Electric Power Transmission and Distribution Developments in the West and Southwest

NM Science, Technology, and Telecommunications Committee
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Mike Hightower
Distinguished Member of the Technical Staff
Sandia National Laboratories
(505) 844-5499
mmhight@sandia.gov

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Presentation Overview

- Recent Hype on Transmission Development in the Southwest
- Reality of Expected Energy and Transmission Development in the West
- DOE Smart Grid Initiative and Current Directions
  - Utility interests and drivers
  - DOE drivers
  - Impacts on transmission and distribution development
  - Distribution provider impacts

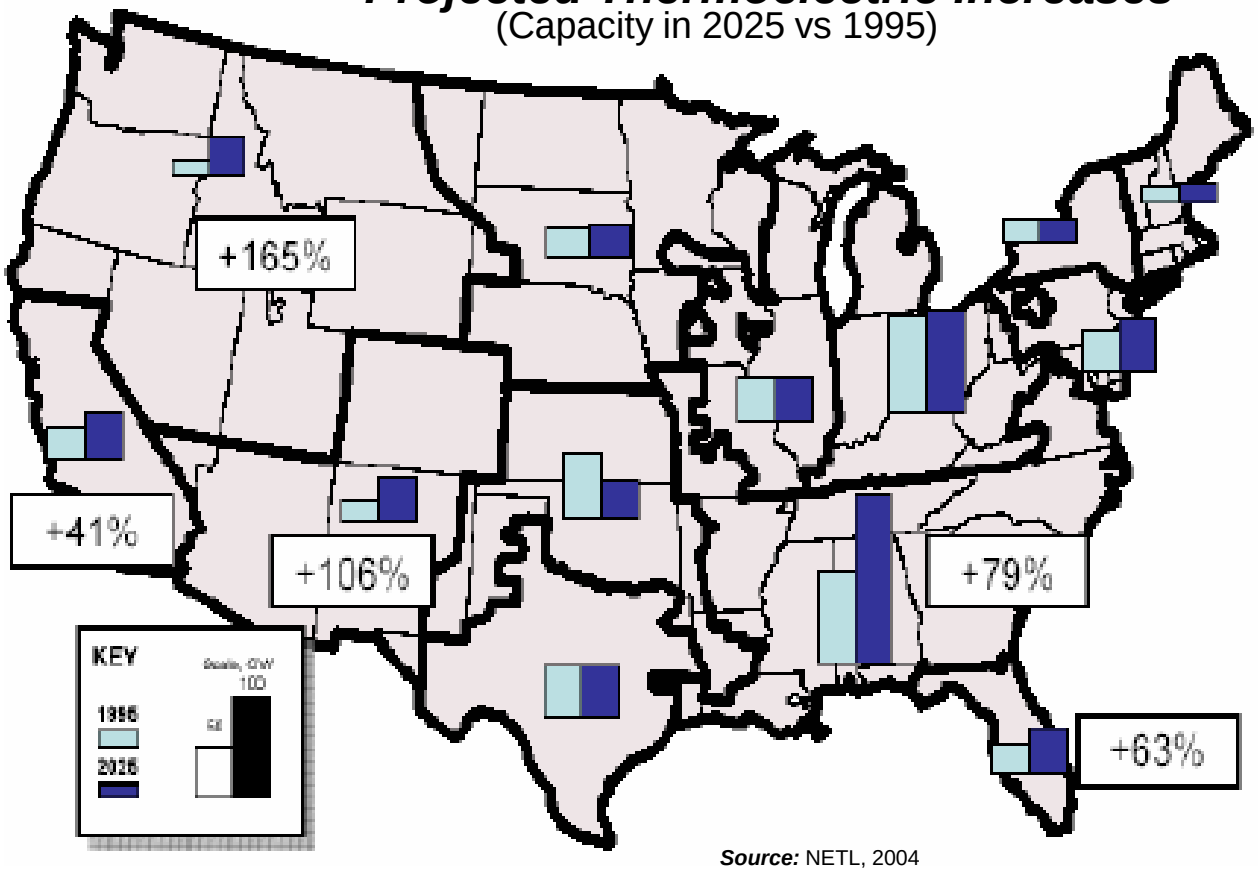
Electric Power Plant Major Location Selection Criteria

- A traditional thermoelectric power plant is located based on four major technical criteria:
  - Access to a fuel supply
  - Access to transmission capacity
  - Access to a water supply for cooling water
  - Airshed quality
- A renewable energy power plant is located based on <u>similar</u> technical criteria, plus:
  - Appropriate quality and appropriate areal extent (land) based on distributed resource (wind, geothermal, solar, biomass, hydro)
  - Managing intermittency of the resource (wind, solar, biomass, hydro)

