

CEERT



Air Quality Impacts of Diversifying the Grid

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Center for Energy Efficiency and Renewable Technologies



CENTER FOR ENERGY EFFICIENCY AND RENEWABLE TECHNOLOGIES, SACRAMENTO, CALIFORNIA

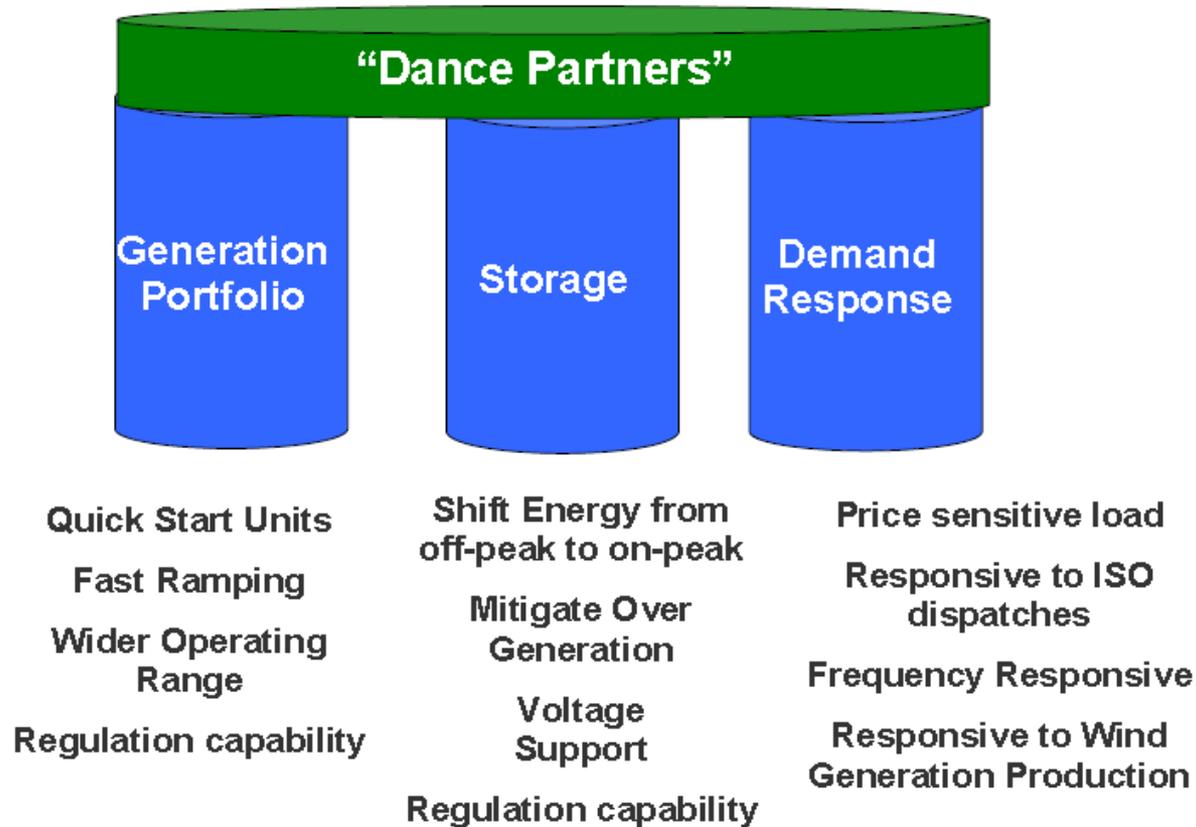
"Providing global warming solutions for California and the West"

The Low Carbon Grid

- Low Carbon Distribution Grid
- Upgraded Transmission System
- Planning the Future Energy Needs of California
- Renewable Energy Generation

The Low Carbon Grid

Resources Required for Renewables Integration



20th Century Grid

21st Century Smart Grid

Electromechanical

Digital

Very limited or one-way communications

Two-way communications every where

Few, if any, sensors – “Blind” Operation

Monitors and sensors throughout – usage, system status, equipment condition

Limited control over power flows

Pervasive control systems - substation, distribution & feeder automation

Reliability concerns – Manual restoration

Adaptive protection, Semi-automated restoration and, eventually, self-healing

Sub-optimal asset utilization

Asset life and system capacity extensions through condition monitoring and dynamic limits

