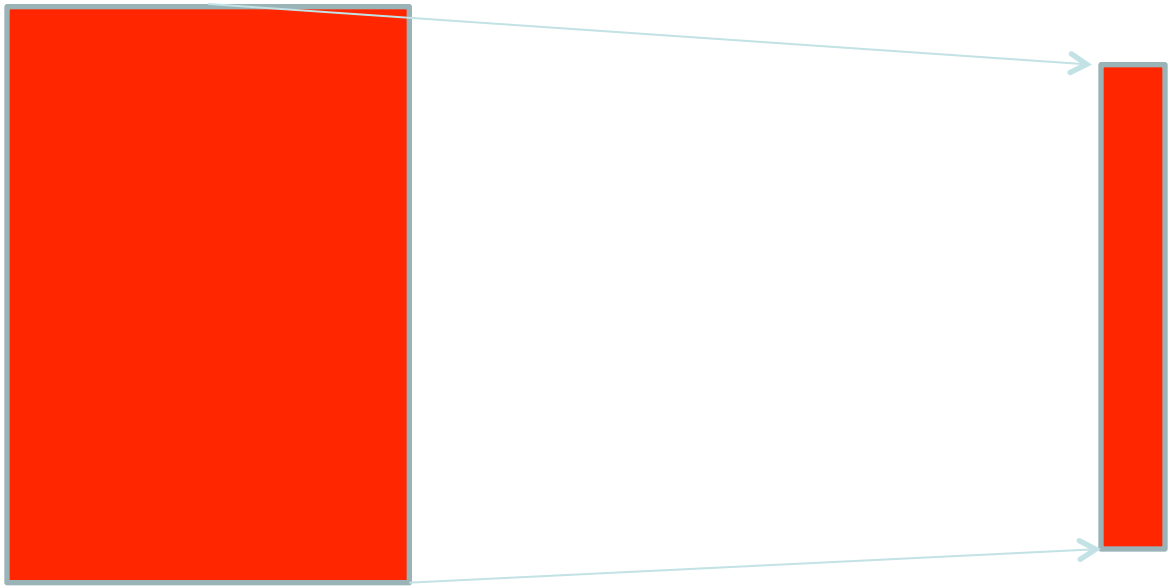
Renewable Energy Standard From 33% to Graham Bigger Box



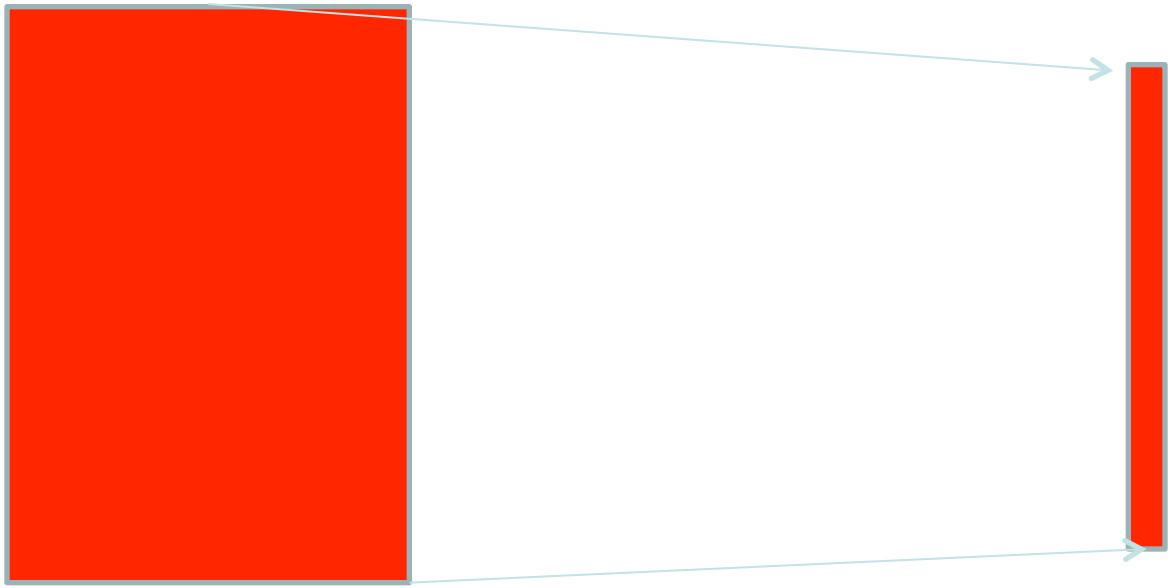
Renewable Energy Standard From 33% to Graham New Nuclear



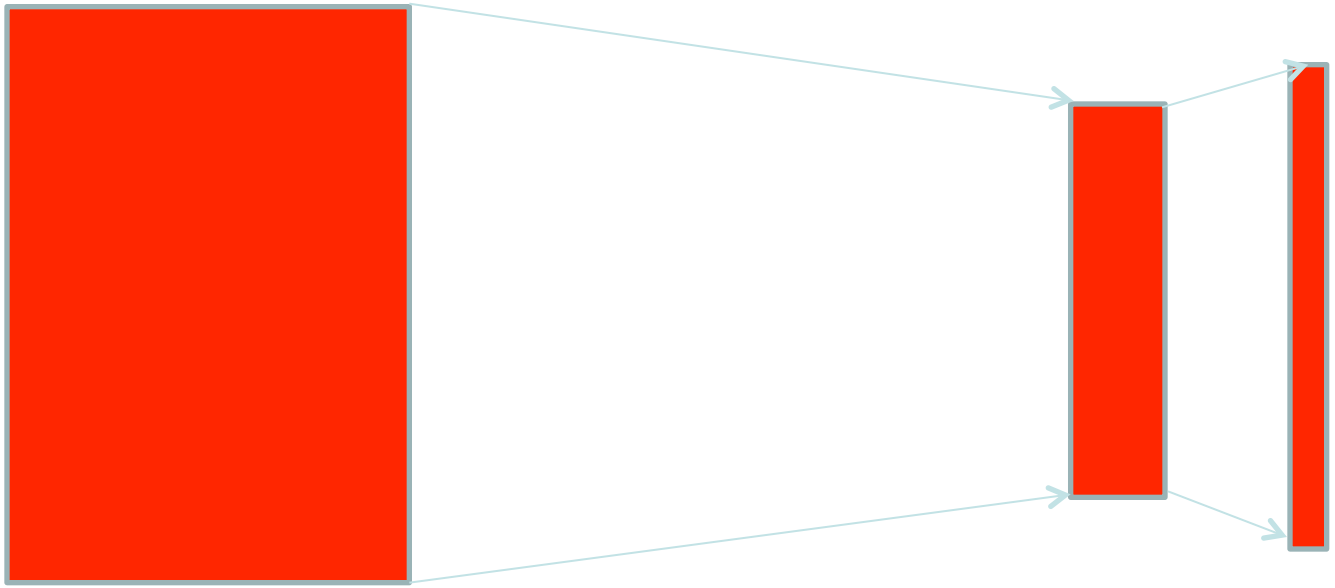
Renewable Energy Standard From 33% to Graham New Coal



Renewable Energy Standard From 33% to Graham Fossil Retirement Credits



Renewable Energy Standard
From 33% to Bingaman to Graham



Science
AAAS

The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity
James H. Williams, *et al.*
Science **335**, 53 (2012);
DOI: 10.1126/science.1208365

RESEARCH ARTICLE

The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity

James H. Williams,[1,2] Andrew DeBenedictis,[1] Rebecca Ghanadan,[1,3] Amber Mahone,[1] Jack Moore,[1] William R. Morrow III,[4] Snuller Price,[1] Margaret S. Torn[3]*

Several states and countries have adopted targets for deep reductions in greenhouse gas emissions by 2050, but there has been little physically realistic modeling of the energy and economic transformations required. We analyzed the infrastructure and technology path required to meet California's goal of an 80% reduction below 1990 levels, using detailed modeling of infrastructure stocks, resource constraints, and electricity system operability. We found that technically feasible levels of energy efficiency and decarbonized energy supply alone are not sufficient; widespread electrification of transportation and other sectors is required. Decarbonized electricity would become the dominant form of energy supply, posing challenges and opportunities for economic growth and climate policy. This transformation demands technologies that are not yet commercialized, as well as coordination of investment, technology development, and infrastructure deployment.