Growth in Thermoelectric Power Generation

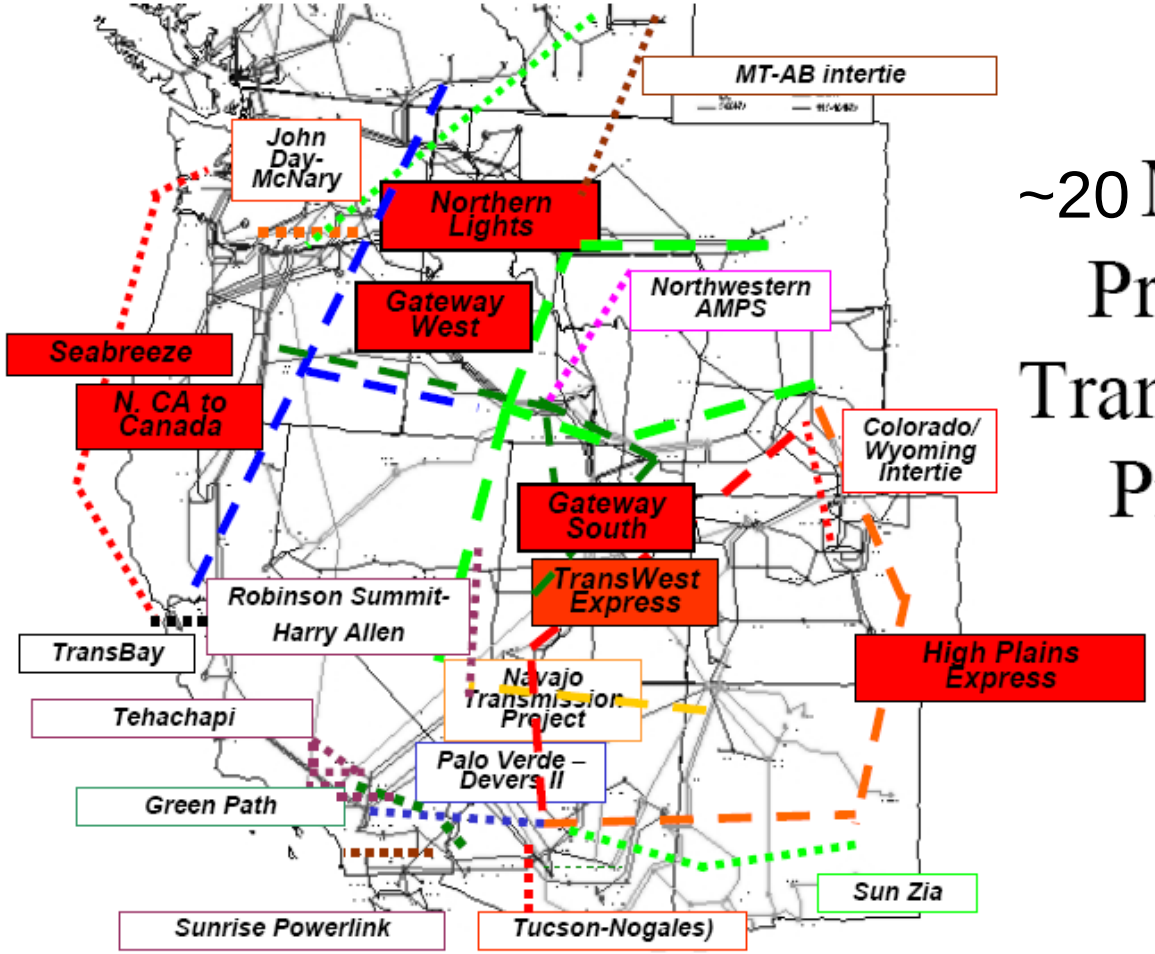
- Most growth in water stressed regions
- Most new plants expected to use evaporative cooling

Projected Thermoelectric Increases
(Capacity in 2025 vs 1995)



Source: NETL, 2004

The majority of lines under development are meant to access coal and wind, but several could access solar projects