Stand-alone information systems and applications

Enterprise Level Information Integration, inter-operability and coordinated automation

Very limited, if any, distributed resources

Large penetrations of distributed, Intermittent and demand-side resources

Carbon based generation

Carbon Limits and Green Power Credits

Emergency decisions by committee and phone

Decision support systems, predictive reliability

Limited price information, static tariff

Full price information, dynamic tariff, demand response

Few customer choices

Many customer choices, value adder services, integrated demand-side automation

Source: Pier, Narburus, KEMA

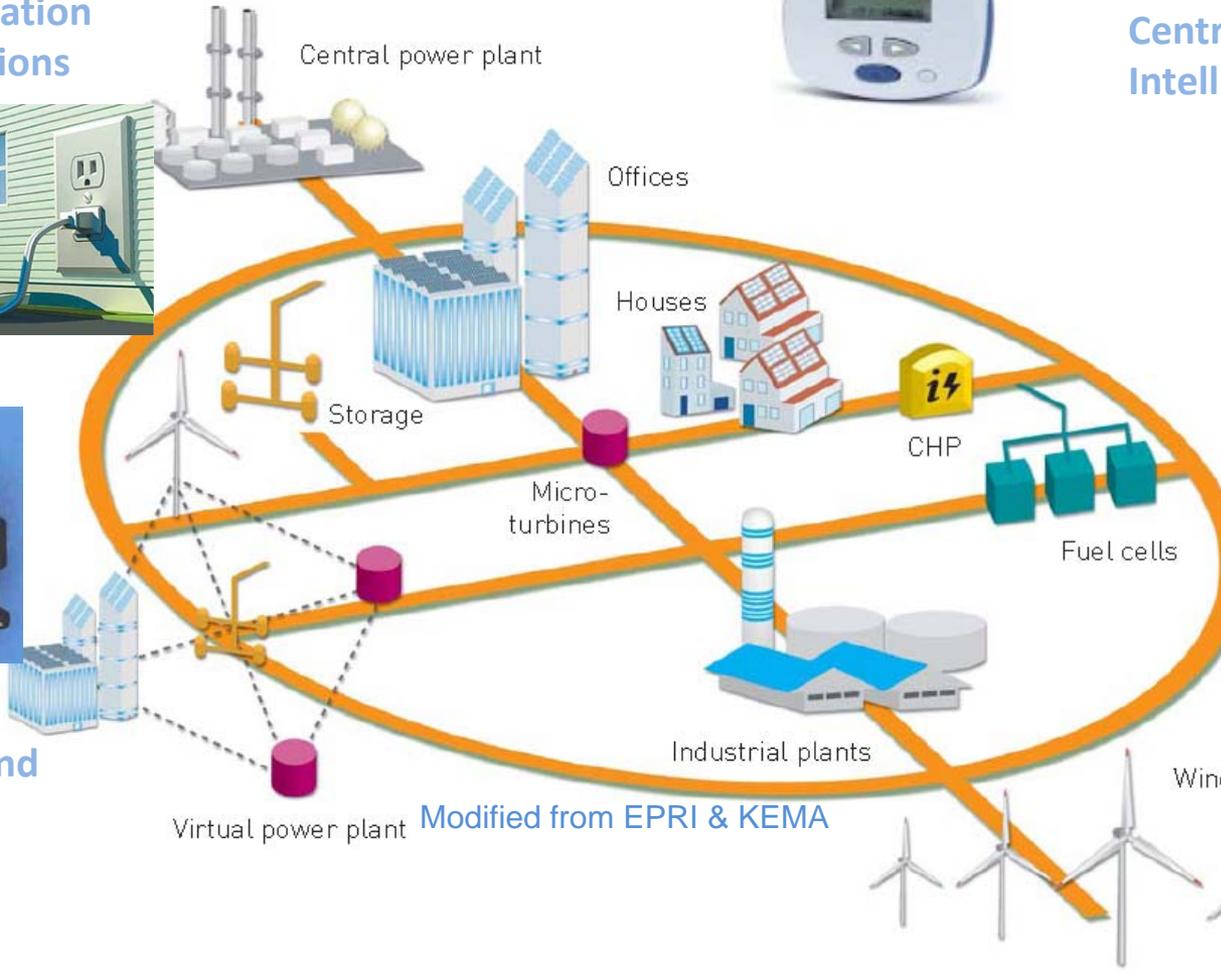
Low Carbon Grid Technologies

Multi-directional

Real time Customer Interaction

Centralized & Distributed Intelligence

Seamless integration of new applications

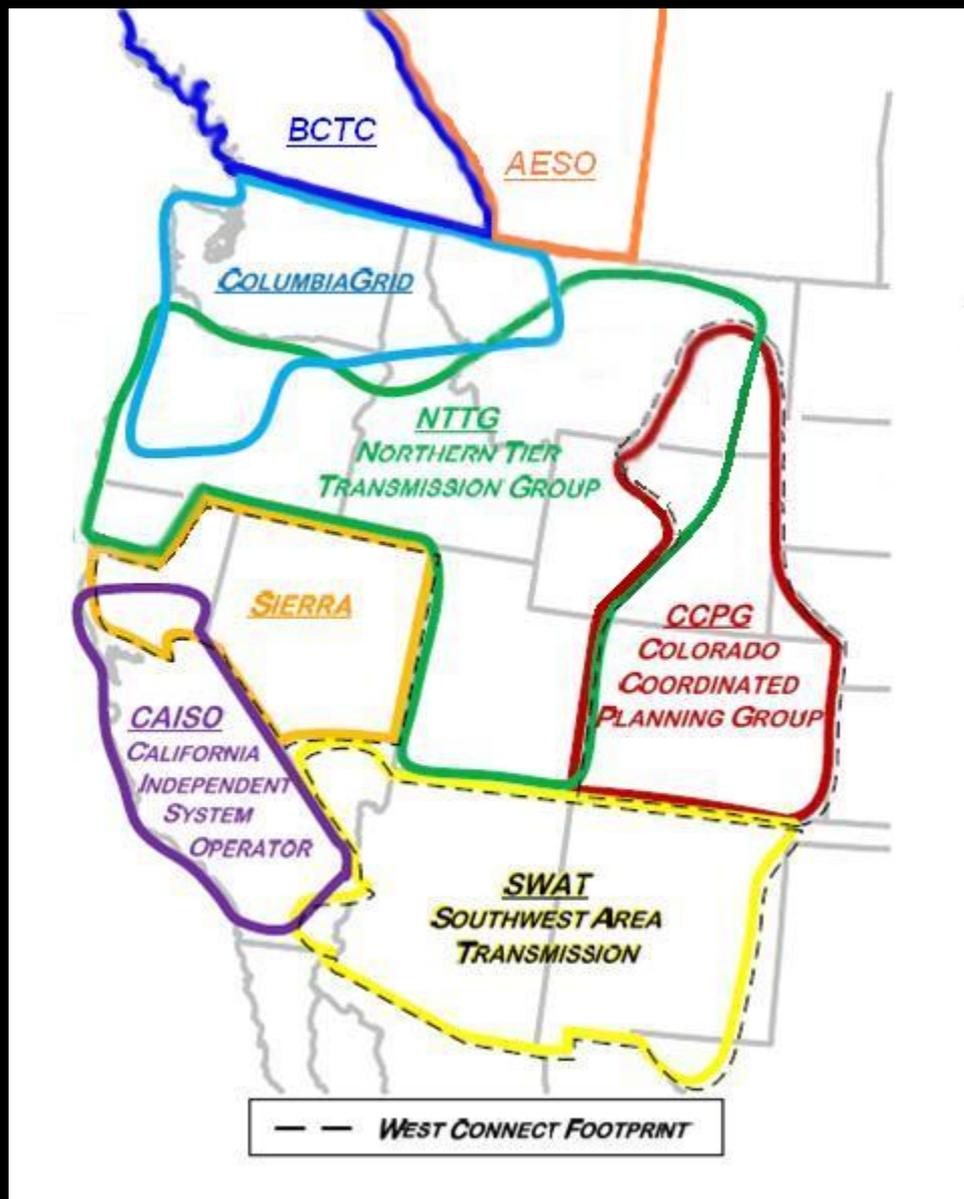


Smart power electronics and materials



Centralized & Distributed Resources

Sub-Regional Planning Groups



Alberta Electric System Operator (AESO)