In 2004, Pacala and Socolow (*1*) proposed a way to stabilize climate using existing greenhouse gas (GHG) mitigation technologies, visualized as interchangeable, global-scale "wedges" sistent with an Intergovernmental Panel on Climate Change (IPCC) emissions trajectory that would stabilize atmospheric GHG concentrations at 450 parts per million carbon dioxide equivalent

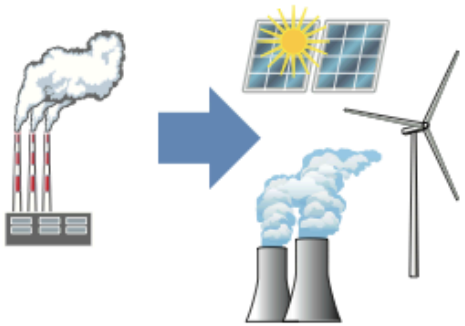
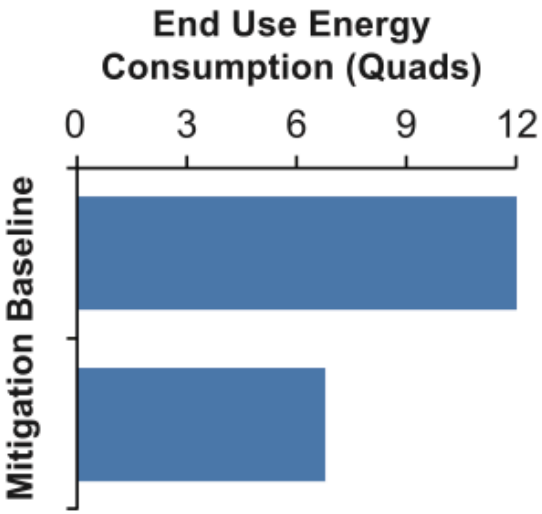
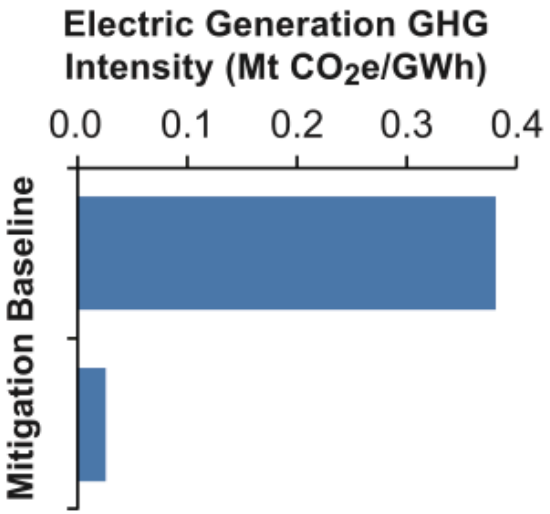
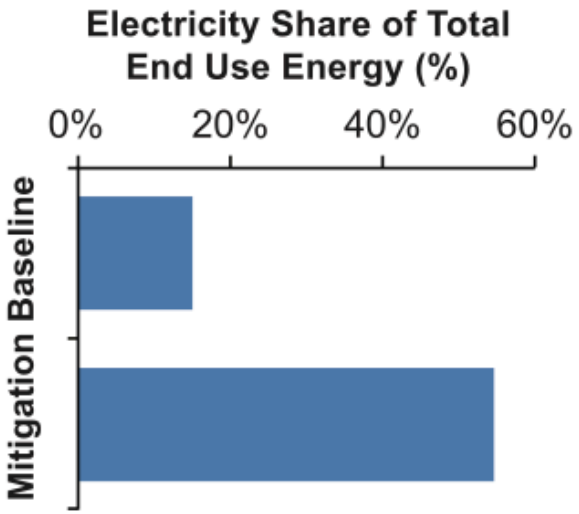
bility, resource availability, and historical uptake rates rather than relative prices of technology, energy, or carbon as in general equilibrium models (*14*). Technology penetration levels in our model are within the range of technological feasibility for the United States suggested by recent assessments (table S20) (*15*, *16*). We did not include technologies expected to be far from commercialization in the next few decades, such as fusion-based electricity. Mitigation cost was calculated as the difference between total fuel and measure costs in the mitigation and baseline scenarios. Our fuel and technology cost assumptions, including learning curves (tables S4, S5, S11, and S12, and fig. S29), are comparable to those in other recent studies (*17*). Clearly, future costs are very uncertain over such a long time horizon, especially for technologies that are not yet commercialized. We did not assume explicit life-style changes (e.g., vegetarianism, bicycle transportation), which could have a substantial effect on mitigation requirements and costs (*18*); behavior change in our model is subsumed within conservation measures and energy efficiency (EE).

To ensure that electricity supply scenarios met the technical requirements for maintaining reliable service, we included an electricity system