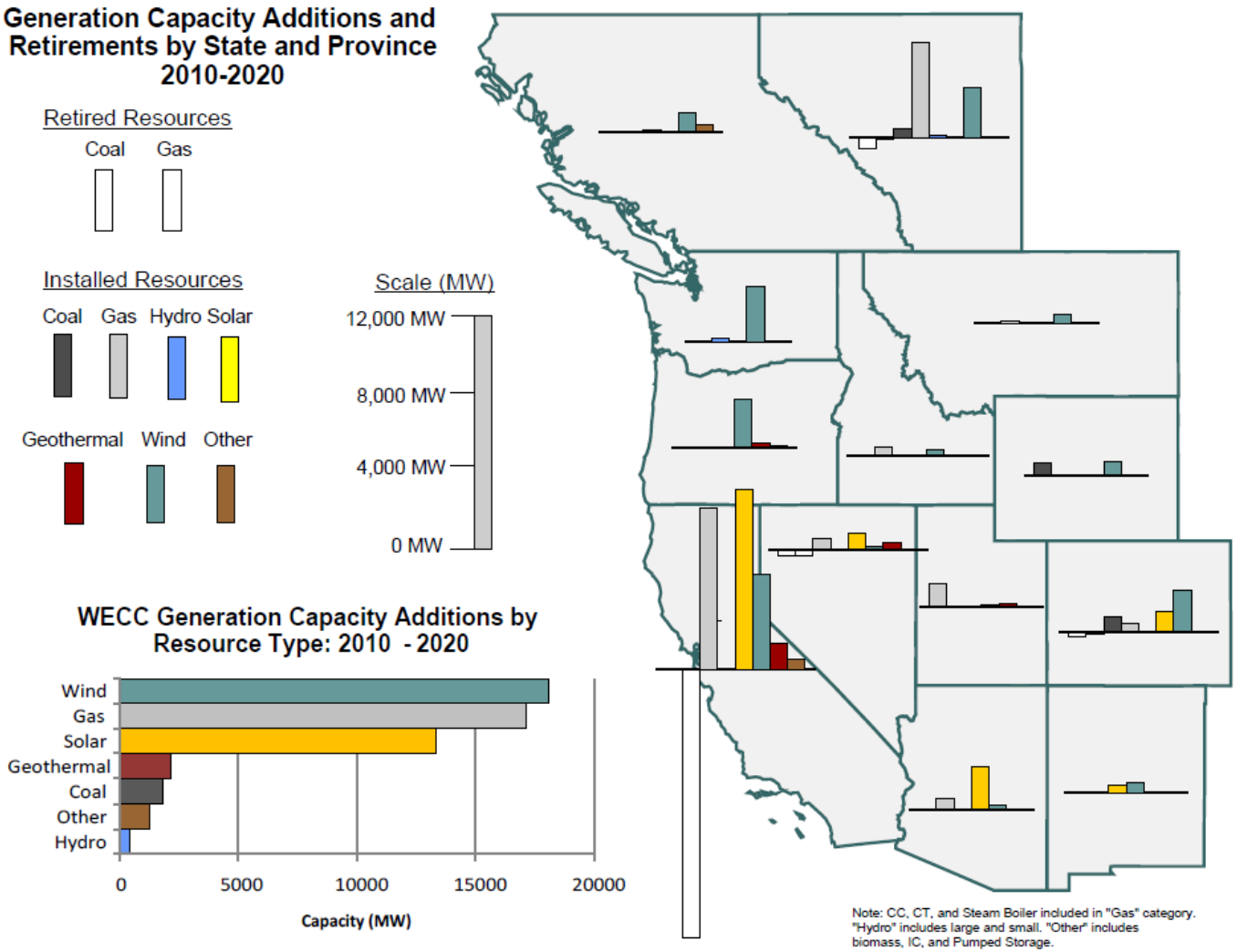


~20 Major Proposed Transmission Projects

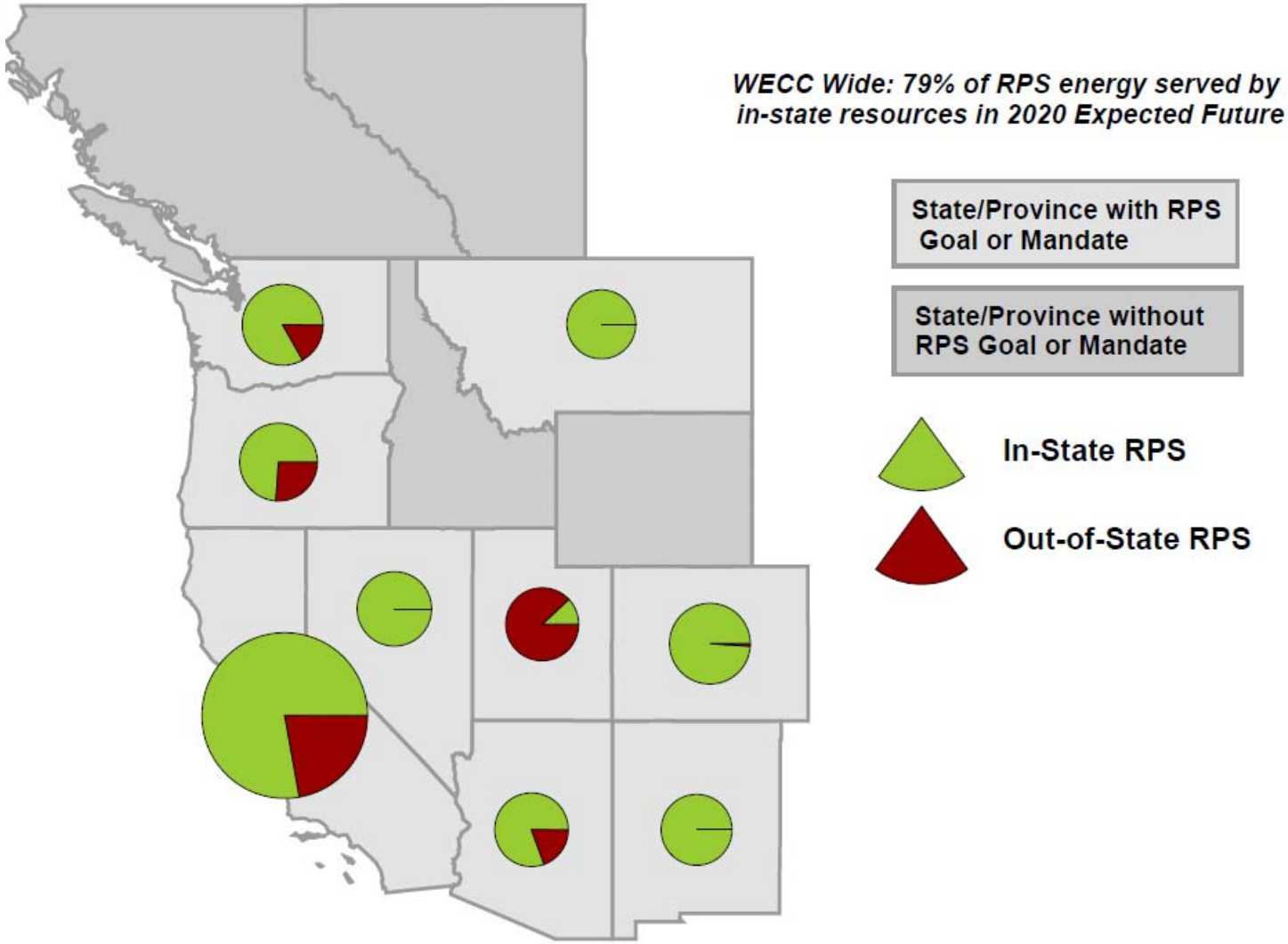
Utility-Scale Solar Opportunities and Needs

