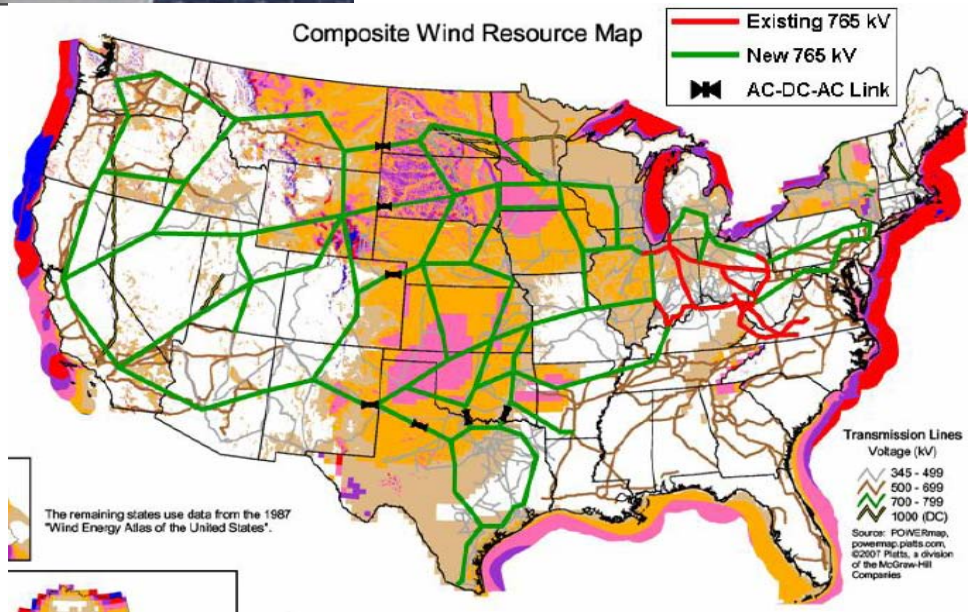
Dealing with climate change: The balance between local power and big transmission

Bill Powers, P.E., University of San Diego, May 8, 2009

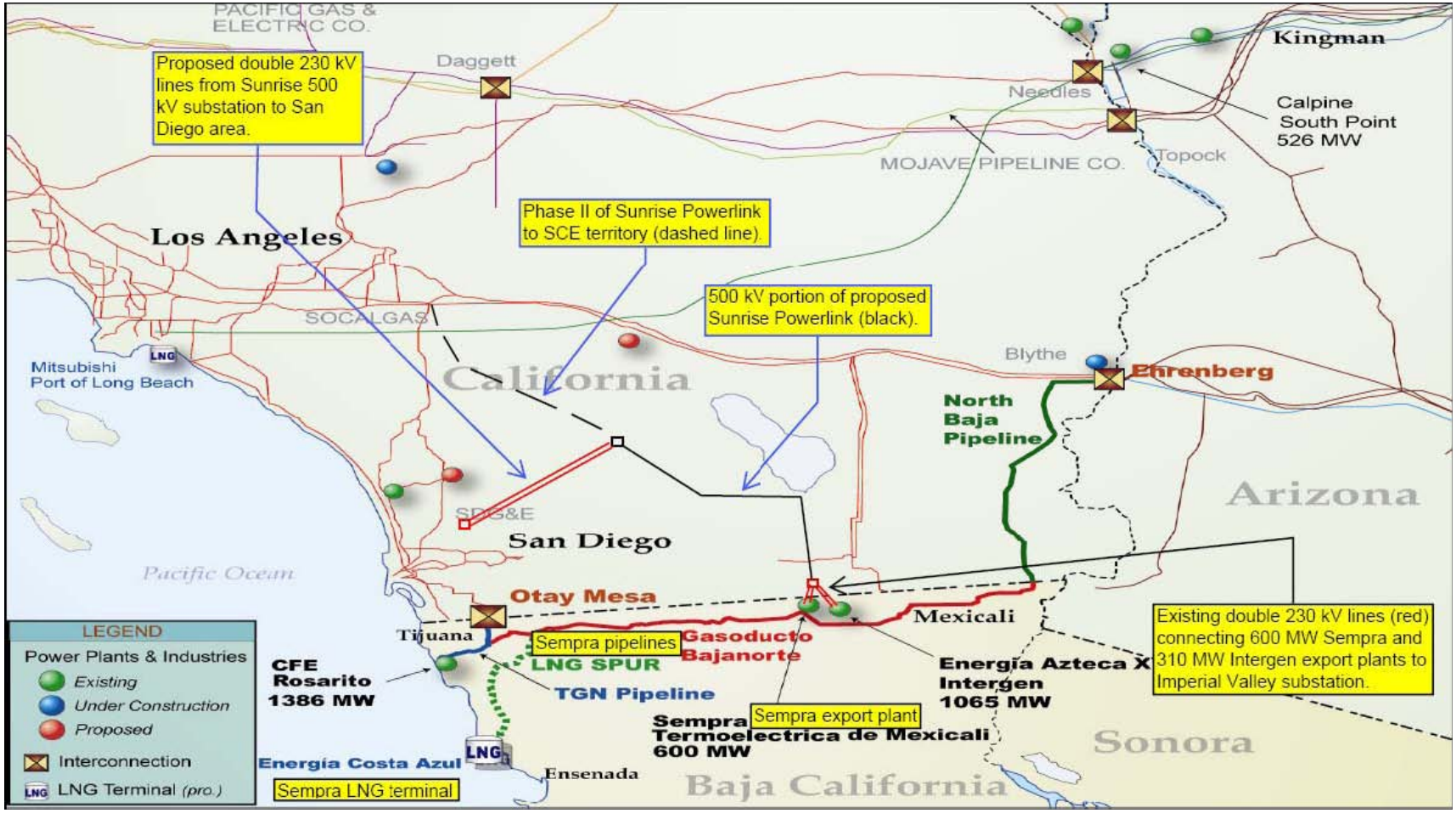


Sunrise Powerlink rejected in October 31, 2008 utilities commission proposed decision

- October 31, 2008 proposed decision by California Public Utilities Commission administrative law judge rejects Powerlink.
- Unnecessary to meet 20% renewable energy requirement, not cost-effective.
- Governor issues executive order requiring 33% on November 17, 2008.
- Peevey alternate issued Nov. 18, 2008, approving Powerlink with no compliance plan.
- Sunrise approved by CPUC with no renewable energy requirements on Dec. 18, 2008.

What is the holding company up to? Sempra/SDG&E regional energy infrastructure

note: Sempra gas-fired power plants in western Arizona (1,250 MW), Las Vegas (480 MW), Kern County (550 MW) are not shown in graphic.



Obama’s high-wire electric act

Christian Science Monitor, January 28, 2009 (editorial)

President Obama, citing a need to curb global warming, wants new transmission lines across America to carry electricity from carbon-free energy sources.