Key Infrastructure Changes to Achieve 80% GHG Reduction by 2050 in California

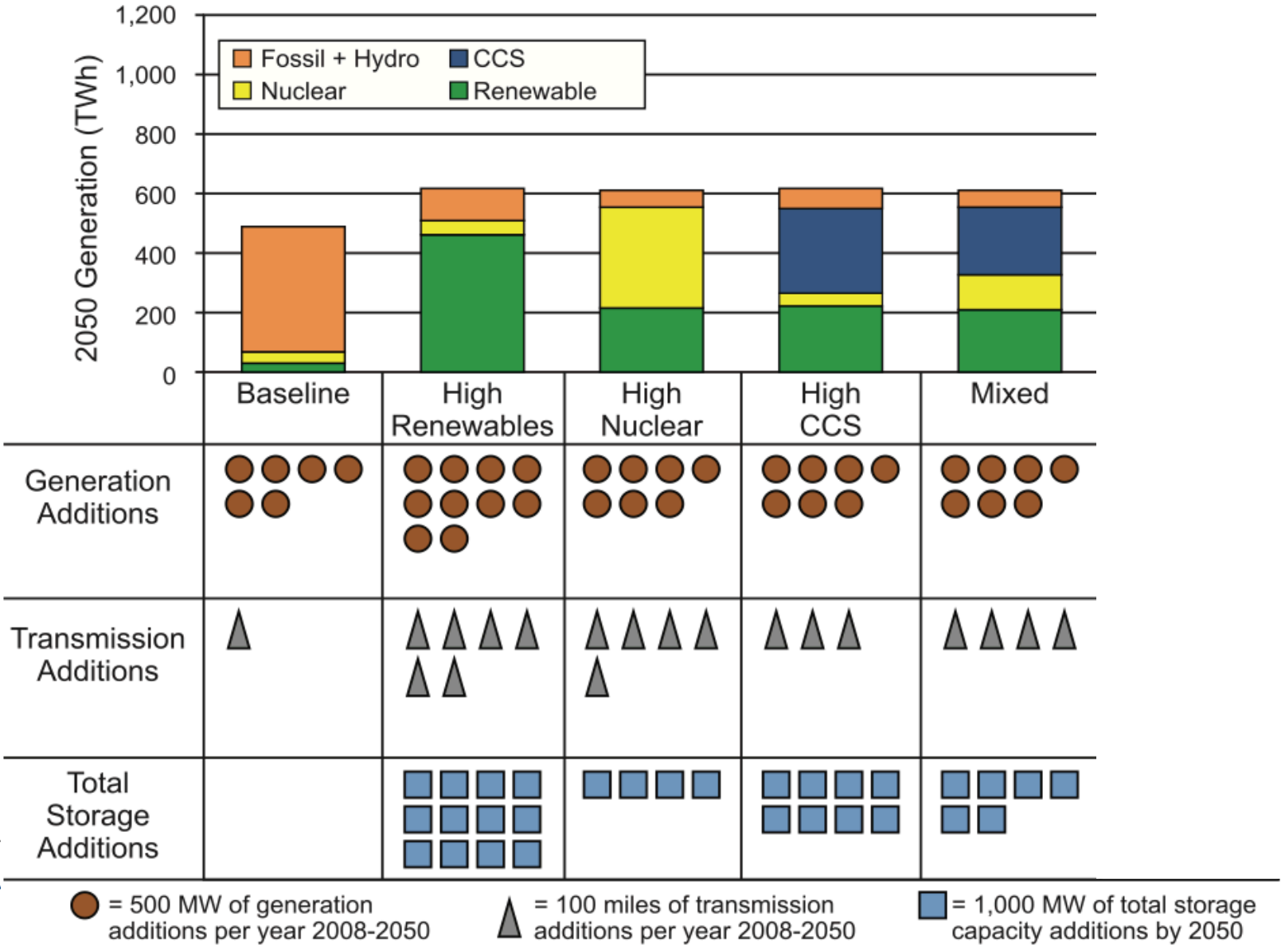
All of these are required

1. Unprecedented Energy Efficiency (Improving efficiency 1.3%/yr for 40 years)
2. Massive Decarbonization of the Electricity Sector (98% carbon-free electricity)
3. Electrification of Most Transportation & Other Fuel Uses (e.g. 70% of transportation energy, plus buildings, industry)
4. Low Carbon Biofuels (Limited but essential for transportation that can't be electrified, e.g. long-haul trucks, airplanes)
5. Non-Energy and Non-CO_2 GHGs (80% reduction from cement, agriculture, industrial gases)

	ENERGY EFFICIENCY	GENERATION DECARBONIZATION	ELECTRIFICATION
Wedge			
Key Metric in 2050			
Constraints	• Max feasible rate of improvement: 1.3% y^{-1} • Fundamental changes in the built environment • Limitations on changes in human behavior	• Grid operability requires some natural gas usage • Large infrastructure investment required • Facility and transmission siting challenges	• Smart charging • Battery technology and cost • Low-carbon source of electricity

Williams et al, 2012

Generation Mix by Scenario



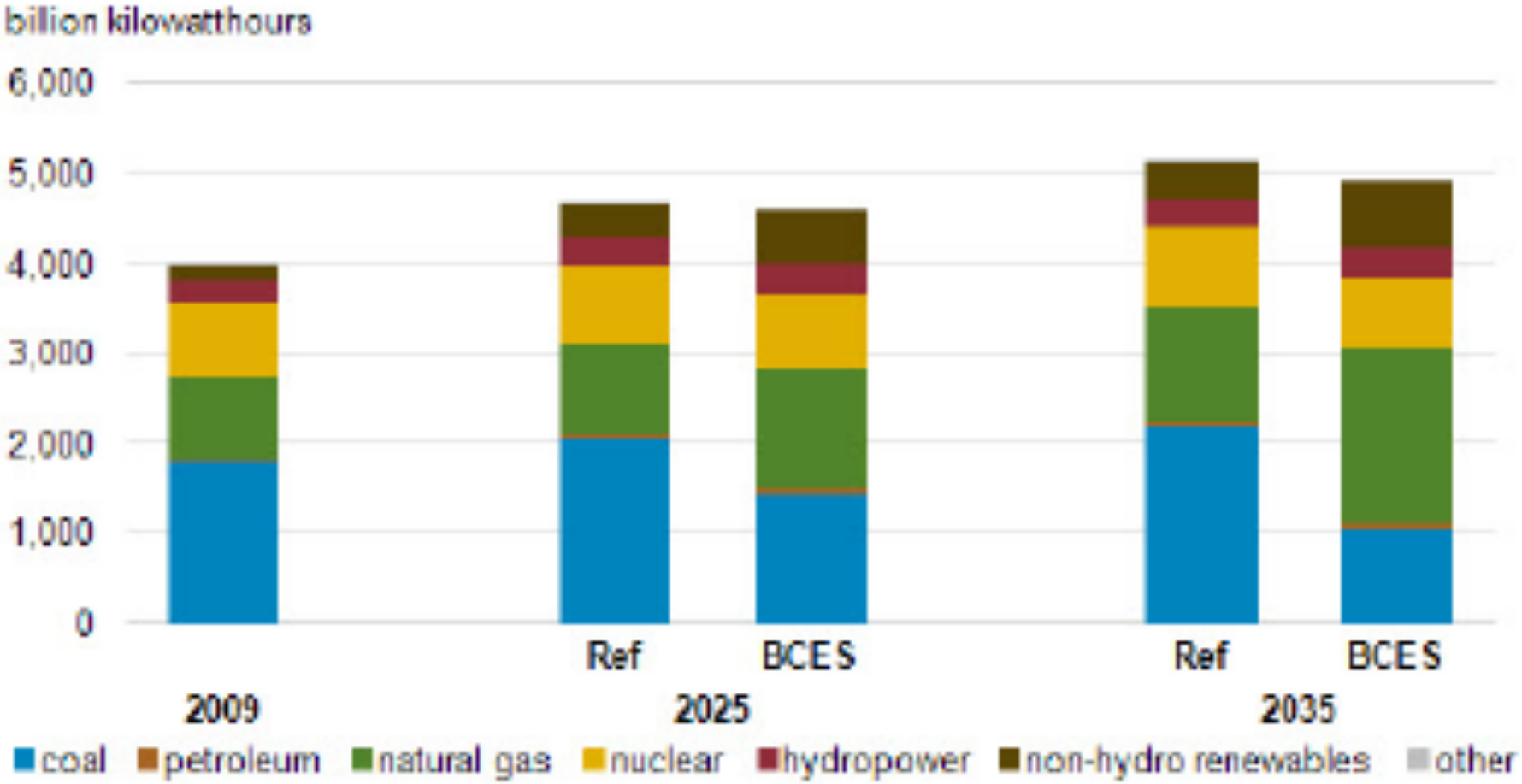

eia
U.S. Energy Information Administration
Analysis of Impacts of a Clean Energy Standard
as requested by Chairman Bingaman
November 2011
Independent Statistics & Analysis
www.eia.gov
U.S. Department of Energy
Washington, DC 20585

Table 2. Clean Energy Goal and Credit Shares Across Select Cases[1]

Year	Overall Clean-Energy Goal[1]	Required Clean Energy Target as a Percent of All Sales					SUE as a Percent of Covered Sales
		BCES	AC	PC	RB	SUE	
2015	45%	17%	45%	20%	23%	12%	17%
2020	50%	23%	50%	26%	32%	17%	23%
2025	60%	34%	60%	37%	46%	25%	34%
2030	70%	45%	70%	48%	60%	34%	45%
2035	80%	56%	80%	58%	74%	42%	56%
2040	85%	62%	85%	64%	80%	46%	62%
2045	90%	68%	90%	70%	87%	50%	68%
2050	95%	74%	95%	76%	94%	54%	74%