BC Hydro

ColumbiaGrid (CG)

California ISO (CAISO)

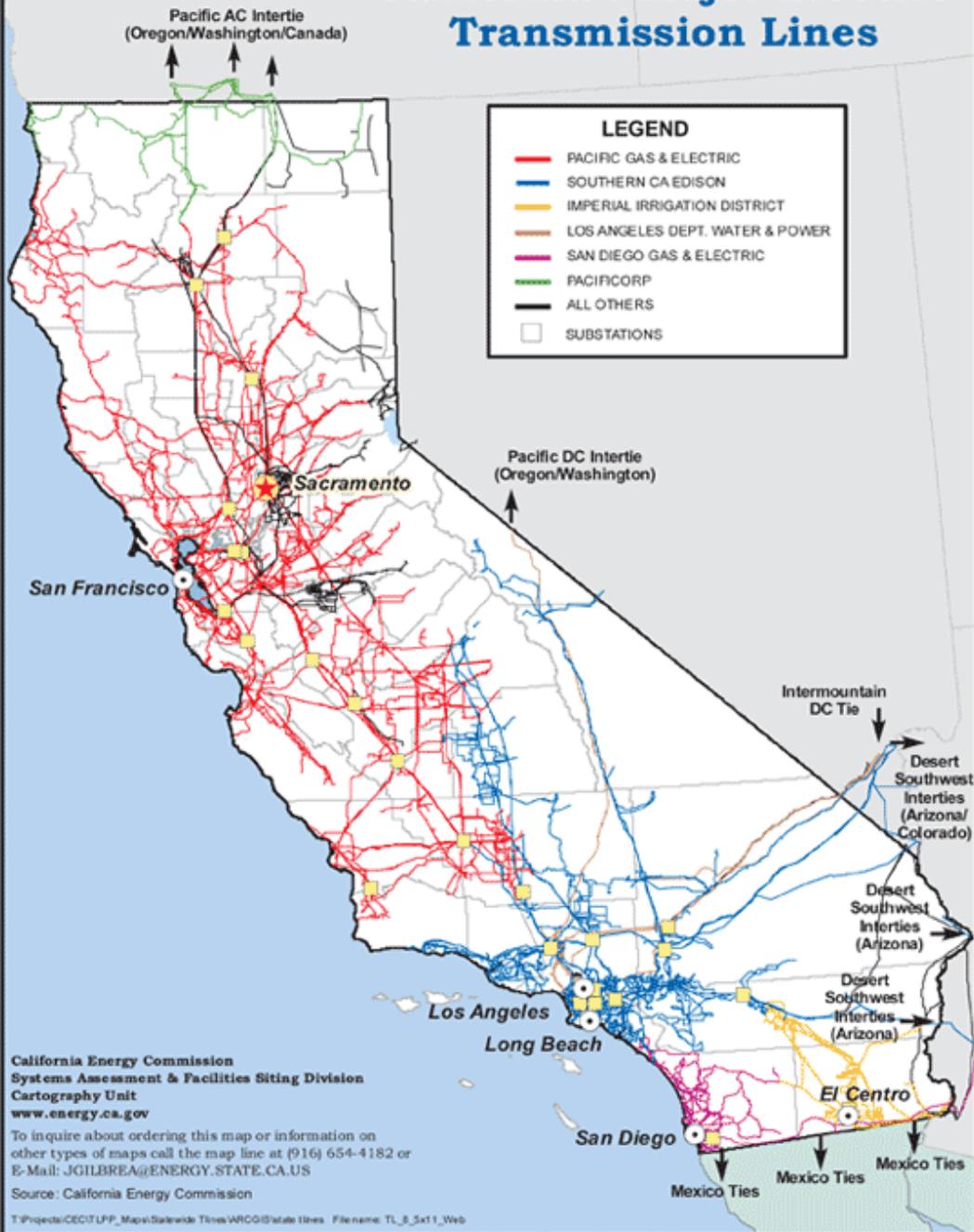
Colorado Coordinated Planning Group (CCPG)