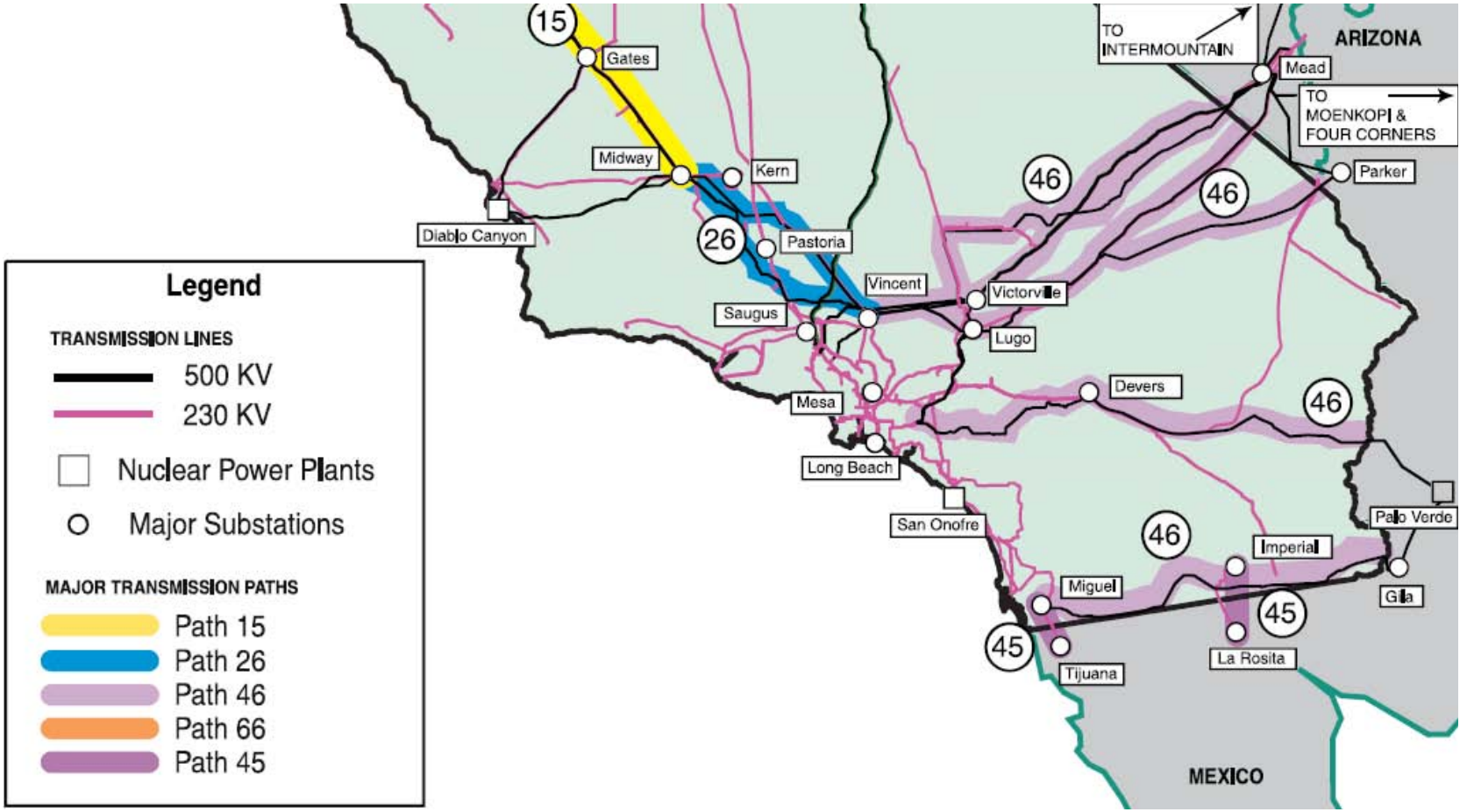
One problem with this approach is that it is too national and potentially Big Brotherish in its methods.

What's needed are "microgrids," or small-scale electricity distribution systems with many sources and local storage – much like the Internet – with a centralized long-distance system only as backup.

Denmark, which relies on renewables for nearly a third of its electricity, has moved to microgrids.

Before Obama starts forcing people off their land for a worthy global cause, he should first think local. Many people – and states – are already ahead of him.

Utility sees its revenue piece of renewable energy pie as new transmission. 20,000 MW supplying SoCal today, average SoCal load is 14,000 MW



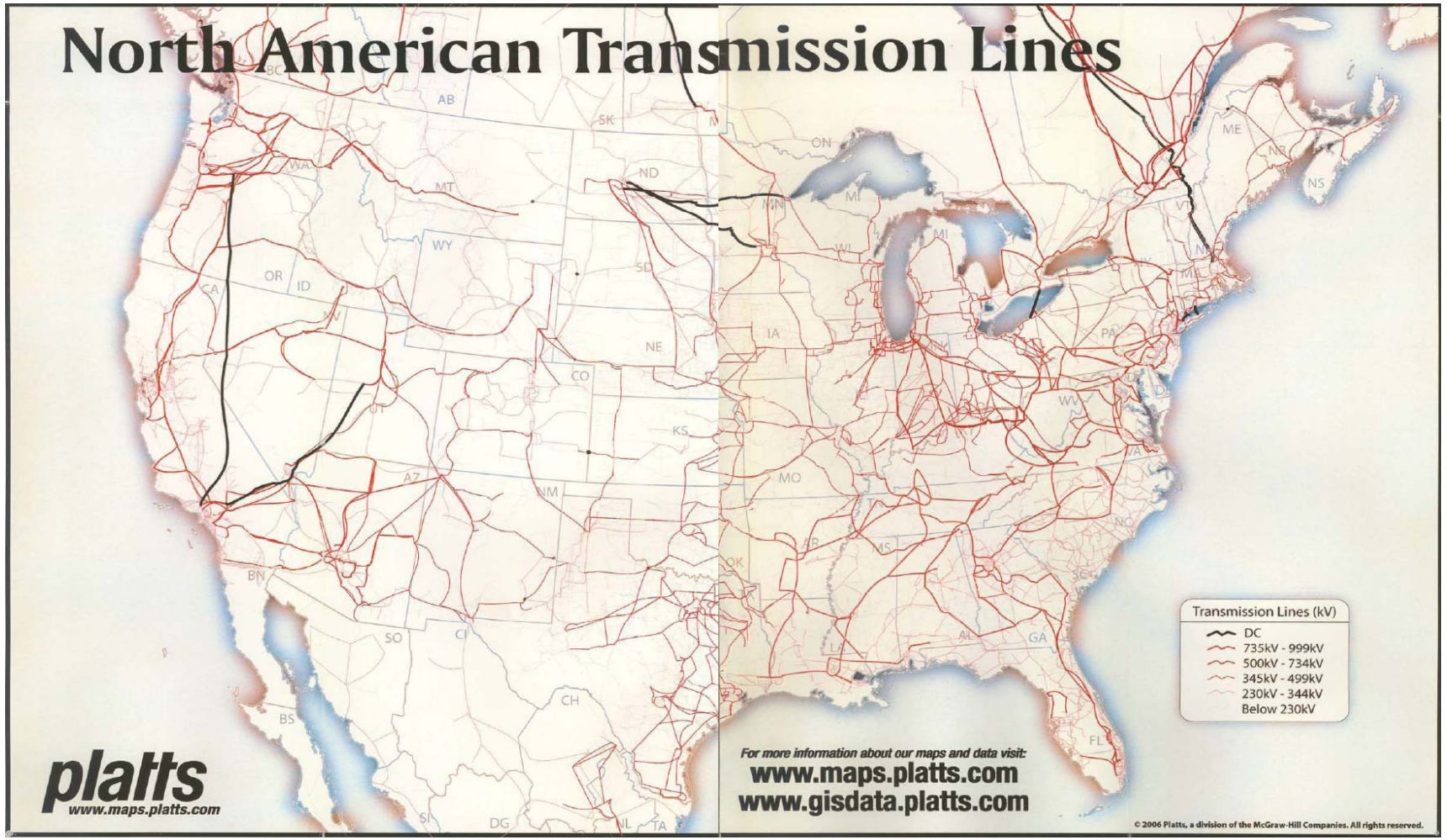
Investor-owned utility background: protect investors, eliminate competition

source: J. Goodell, “Big Coal”, 2006.

- Concept developed by Samuel Insull, assistant to Thomas Edison.
- Competing model was JP Morgan sale of equipment directly to users, distributed generation model.
- Advocated for monopoly status for investor-owned monopoly utility subject to “regulation” by (compliant) utilities commission.
- Assures market and good profit with little or no risk, effectively bars competition.
- Profits generated by building infrastructure (transmission lines, power plants, meters).
- Highest profit for transmission lines.
- Example: SDG&E will receive $1 billion in profit (2010 dollars) over 40-year life of $2 billion transmission line.