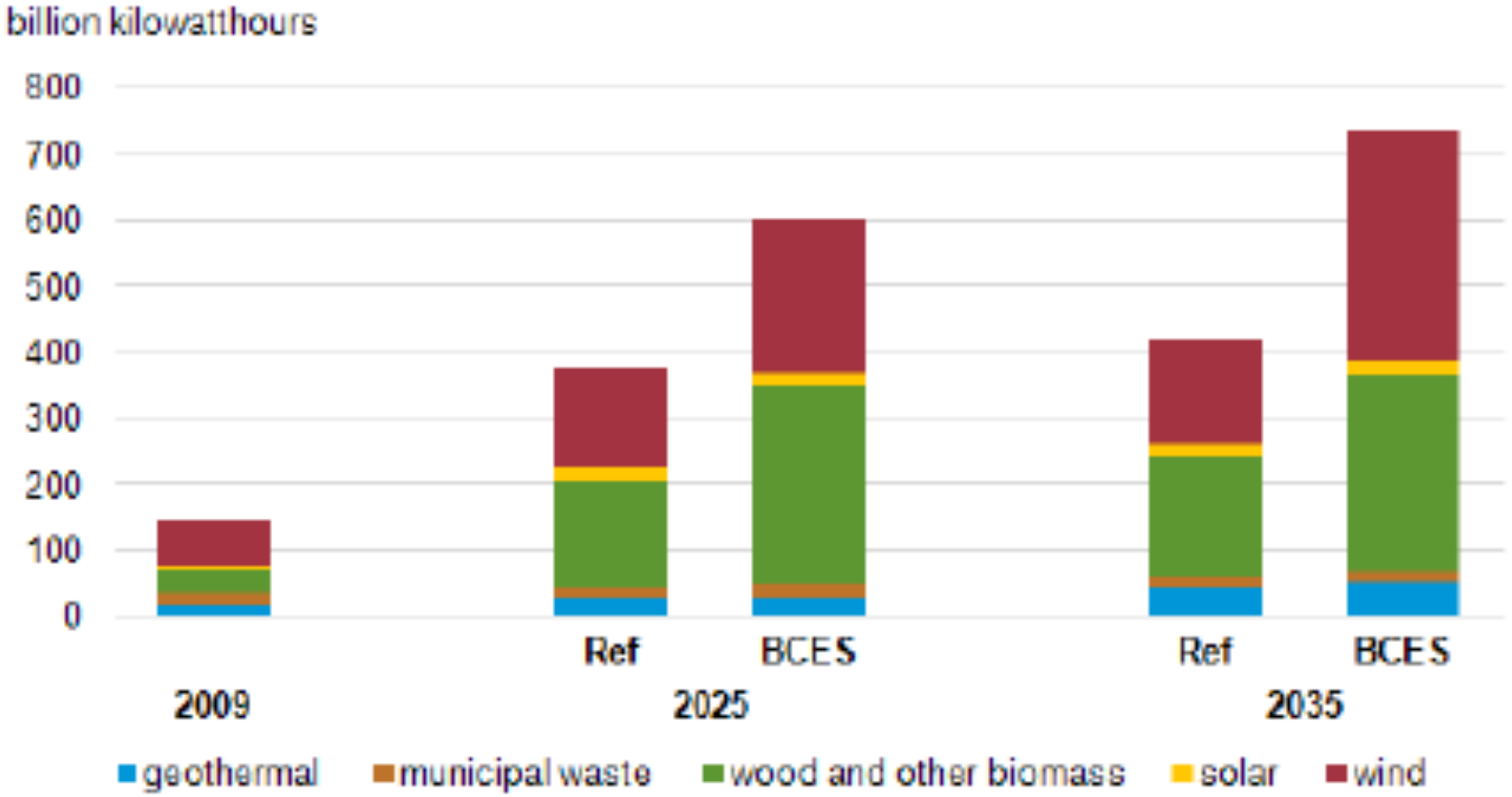
[1] Goal is expressed as a percent of all sales, except for the Small Utilities Exempt (SUE) case, where it is expressed as a percent of covered sales, as specified in the modified request letter for this study (see Appendix A). In 2035, covered sales in the SUE case are about 75 percent of national sales, reducing the effective clean energy goal to about 60 percent of national sales. For the C2.1 and C3.0 cases, the realized clean energy goal may fall below the 80 percent national target due to the use of alternative compliance credits.

Figure 1. Total Net Electricity Generation



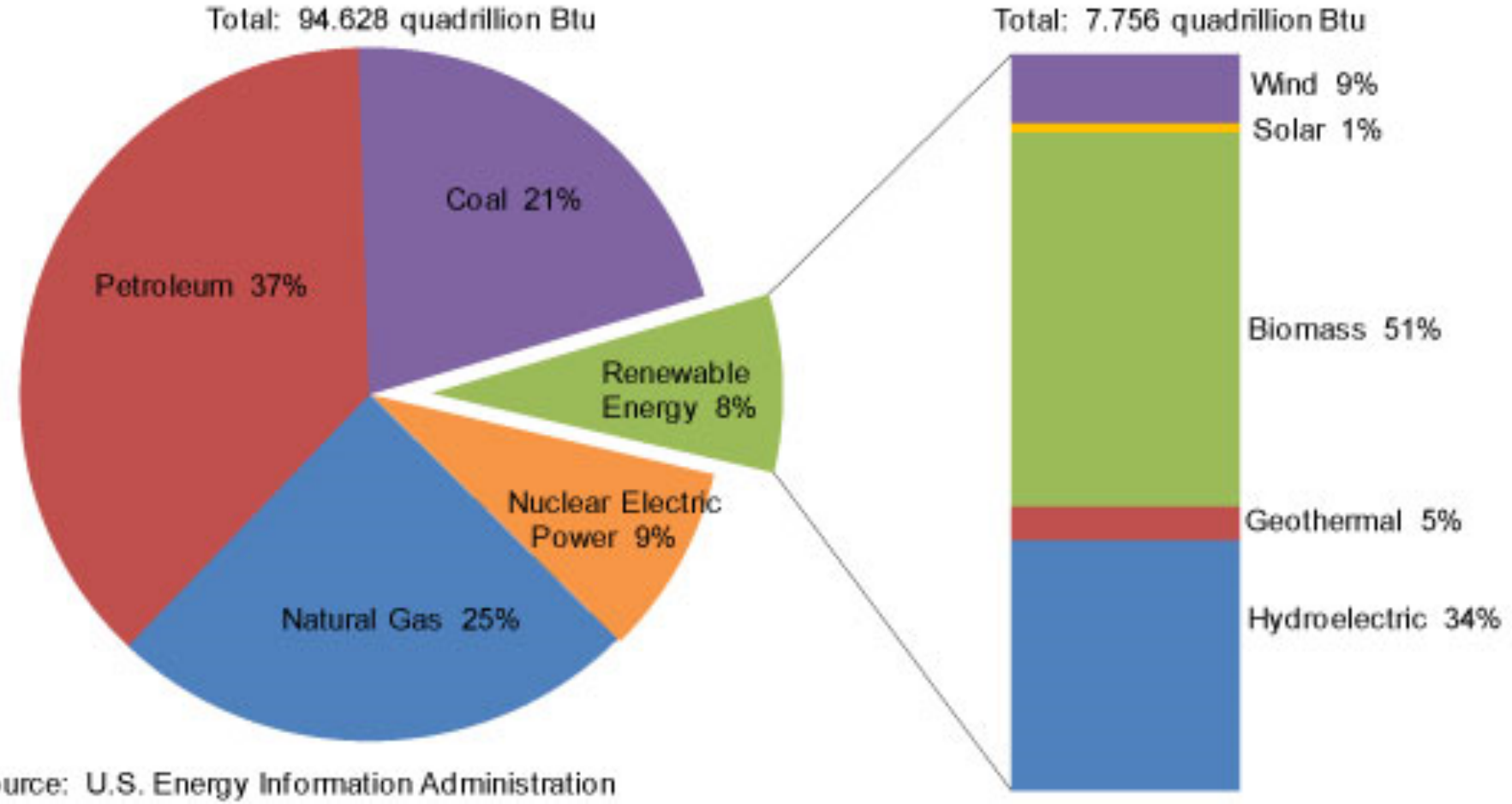
Source: U.S. Energy Information Administration, National Energy Modeling System, runs refhall.d062611b and cesbingbk.d100611a.

Figure 2. Total Non-Hydroelectric Renewable Generation



Source: U.S. Energy Information Administration, National Energy Modeling System, runs refhall.d082611b and cesbingbk.d100611a.