Northern Tier Transmission Group (NTTG)

Sierra Subregional Planning Group (SIERRA)

Southwest Area Transmission (SWAT)

California's Major Electric Transmission Lines



Transmission Lines By Owner

California Energy Commission
Systems Assessment & Facilities Siting Division
Cartography Unit
www.energy.ca.gov

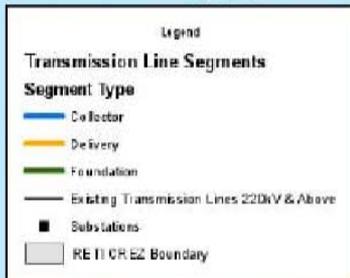
To inquire about ordering this map or information on other types of maps call the map line at (916) 654-4182 or E-Mail: JGILBREA@ENERGY.STATE.CA.US

Source: California Energy Commission

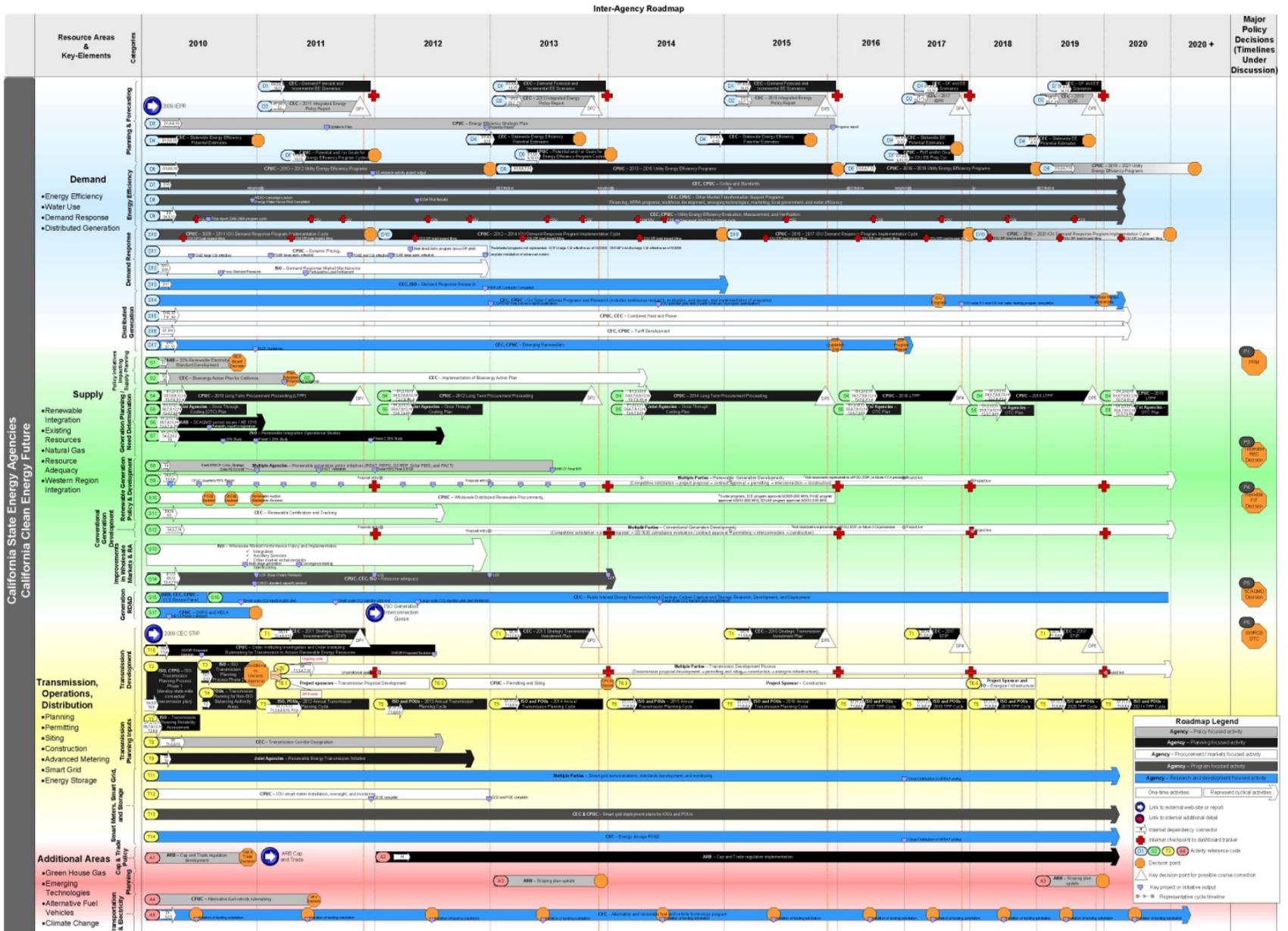
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RETI Phase 2A Transmission Segments Southern California