- Connected directly to transmission grid
  - Voltage > 69 kV
  - To date all PV systems are <69kV, though some are in planning
  - Kramer Junction Troughs are 115 kV
- As of August 2008 …
  - CSP
    - 3,000 MW advanced stage of planning
    - 33,000 MW in CA ISO queue
    - 69,000 MW of applications to BLM
  - PV
    - 11,000 MW in CA ISO queue
    - 21,000 MW of applications to BLM
- Expected CSP needs in the Southwest– 6,000-10,000 MW

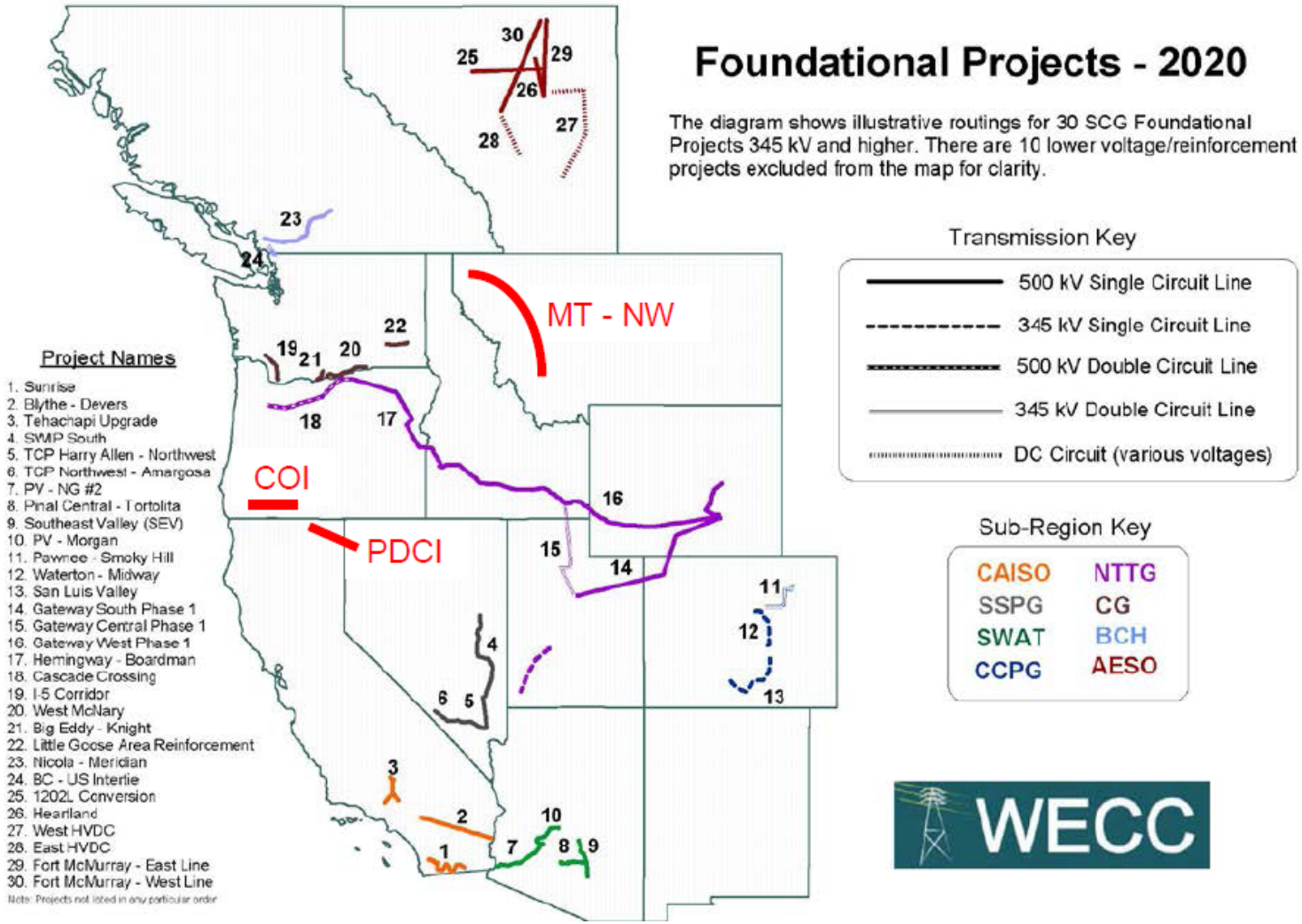
Expected Generation



States possibly Looking for Additional Renewable Power



WECC Identified Major Transmission Projects



Identified Western US Cost Effective Transmission Projects

Case		Cost Estimates ($M/yr)[31]			
Resource Relocation	Transmission Expansion	12,000 GWh of Resources	Incremental Transmission	Change in Production Cost Relative to Expected Future	Net Change in Cost
Expected Future		1,810	-	-	-
Arizona/ Southern Nevada	Phoenix-Mead-Adelanto AC to DC Conversion	1,638	116	(49)	(105)
Arizona/ Southern Nevada	Green Energy Express Phase 2&3 HVDC	1,638	207	(44)	(9)
New Mexico	Centennial West Clean Line HVDC	1,109	369	11	(321)
Montana	Chinook HVDC	956	529	(17)	(342)
Wyoming	Zephyr HVDC	813	418	2	(577)
Wyoming	TransWest Express HVDC	813	337	1	(659)