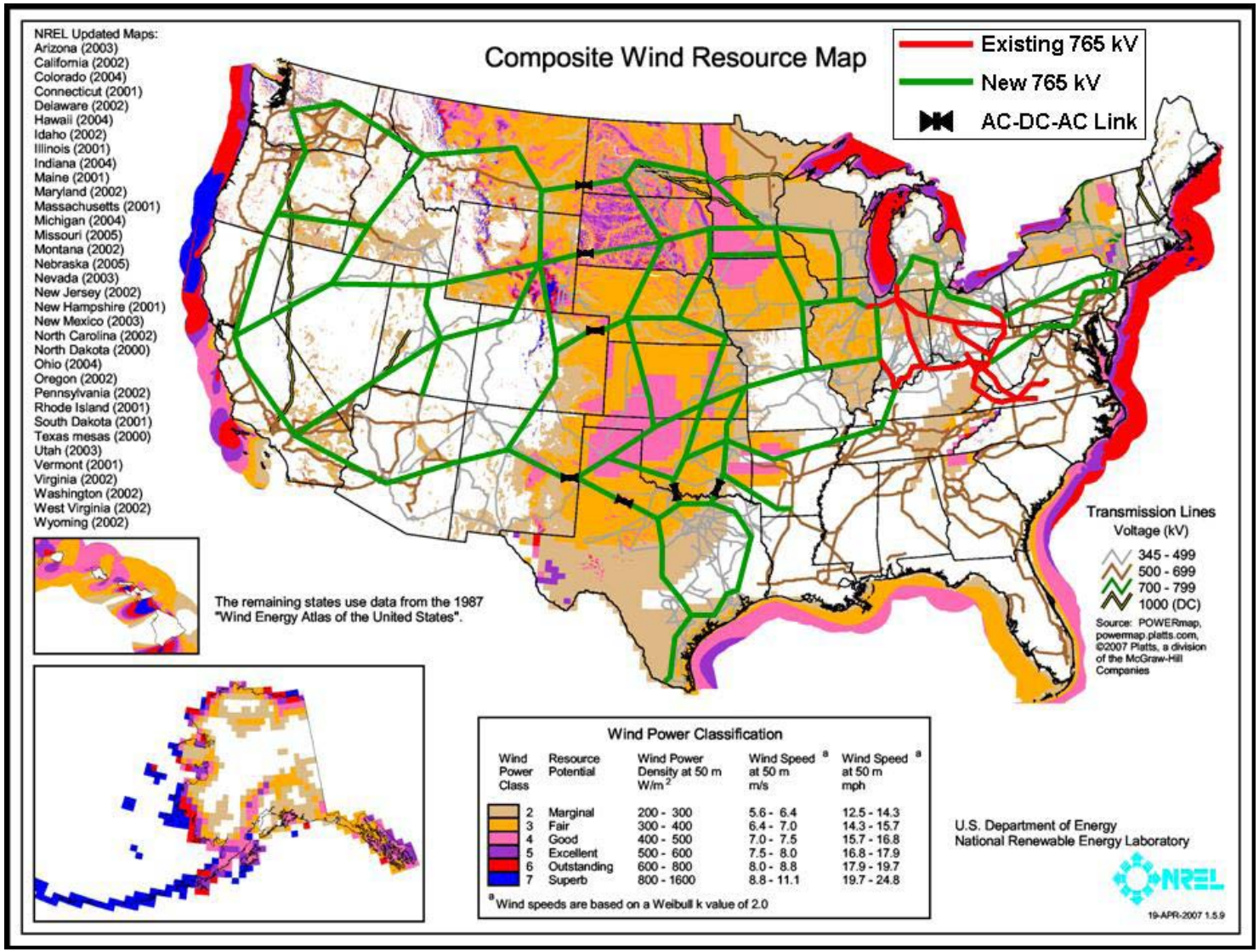
527,000 miles of existing high voltage transmission – Is it being used efficiently?

source of 527,000 miles: NYT, Hurdles (Not Financial Ones) Await Electric Grid Update, February 7, 2009



Utility view of the renewable energy future: Great Plains wind high voltage transmission grid

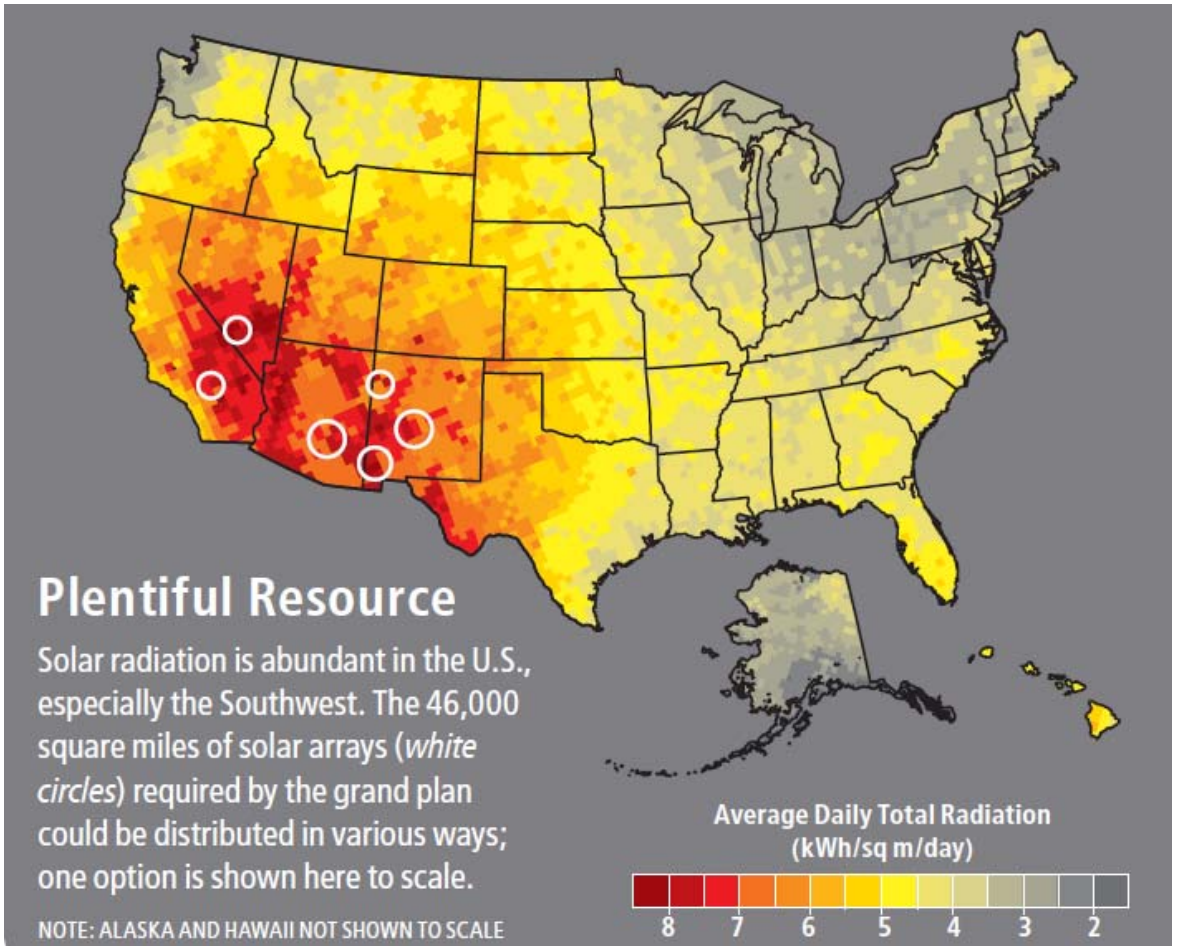
source: American Electric Power, Interstate transmission vision for wind integration – white paper, 2008.