Lines indicate conceptual electrical connections only
and do not constitute geographic routes



Planning for California's Energy Needs



Planning and Policy Venues

- CPUC Long Term Procurement Plan (LTPP)
 - 10-year planning horizon helps PUC determine the amount of fossil procurement necessary
- CAISO 20% and 33% Integration Analyses
 - Findings support LTPP
- CEC 2011 Integrated Energy Policy Report
 - Considers all state energy policies in planning
- CARB 33% Renewable Electricity Standard
 - 33% by 2020 requirement
 - Requires achievement plans, annual progress reports, and compliance interval reports

2,411 MW Wind and Geothermal Proposed in California

Wind Turbines



Geothermal Energy



7,700 MW Solar Proposed in Southern California

Power Tower



Stirling Engine

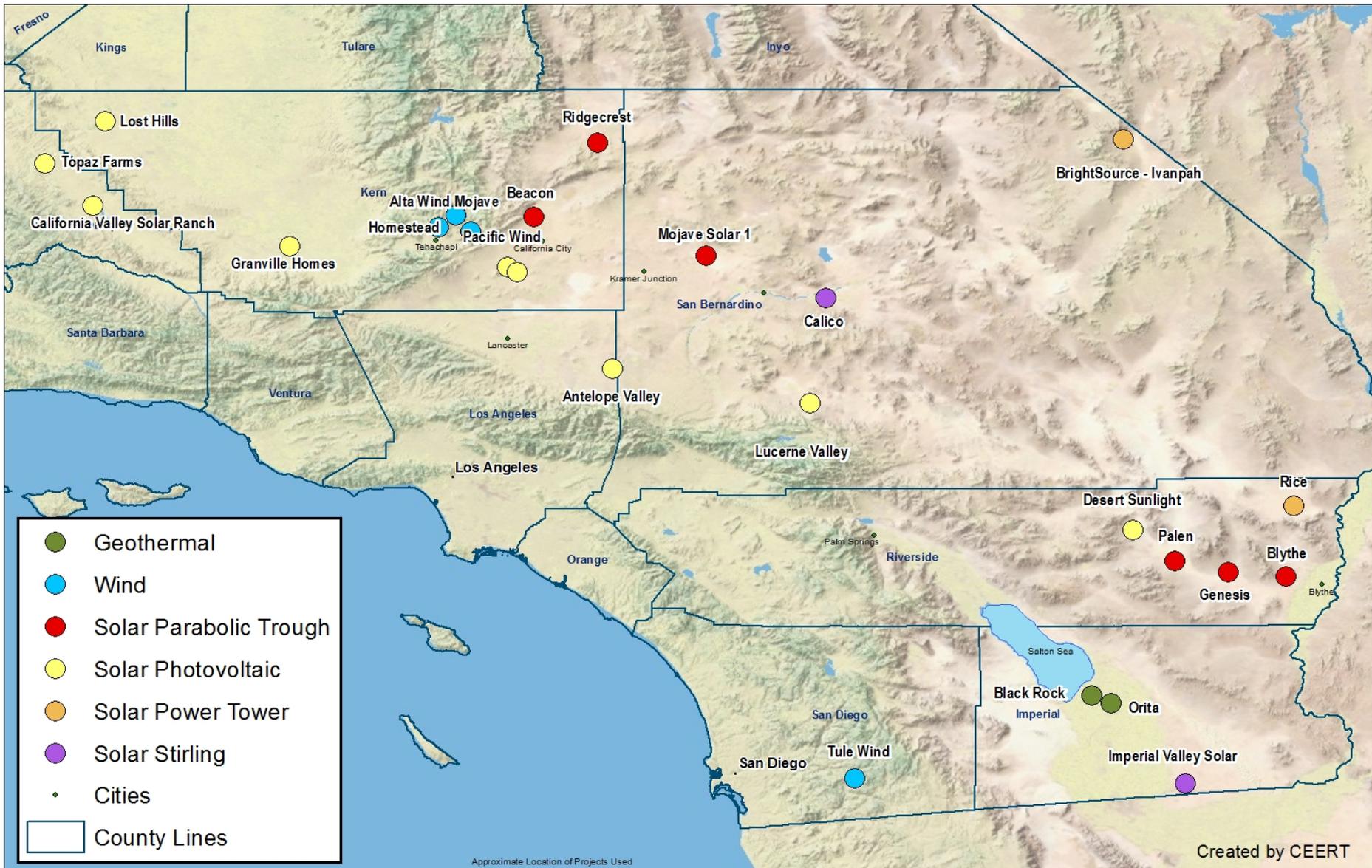


Photovoltaic



Parabolic Trough





Key Renewable Projects 2010-2011

GEOHERMAL & WIND CONSTRUCTION WORKFORCE NEEDS

DEVELOPER	TECHNOLOGY	PROJECT NAME	MW SIZE	AVG # JOBS	EMPLOYMENT LENGTH
				FTEs PER MONTH	
GEOHERMAL					
CALENERGY	Geothermal	Black Rock 1-3	162	323	4 YEARS
RAM POWER	Geothermal	Orita 1	49	90	3 YEARS