Figure 1.2 Renewable energy consumption in the nation's energy supply, 2009



Source: U.S. Energy Information Administration

DSIRE™
Database of State Incentives for Renewables & Efficiency

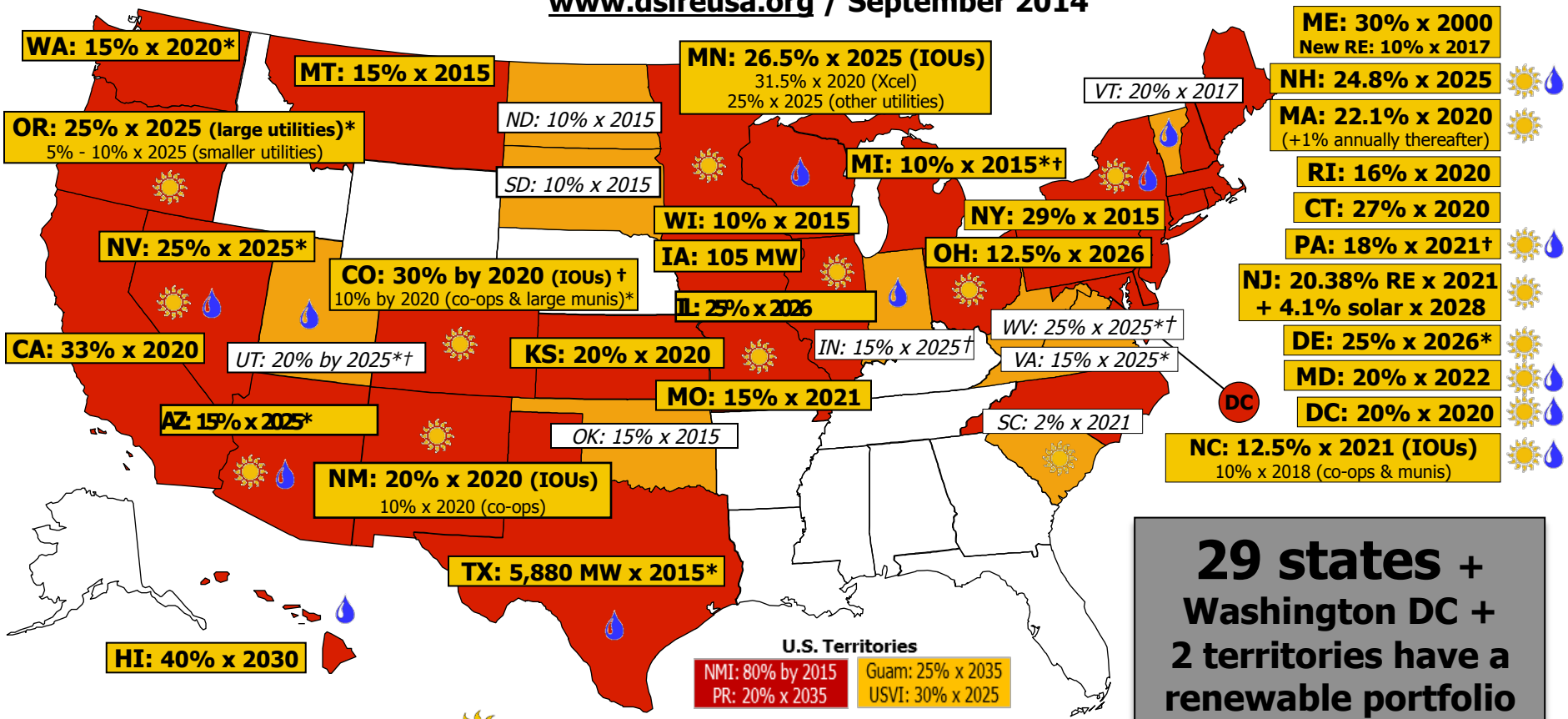
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IREC Interstate Renewable Energy Council

North Carolina Solar Center

Renewable Portfolio Standard Policies

www.dsireusa.org / September 2014



29 states + Washington DC + 2 territories have a renewable portfolio standard

(9 states and 2 territories have renewable portfolio goals)

Renewable portfolio standard

Renewable portfolio goal

Solar water heating eligible

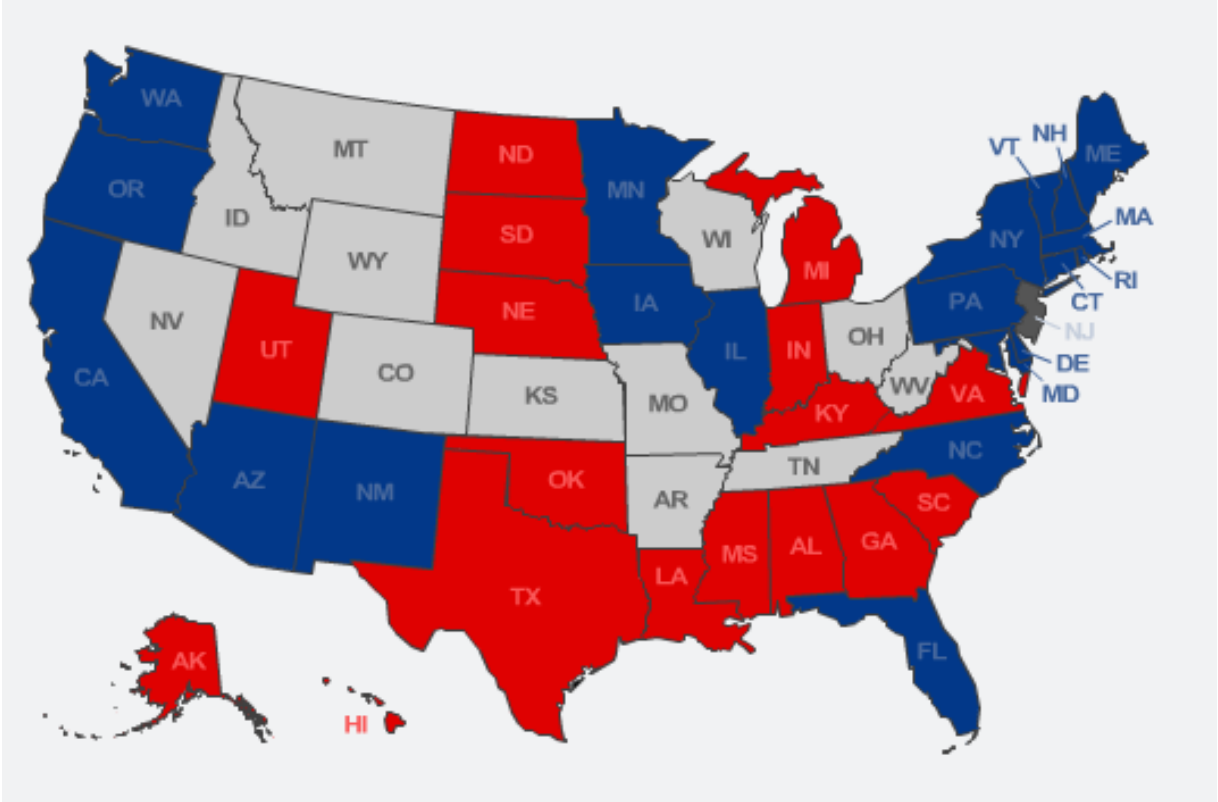
Minimum solar or customer-sited requirement