Scientific American: “A solar grand plan”

source: Scientific American, *A grand plan for solar energy*, January 2008.

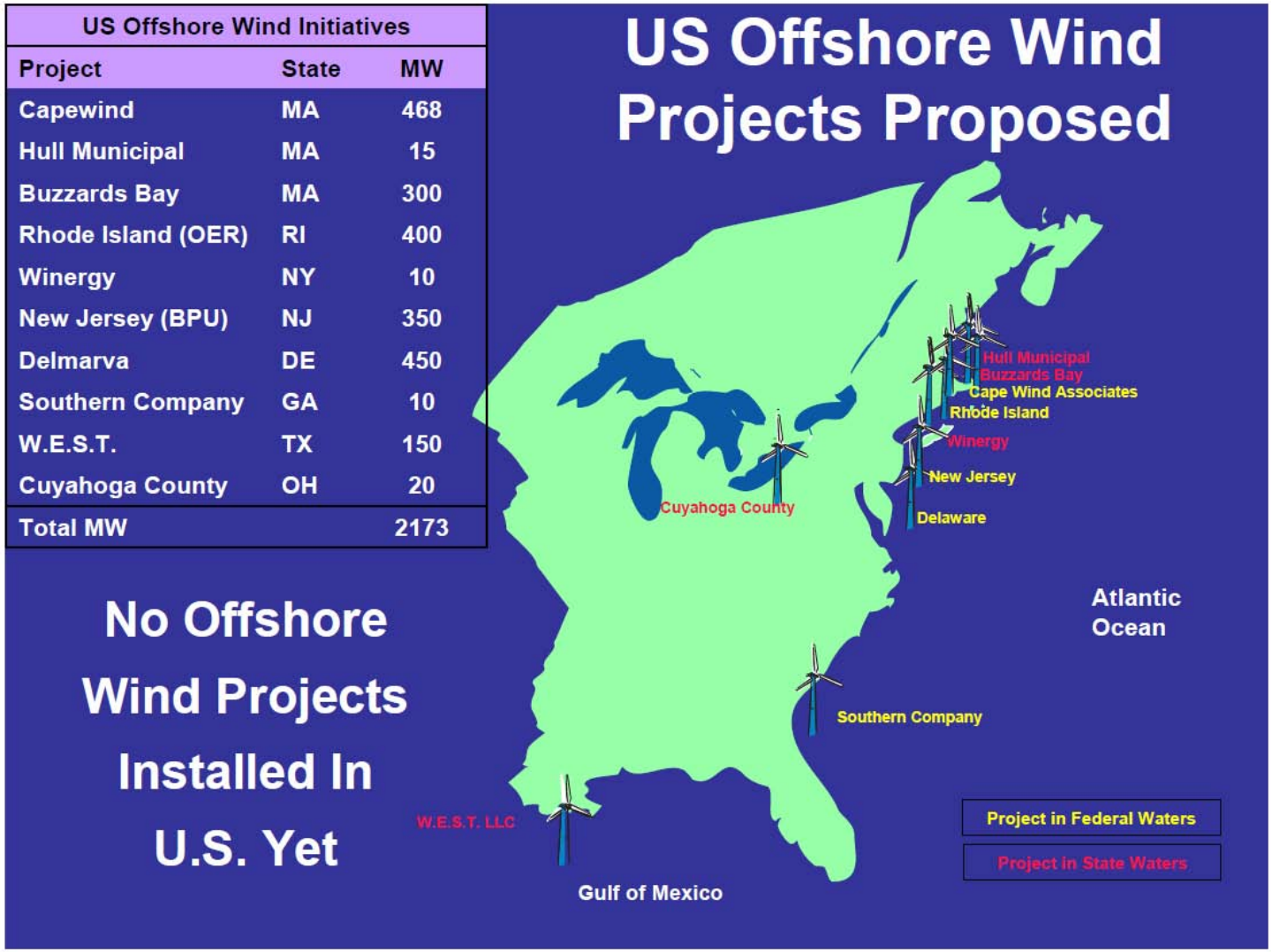
- “To convert the country to solar power, huge tracts of land would have to be covered with photovoltaic panels and solar heating troughs.”
- “A direct-current (DC) transmission backbone would also have to be erected to send that energy efficiently across the nation.”
- “The AC system is also simply out of capacity, leading to noted shortages in California and other regions.”
- 100,000 to 500,000 miles of new high voltage DC grid.
- $420 billion in subsidies needed for solar plan.
- “The HVDC transmission companies would not have to be subsidized, because they would finance construction of lines and converter stations just as they now finance AC lines, earning revenues by delivering electricity.”



US Offshore wind projects in development

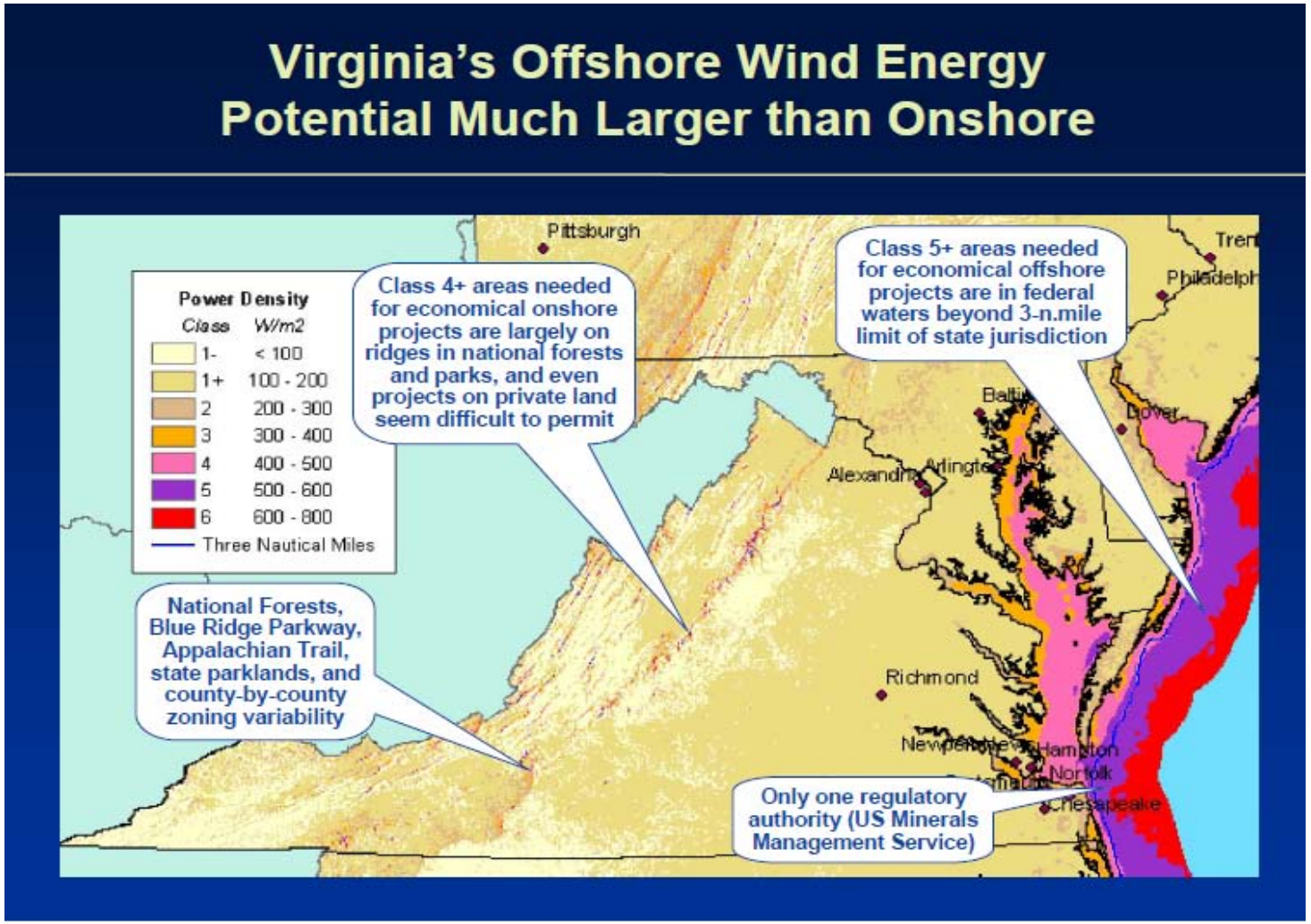
source: W. Musial, NETL, *Wave, Wind and Tidal Technologies and Future Trends*, presented at Alternative Energy Development in the West Coast Ocean Environment, Portland, Oregon, September 23, 2008.