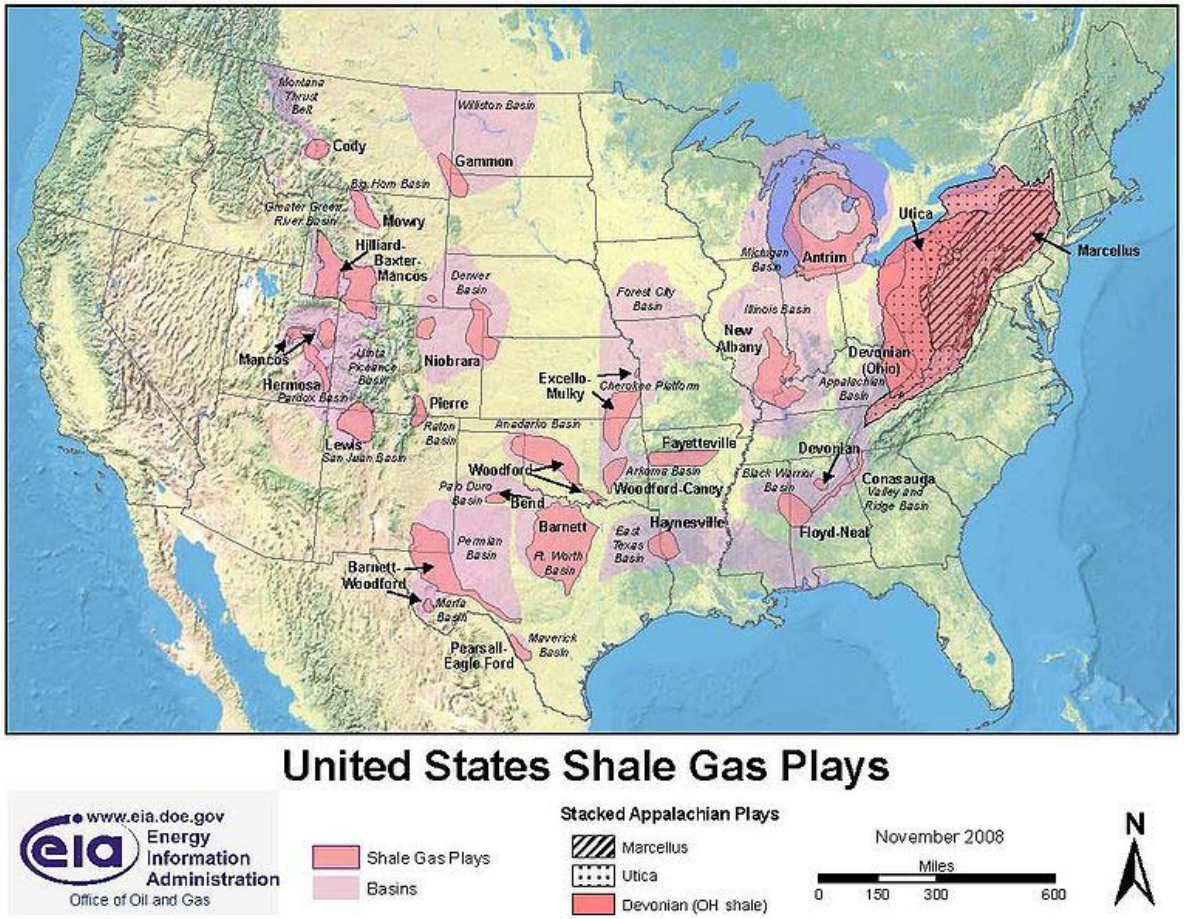
Table 6: Cost Comparison of Potentially Cost-Effective Resource Relocation Alternatives with Transmission Expansion