* Extra credit for solar or customer-sited renewables

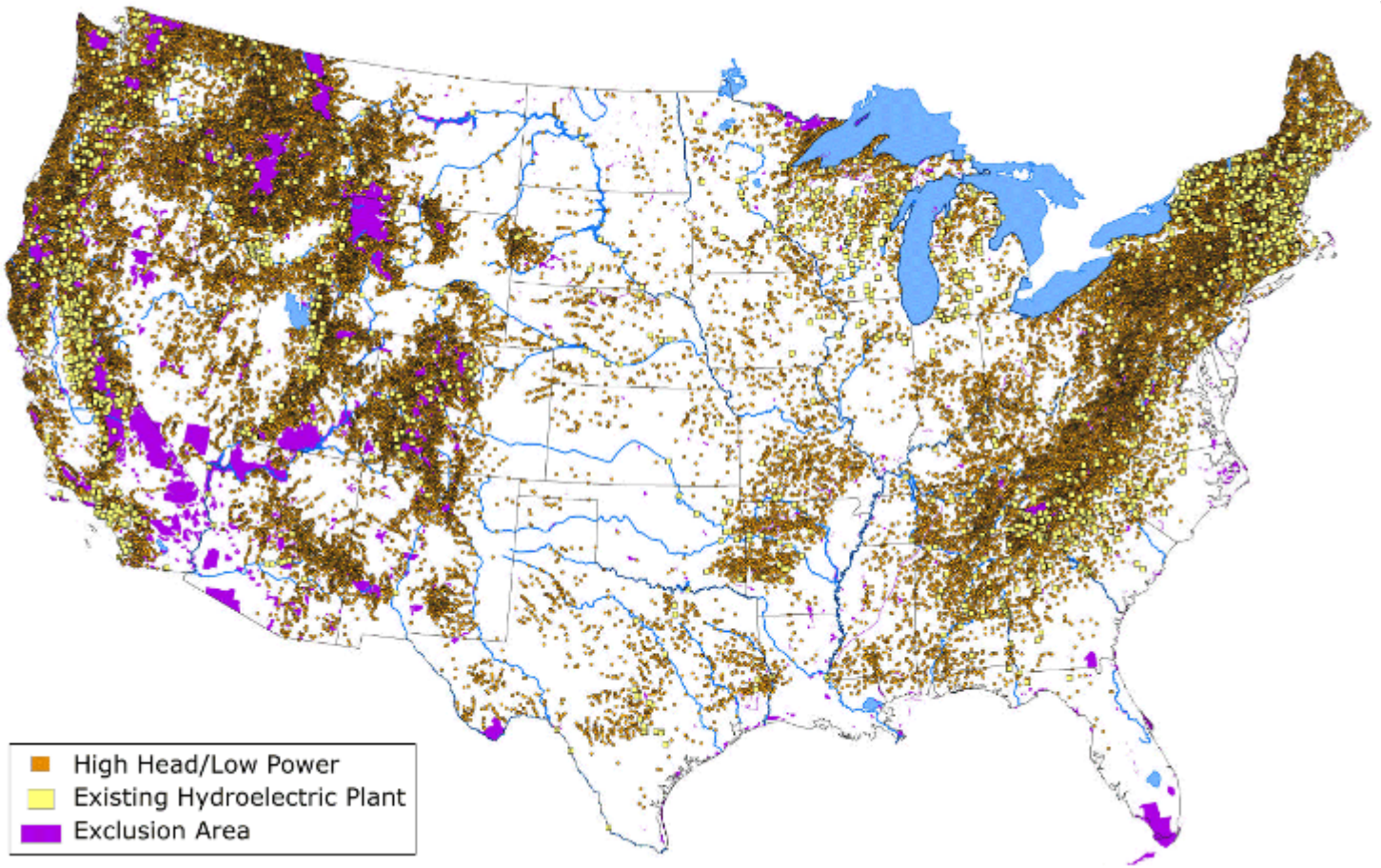
† Includes non-renewable alternative resources