US Offshore Wind Initiatives		
Project	State	MW
Capewind	MA	468
Hull Municipal	MA	15
Buzzards Bay	MA	300
Rhode Island (OER)	RI	400
Winergy	NY	10
New Jersey (BPU)	NJ	350
Delmarva	DE	450
Southern Company	GA	10
W.E.S.T.	TX	150
Cuyahoga County	OH	20
Total MW		2173



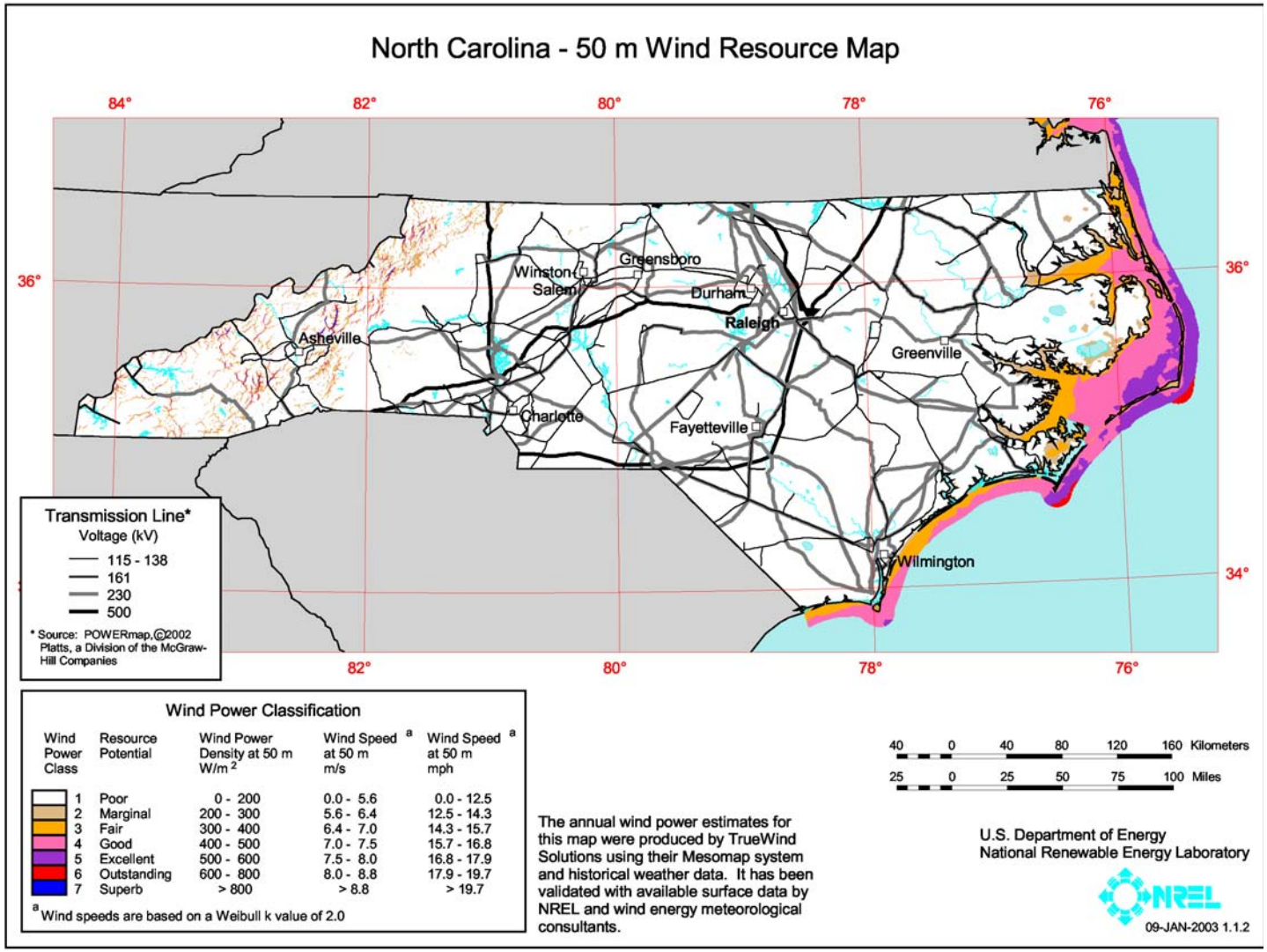
Over-emphasis on remote renewable energy and new transmission on sensitive lands will lead to gridlock - smarter local solutions are at hand

source of graphic: G. Hagerman – Virginia Tech, *Challenges and Opportunities for Offshore Wind Power in Virginia*, Southeast Regional Offshore Wind Power Symposium**,** Charleston, SC, February 27, 2007.



North Carolina has outstanding wind resources close to existing high voltage transmission

source: Southeast Regional Offshore Wind Symposium, 2007: http://www.clemson.edu/scies/Wind.htm



Regional offshore wind may be lower cost of energy than Great Plains wind when all cost and performance issues are considered

source: CEC, Renewable Energy Transmission Initiative Phase 1A Final Report, August 2008, p. 1-8.

	Capital Cost ($/kW)	Transmission Cost ($/kW)	Total installed cost ($/kW)	Capacity factor (%)	Least cost of energy
Great Plains wind	2,000	2,000	4,000	25 - 40	
NC offshore wind	5,000	Tie-in to existing transmission assumed in capital cost.	5,000	35 - 45	yes