But

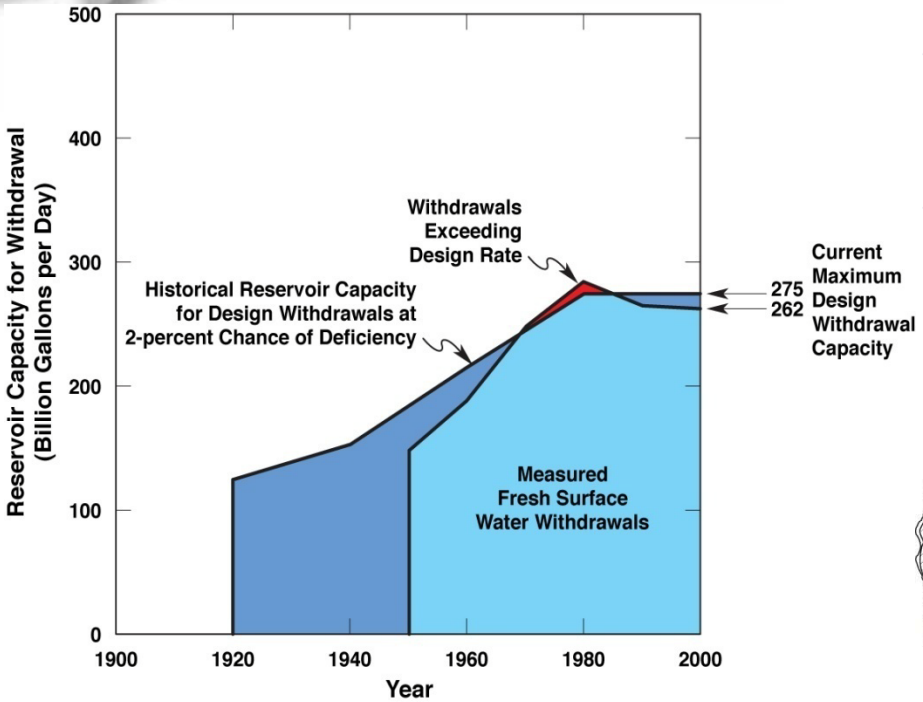
- Tres Amigas project is getting more national attention and higher visibility
  - Benefits of SE NM location relative to the three major national grids is getting interest as energy security and reliability hub
  - Stranded gas and gas shale potential in SE NM to support wind and solar
- Sun Zia Southwest is also getting national attention and visibility
  - especially as a solar focused transmission vs. other wind and coal focused transmission

Gas Shale development could be extensive and impact water availability and quality

- Water is used in drilling, completion, and fracturing
- Up to 3 million gallons of water is needed per well
- Water recovery can be 20% to 70%
- Recovered water quality varies – from 10,000 ppm TDS to 100,000 ppm TDS
- Recovered water is commonly injected into deep wells, but not appropriate for all areas

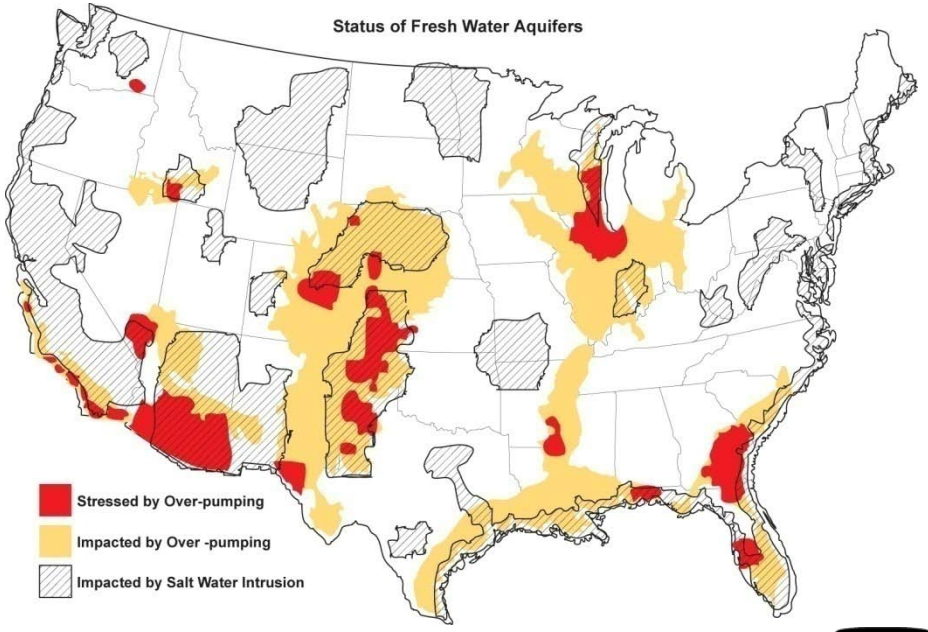


Growing Limitations on Fresh Surface and Ground Water Availability



(Based on USGS WSP-2250 1984 and Alley 2007)

- Little increase in surface water storage capacity since 1980
- Concerns over climate impacts on surface water supplies



(Shannon 2007)