States Favoring or Opposing EPA Climate Rules

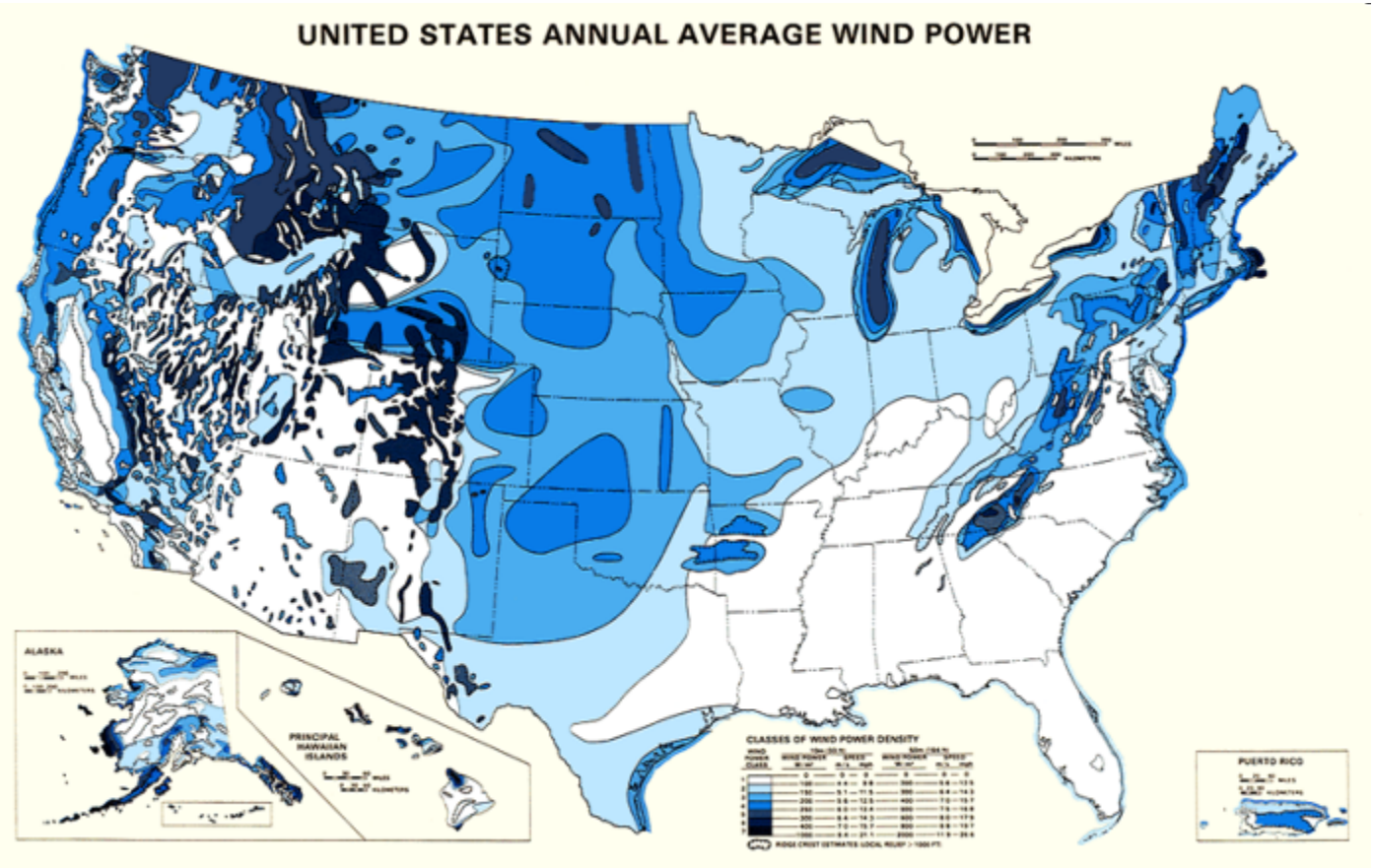
E&E Daily



Regional Potential: Hydroelectric

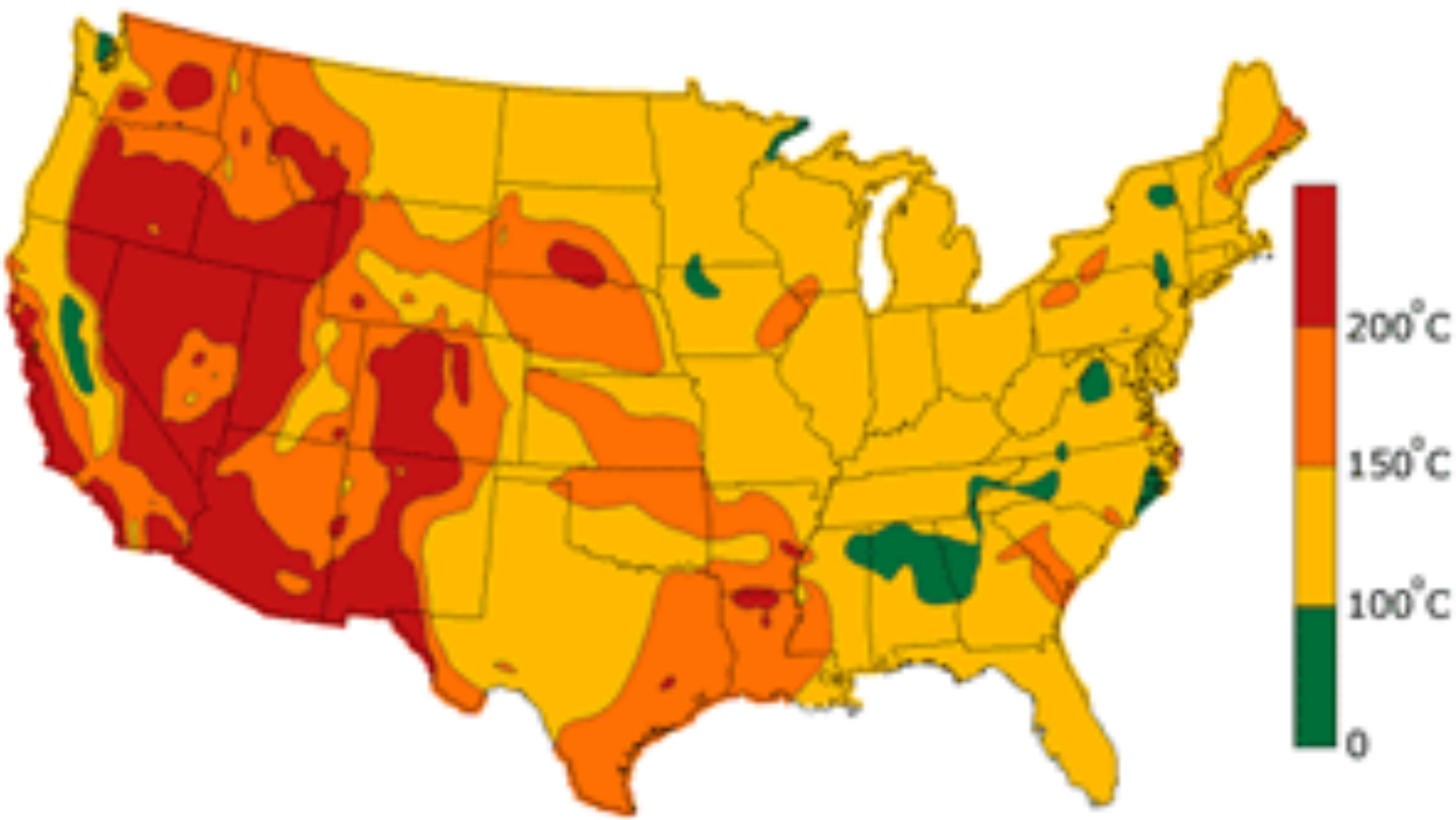


Regional Potential: Wind

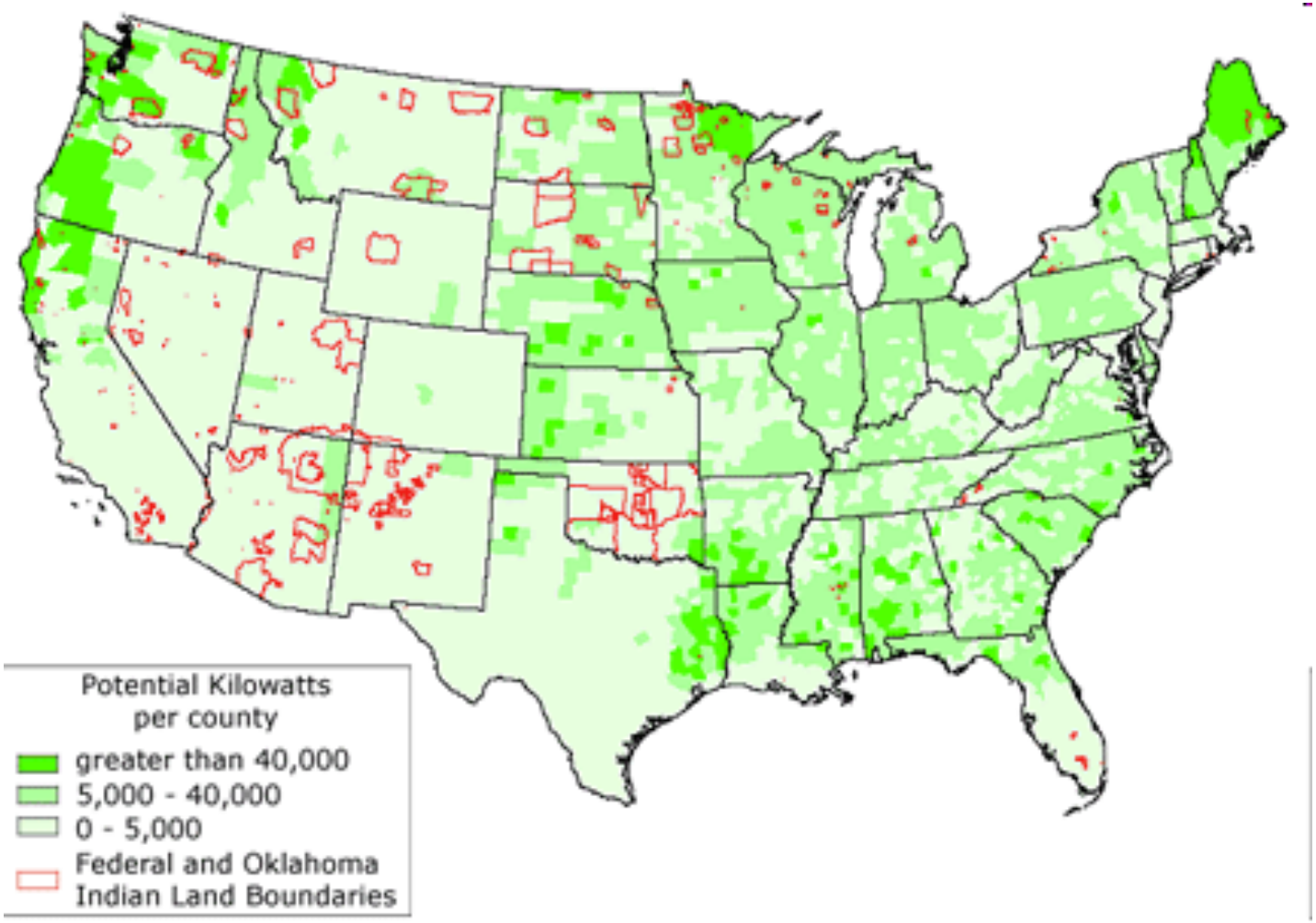


Regional Potential: Solar

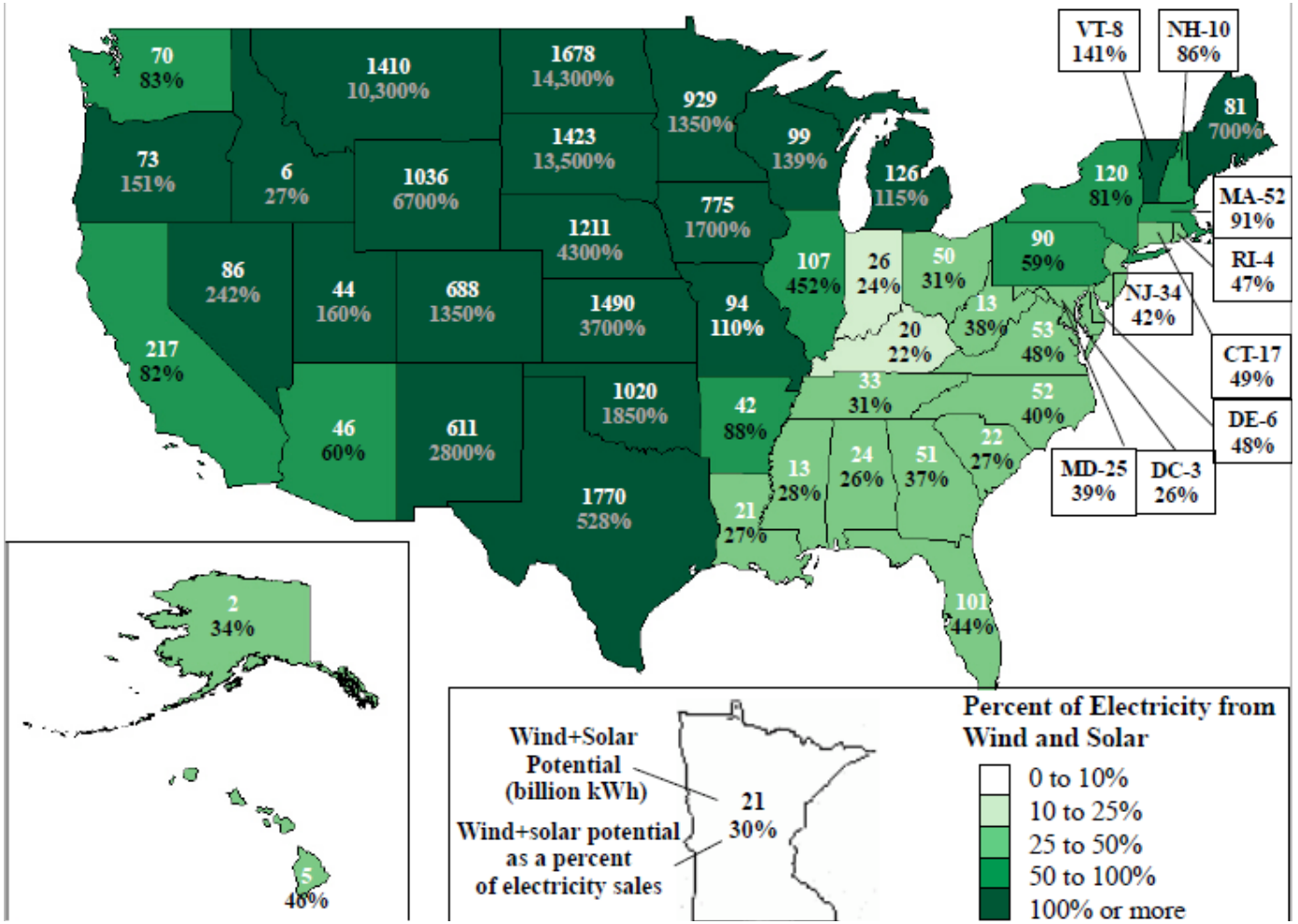
Regional Potential: Geothermal



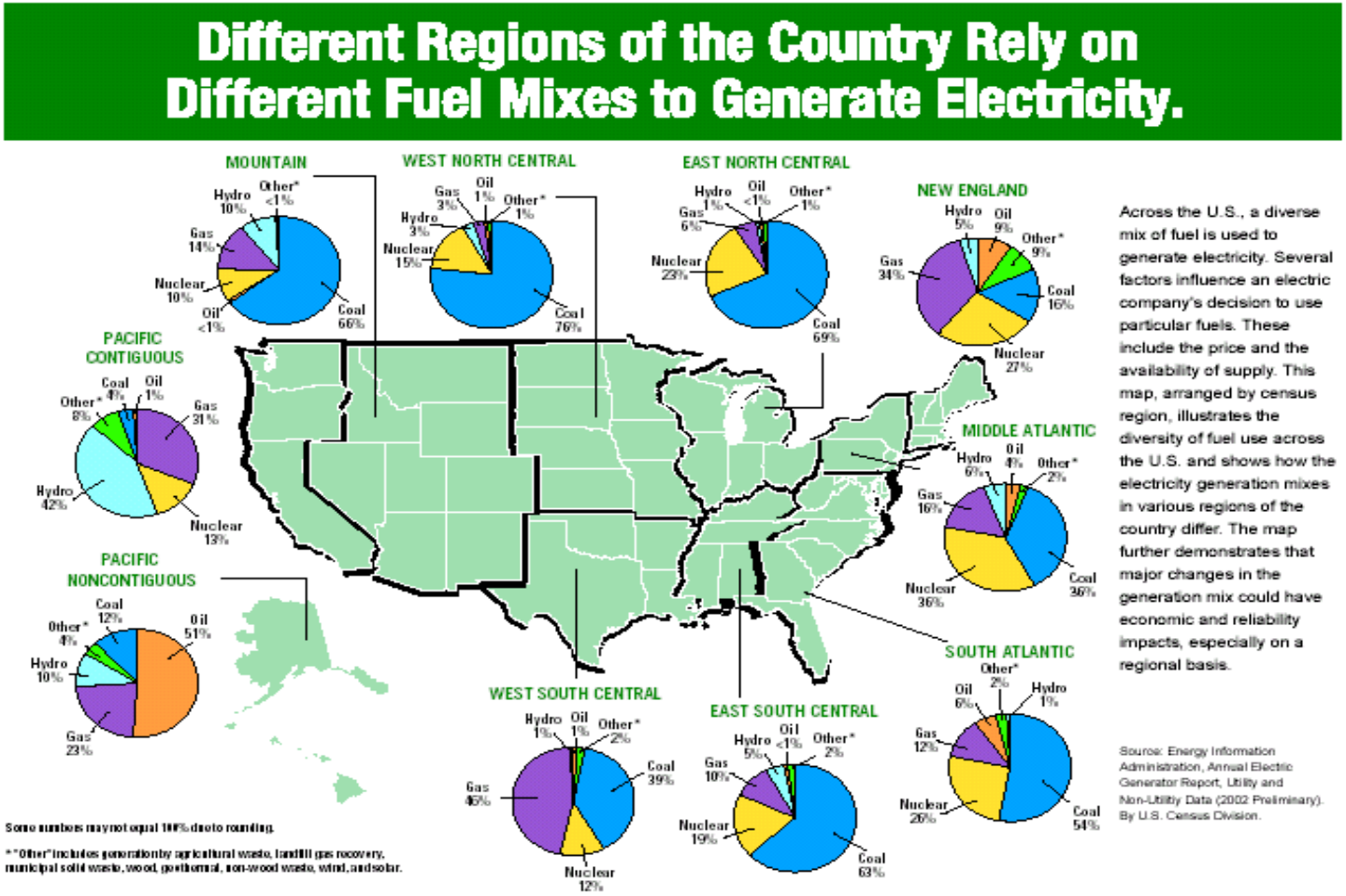
Regional Potential: Biomass



Potential Electricity Self-Reliance on Wind and Rooftop Photovoltaics Institute for Local Self-Reliance 2008



Regional Fuel Differences



Federal Energy Policy
Another Approach to Renewable Electricity

- No federal standard
- Require a state standard
- Establish a national Renewable Energy Credit Program

Federal Energy Policy
Another Approach to
Renewable Electricity

- Reward states for ambitious goals by granting exceptions to dormant commerce clause restrictions
- Allow for discretion in the use of RECs
- Allow feed-in tariffs

Federal Energy Policy Another Approach to Grid-Related Storage

- Vastly expand RD&D
- Distribute funds to individual states based on the size of the state commitment

Federal Energy Policy
Another Approach to Energy Efficiency

- Must be a separate program
- States must set goals
  - Objectives (just speed up changes?)
  - Target penetration
- Require an aggressive effort aimed at renters
- Consider 3rd party management of ratepayer-funded programs

“[T]he solution of our energy crisis can also help us to conquer the crisis of the spirit in our country. It can rekindle our sense of unity, our confidence in the future, and give our nation and all of us individually a new sense of purpose.“

Jimmy Carter July 15, 1979.

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