2003 California Energy Action Plan prioritizes local power

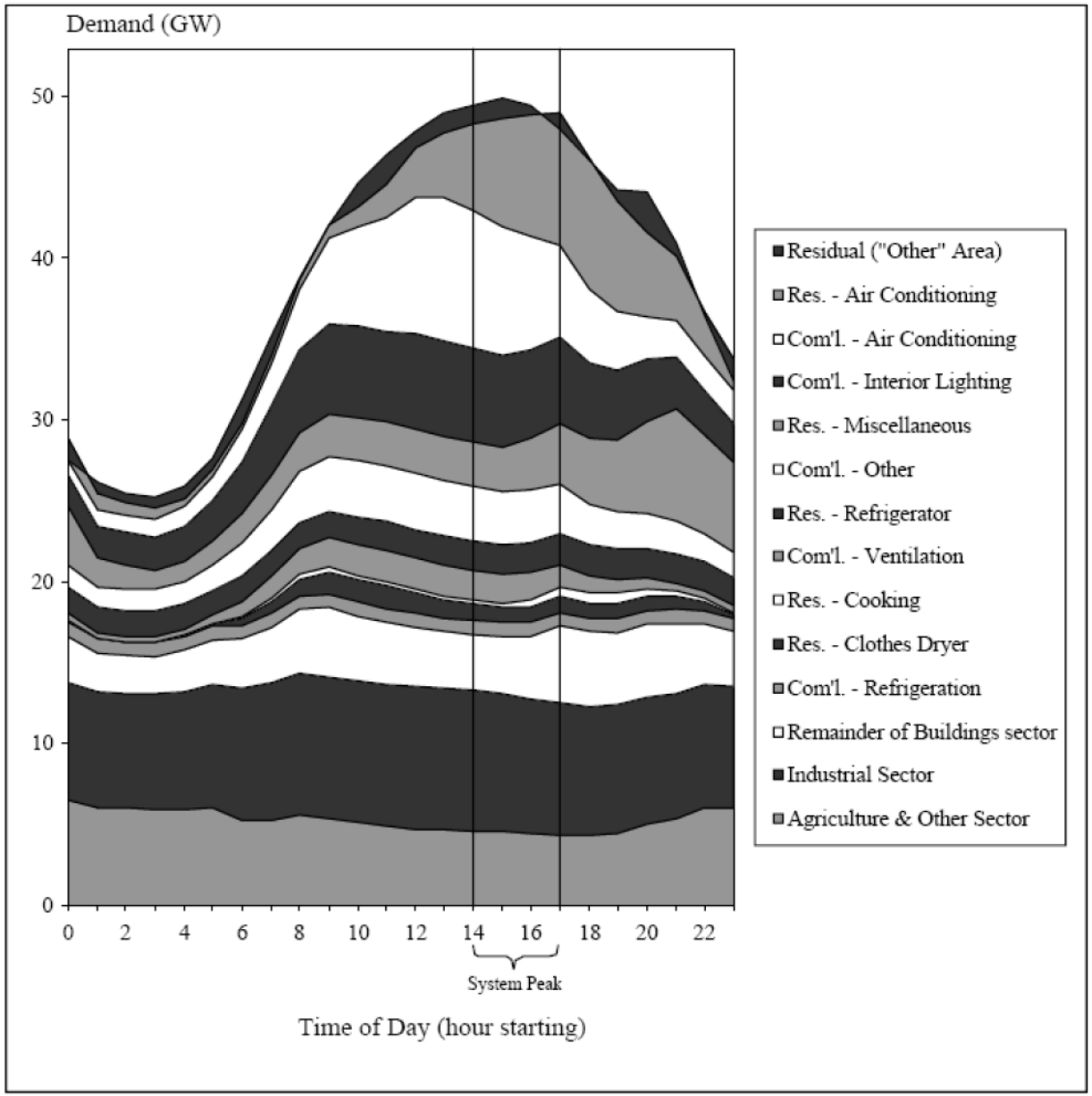
- Energy Action order of preference, also known as the “loading order”:

  1. energy efficiency
  2. demand reduction
  3. renewable energy
  4. non-renewable distributed generation
  5. utility-scale natural gas-fired power generation
  6. transmission

State steps to implement Energy Action Plan

Element	Action
1. Energy efficiency	2007 CPUC risk/reward incentive mechanism, potential to reach same profit margin as generation or transmission.
2. Demand response	2007 CPUC approval of smart meters, nascent controllable thermostat program.
3a. Renewable energy - local	CSI, AB 1969 (standard offer contract), AB 811 (EE and PV paid via property taxes).
3b. Renewable energy - remote	AB 107 (20% renewable energy by 2010), AB 32 (GHG reduction act).
4. Combined heat & power	AB 1613 (standard offer contract) - implementation problem has been low rates.
5. Utility-scale gas-fired generation	CPUC authorizes with 8-9% guaranteed profit.
6. Transmission ($\geq$ 69 kV)	CPUC authorizes with 11-12% guaranteed profit.

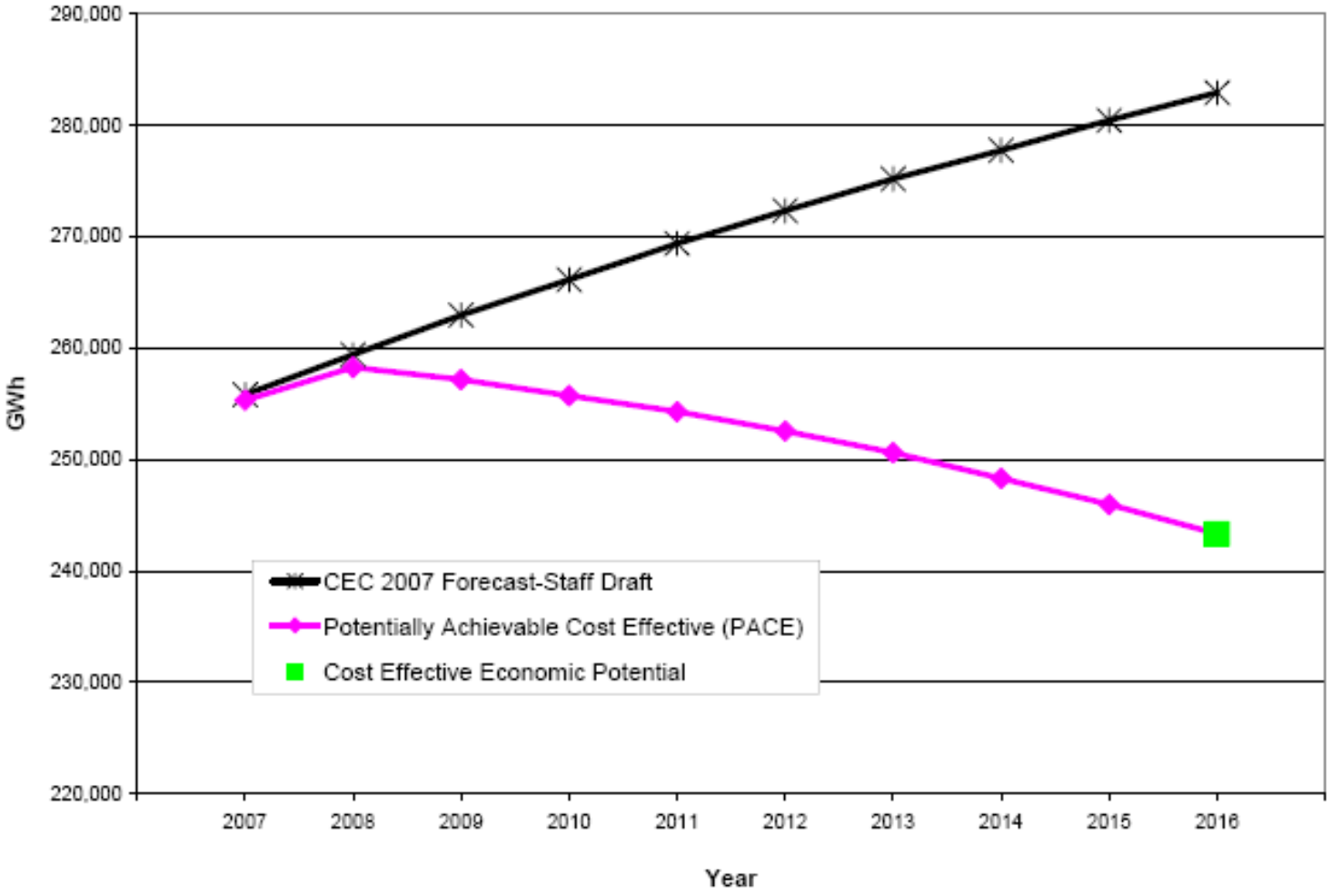
Representative California peak load profile



How would you implement the EAP if you had a blank slate?