- Many major ground water aquifers seeing reductions in water quality and yield

Electric Power Generation Water Consumption

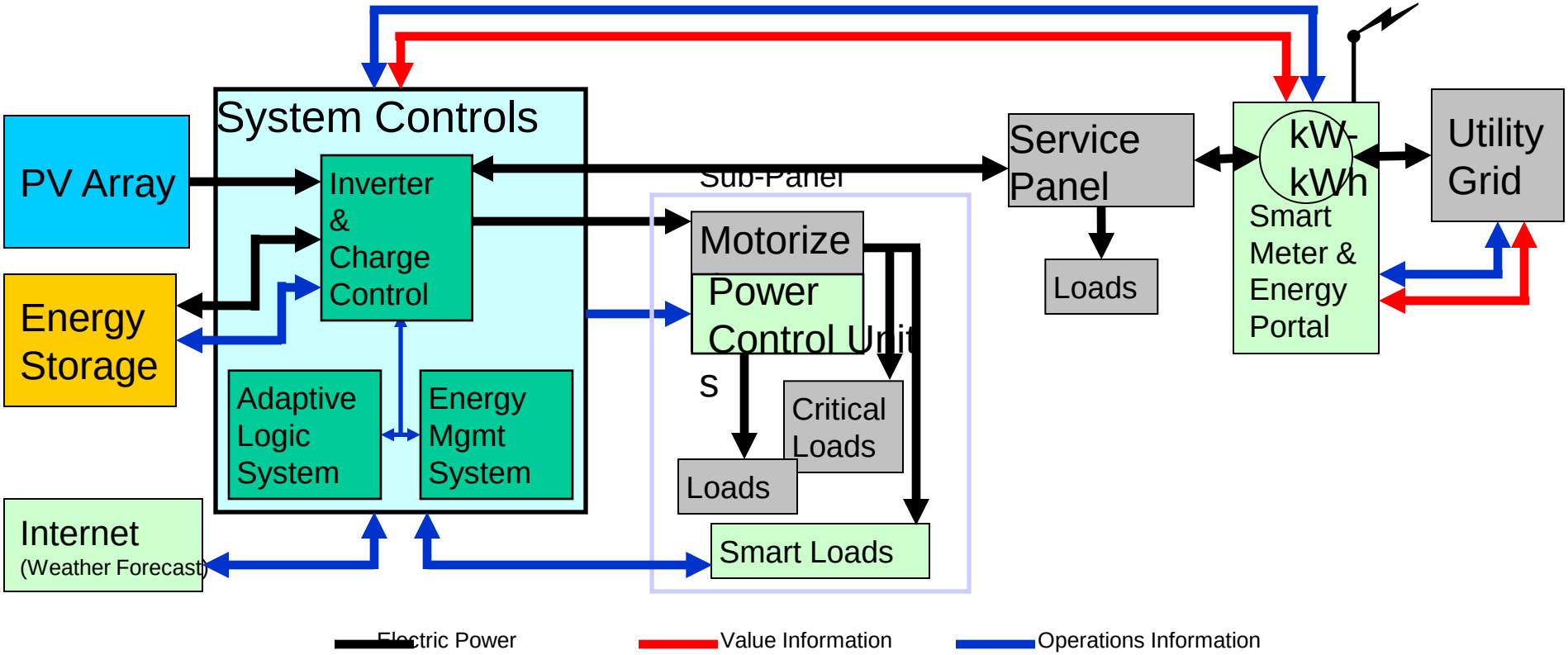
Plant-type	Cooling Process	Water Use Intensity (gal/MWh$_e$)		
		Steam Condensing[a]		Other Uses[b]
		Withdrawal	Consumption	Consumption
Fossil/ biomass steam turbine[c]	Open-loop	20,000–50,000	~200-300	~30-90[d,i]
	Closed-loop	300–600	300–480	
	Dry	0	0	
Nuclear steam turbine[c]	Open-loop	25,000–60,000	~400	~30[d]
	Closed-loop	500–1,100	400–720	
	Dry	0	0	
Natural Gas Combined-Cycle[c]	Open-loop	7,500–20,000	100	10[e]
	Closed-loop	~230	~180	
	Dry	0	0	
Coal Integrated Gasification Combined-Cycle[c]	Closed-loop	200	170	150[c,e]
	Dry	0	0	150[c,e]
Geothermal Steam[f]	Closed-loop	2000	1350	NA
Concentrating Solar[g,h]	Closed-loop	900	900	10
	Dry	10	10	10
Wind and Solar Photovoltaics[j]	N/A	0	0	1-2
Carbon sequestration for fossil energy generation				
Fossil or biomass[k]	All	~90% increase in water withdrawal and consumption		

DOE and Industry Smart Grid Directions

- DOE Focus
  - Currently on Smart meters
  - Moving toward distributed generation, and microgrids or Smart Grid Nodes with distributed generation
- Industry Focus
  - Smart meters
  - Smart Grid Nodes – cyber and data issues
- Distributed energy management seen as large cost center
  - Intel, Cisco, IBM, Google, etc.