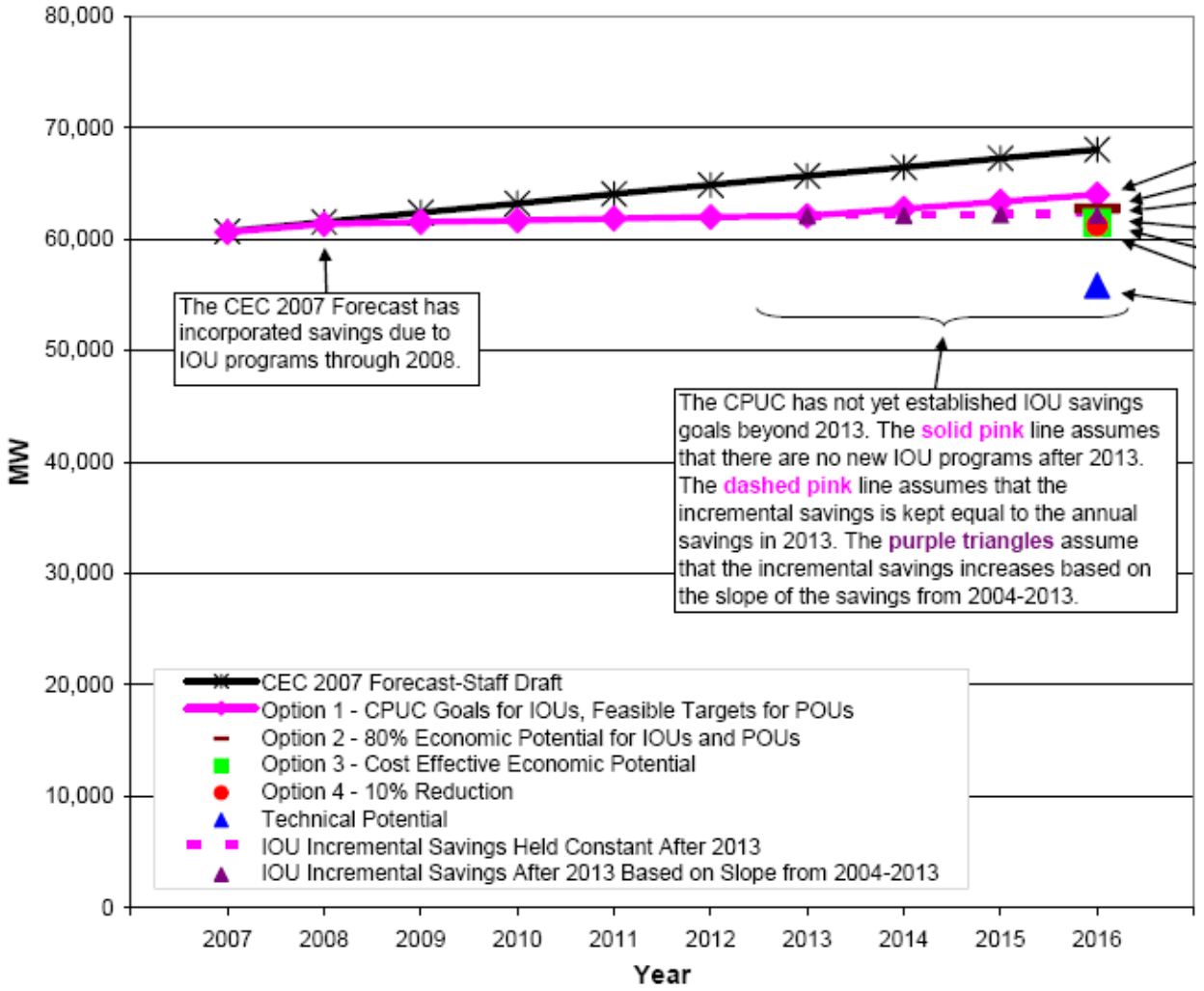
October 2007 energy efficiency decision – California Public Utilities Commission gets serious and energy usage drops continuously over time

source: CEC, Achieving All Cost-Effective Energy Efficiency for California, December 2007, Figure 38, p. 103.



Peak demand stays flat for foreseeable future as result of Utilities Commission 2007 decision

source: CEC, Achieving All Cost-Effective Energy Efficiency for California, December 2007, Figure 33, p. 96.



Comverge smart thermostat – smart, low cost solution to peak demand

- Utility signals thermostat during peak demand.
- Thermostat modulates on/off cycle, little or no change in customer comfort level.
- Austin, TX utility installs 45,000 smart thermostats, $150 each.
- Reduces peak load by 45 MW at less than 1/5th cost of 45 MW peaking gas turbine w/ no greenhouse gas emissions.
- SDG&E initiating program utilizing Comverge smart thermostat – unclear how many units will be installed

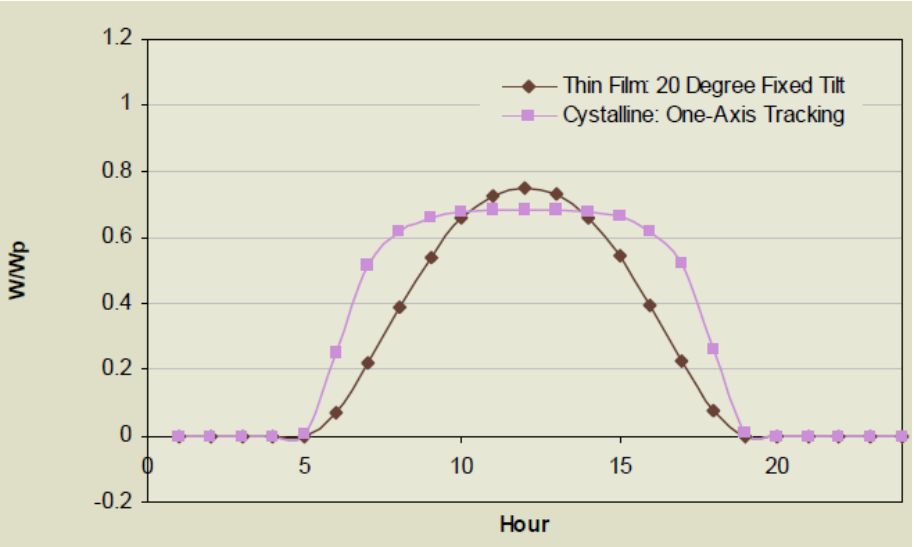
SDG&E's peak load dropped nearly 300 MW between 2007 and 2008, energy demand dropping around the country

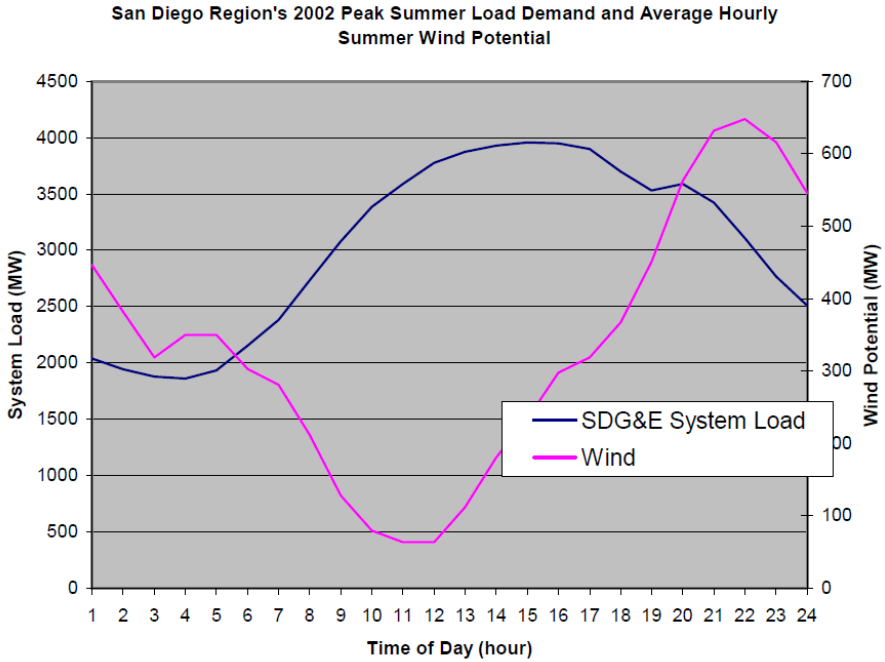
- 2007 peak: 4,636 MW
- 2008 peak: 4,348 MW
- reduction: - 288 MW

Sources:

1. CAISO OASIS 24-hour load database for each investor-owned utility.
2. Wall Street Journal, Decline in power usage catches utilities off guard, November 23, 2008.