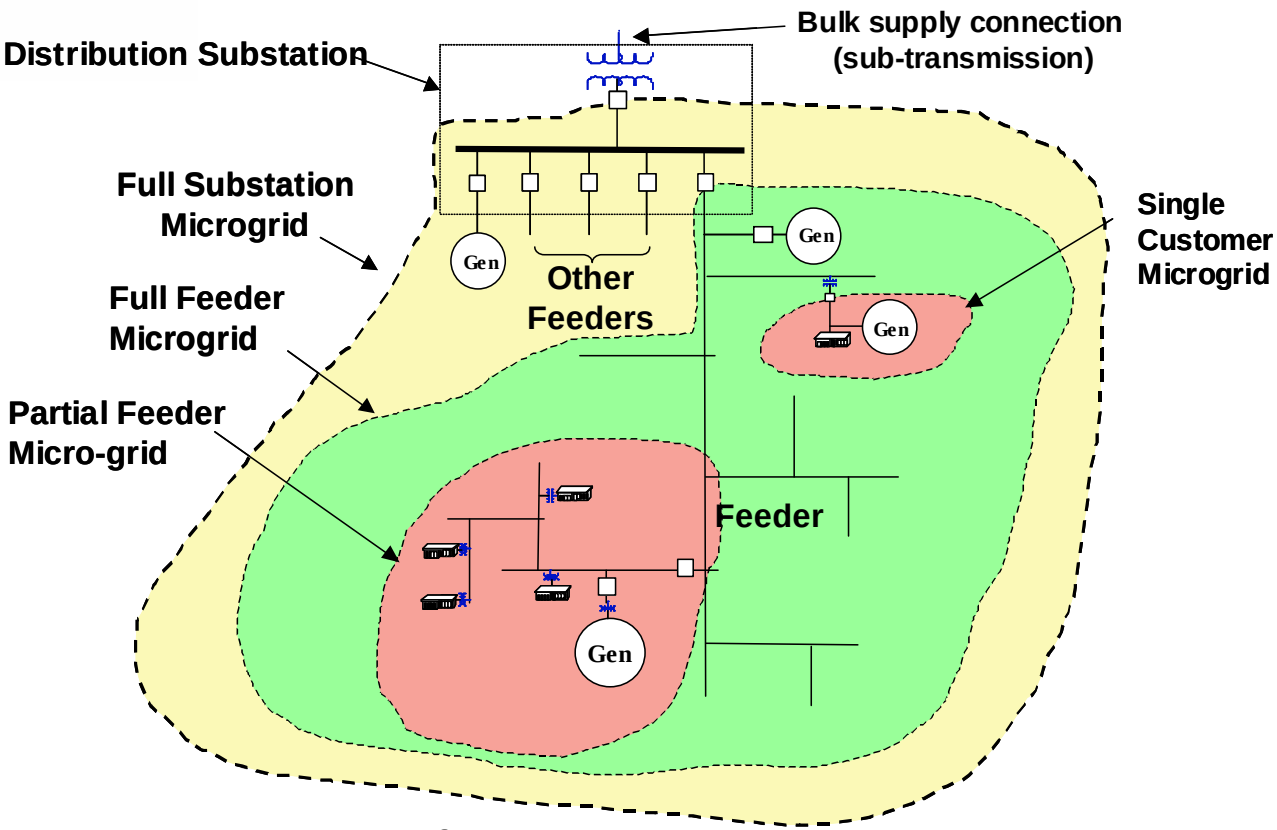
Complexity of Microgrids with Intelligence and Control

System for Supporting Advanced Distribution Infrastructure Operations



Renewable and Distributed Generation Supporting Microgrids and the Smart Grid

- Small combustion and µ-turbines
- Fuel cells
- IC engines
- Small hydro and wind
- Solar electric and solar thermal
- Energy storage (batteries, flywheels,…)
- Plug in hybrid vehicles



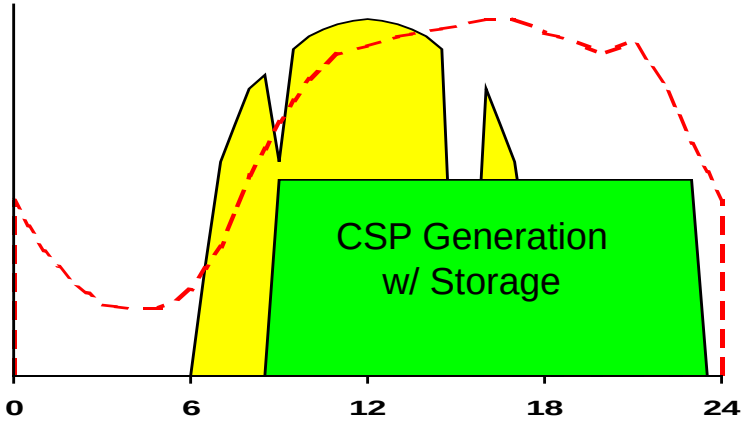
Ref. EPRI

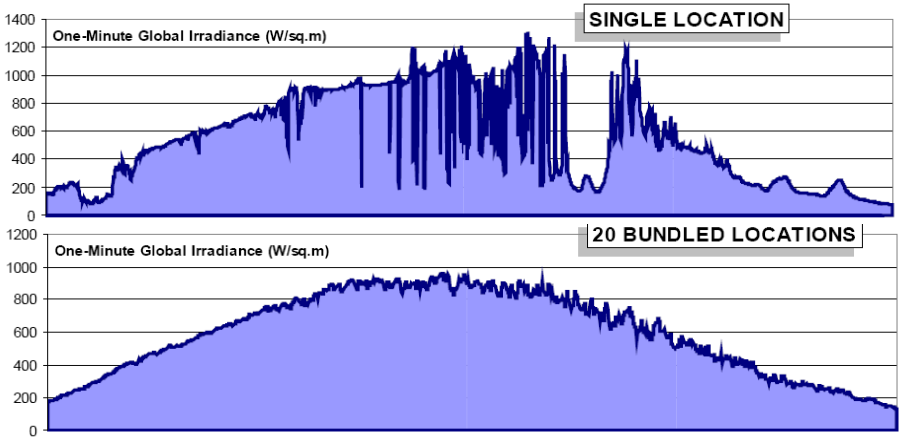
Residential	Less than 10-kW, single-phase
Small Commercial	From 10-kW to 50-kW, typically three phase
Commercial	Greater than 50-kW up to 10MW

Options to Address Renewable Generation Intermittency and Capacity Factors

Solar Resource

Hourly Load





Molten Salt Storage + Natural Gas

Geographic Diversity of Energy Generation