PV and wind: summer output profiles





CEC cost estimate for thin-film PV is one-half cost of dish Stirling solar power without considering cost of Sunrise Powerlink

- RETI estimate for thin-film PV: $3,700/kW a/c
- CEC estimate for dish Stirling: $6,000/kW a/c
- Cost of Powerlink: ~$2,000/kW
- Combined cost, dish Stirling + Powerlink: ~$8,000/kW

sources:

1. CEC thin-film cost estimate: RETI Phase 1B final report, Jan 09, p. 5-27.
2. CEC dish Stirling cost estimate: CEC Comparative Costs of California Central Station Electricity Generation Technologies, December 2007, Appendix B, p. 49.
3. Sunrise Powerlink cost esdtimate: SDG&E ex parte notice, CPUC proceeding A.06-08-010, Nov. 14, 2008, p. 2, $1.883 billion.

Thin-film PV: remote or urban and distributed

- 21,000 MW of thin-film PV projects in BLM queue alone (RETI, August 08).
- PV is more cost-effective than solar trough at current thin-film PV pricing of $3,700/kW a/c (RETI, January 09)
- Sempra has announced ~1,000 MW of thin-film PV projects/applications using First Solar PV.
- Sempra is momentarily operator of largest thin-film PV installation in country producing “lowest cost solar power in world” - $0.12/kWh without CSI incentives (10 MW AC, Boulder City, NV).
- Governor Schwarzenegger announces “33% renewable energy target by 2020” executive order at OptiSolar thin-film PV plant in Sacramento, November 17, 2008.

SCE 250 to 500 MW urban warehouse PV project 2008 using low-cost thin-film PV

1.2 MW Non-Penetrating Solar PV
System on Commercial Rooftop in Sacramento, CA

Los Angeles Solar Energy Plan: 400 MW PV by 2014, 780 MW by 2020

Los Angeles Solar Energy Plan vs. SDG&E's San Diego Solar Project

- Los Angeles Dept. Water & Power
- Peak load: 6,000 MW
- Ave. load: 3,000 MW
- Urban PV by 2014: 400 MW
- Urban PV by 2020: 780 MW

- San Diego Gas & Electric
- Peak load: 4,500 MW
- Ave. load: 2,500 MW
- Urban PV by 2013: 35 – 50 MW
- Urban PV by 2020: no target

Example: San Diego County PV potential is vast

Commercial buildings: 1,600 to 1,800 MW (www.renewablesg.org)
Commercial parking lots: 3,000 MW
Residential: 2,800 MW
Total PV potential: ~7,500 MW
Highest demand ever recorded in SDG&E territory: 4,600 MW

PV and parking lots

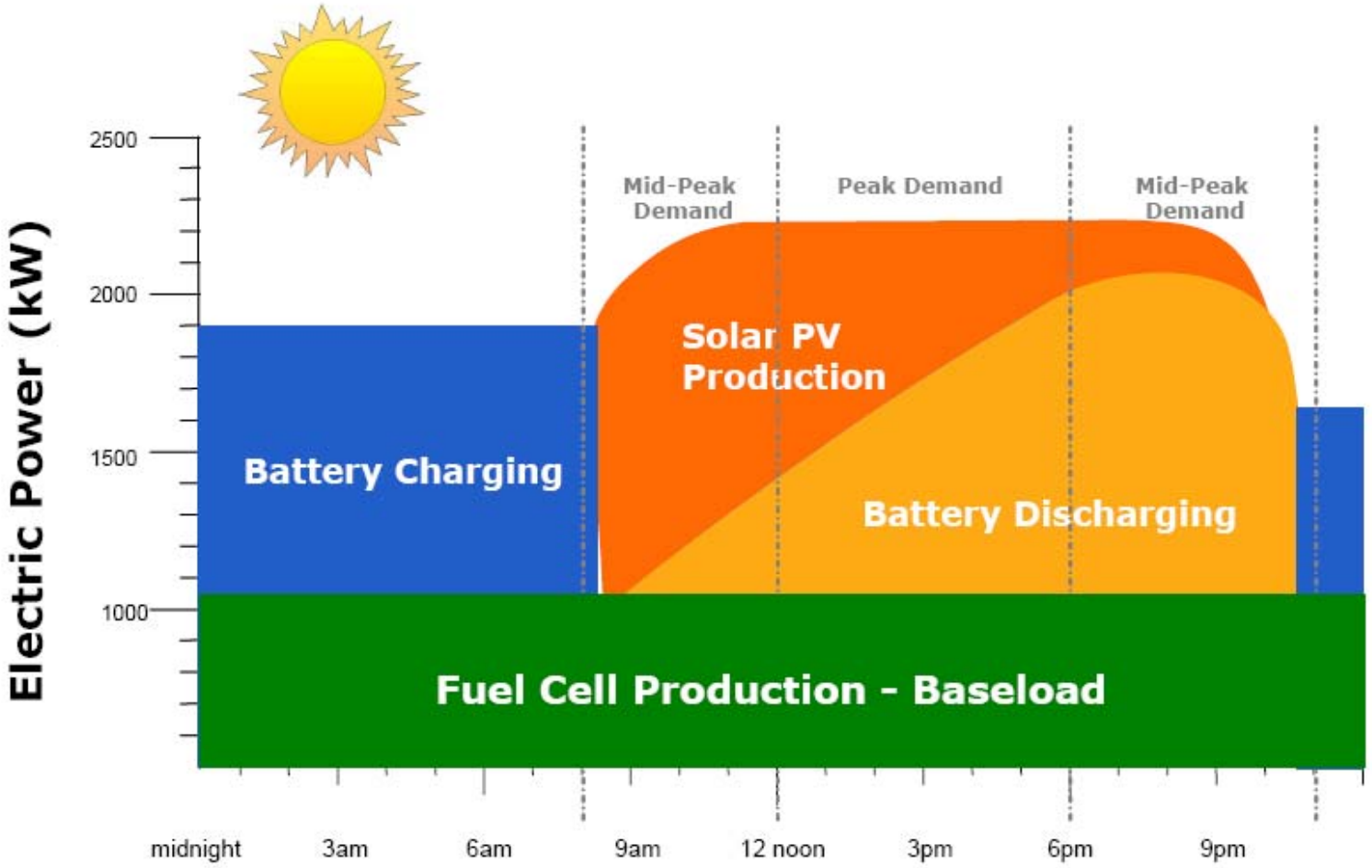
Presentation by Chevron Energy Solutions, Solar Forum at Diablo Valley College, Feb. 8, 2008

PV for parking lot- shade is added value

Presentation by Chevron Energy Solutions, Solar Forum at Diablo Valley College, Feb. 8, 2008

Combining storage w/ PV to match peak demand

Presentation by Chevron Energy Solutions, Solar Forum at Diablo Valley College, Feb. 8, 2008



34 MW sodium-sulfur battery storage system at wind farm in Japan

source: Megawatt Farms, Inc., CEC presentation, August 21, 2008.

Combined heat & power – lowest CO_2 emissions, energy savings, good for local economy

source: Solar Turbines cogeneration project case studies - http://mysolar.cat.com/cda/layout?m=41110&x=7

26 MW UCSD CHP

- plant provides up to 90% of campus electricity and 75% of steam demand.
- UCSD saves nearly $250,000 per month by producing its energy instead of purchasing from SDG&E.

5 MW Veteran's Hospital CHP

- contract guarantees $1.3 million per year in savings.
- new turbine installed in same building that housed old turbines.

Local energy efficiency, demand response, PV, and CHP is least-cost, lowest greenhouse gas, most local jobs

- No technical or economic impediments.
- Readily available thin-film PV is now more cost-effective than other forms of solar power like dish Stirling.
- Hurdles are institutional – utilities make best money building transmission lines to serve large remote projects.