WIND					
ENXCO	Wind	Pacific Wind	250	318	3 YEARS
HORIZON WIND	Wind	Homestead	100	159	1 YEAR
TERRAGEN	Wind	Alta Wind 1 Mohave	720	250	1.5 YEARS
TOTAL			1,281 MW	1,140 JOBS/MONTH COMBINED	1-3 YEARS
The survey is a sample, not a census, of all the projects being developed. Prepared by Center for Energy Efficiency & Renewable Technologies					

LARGE-SCALE SOLAR CONSTRUCTION WORKFORCE NEEDS

DEVELOPER	TECHNOLOGY	PROJECT NAME	MW SIZE	AVG # JOBS	EMPLOYMENT LENGTH
				FTEs PER MONTH	
ABENGOA	Parabolic Trough	Mojave Solar 1 Project	250	830	2 Years
SOLAR MILLENNIUM	Parabolic Trough	Blythe Solar Power Plant	1,000	604	~6 Years
SOLAR MILLENNIUM	Parabolic Trough	Palen Solar Power Plant	500	566	3.5 Years
SOLAR MILLENNIUM	Parabolic Trough	Ridgecrest Solar Power Plant	250	405	2.5 years
NEXTERA	Parabolic Trough	Beacon Solar Energy Project	250	507	3.5 years
NEXTERA	Parabolic Trough	Genesis Solar Energy Project	250	507	2.5 Years
TESSERA	Stirling Engine	Imperial Valley Solar	709	360	3.5 years
PERMACITY	Photovoltaics	Five 5 MW Systems	25	500	.5 year
SUNPOWER	Photovoltaics	California Valley Solar Ranch	250	353	~3 Years
TOTAL			3,484 MW	4,632 JOBS/MONTH	~3 YEARS

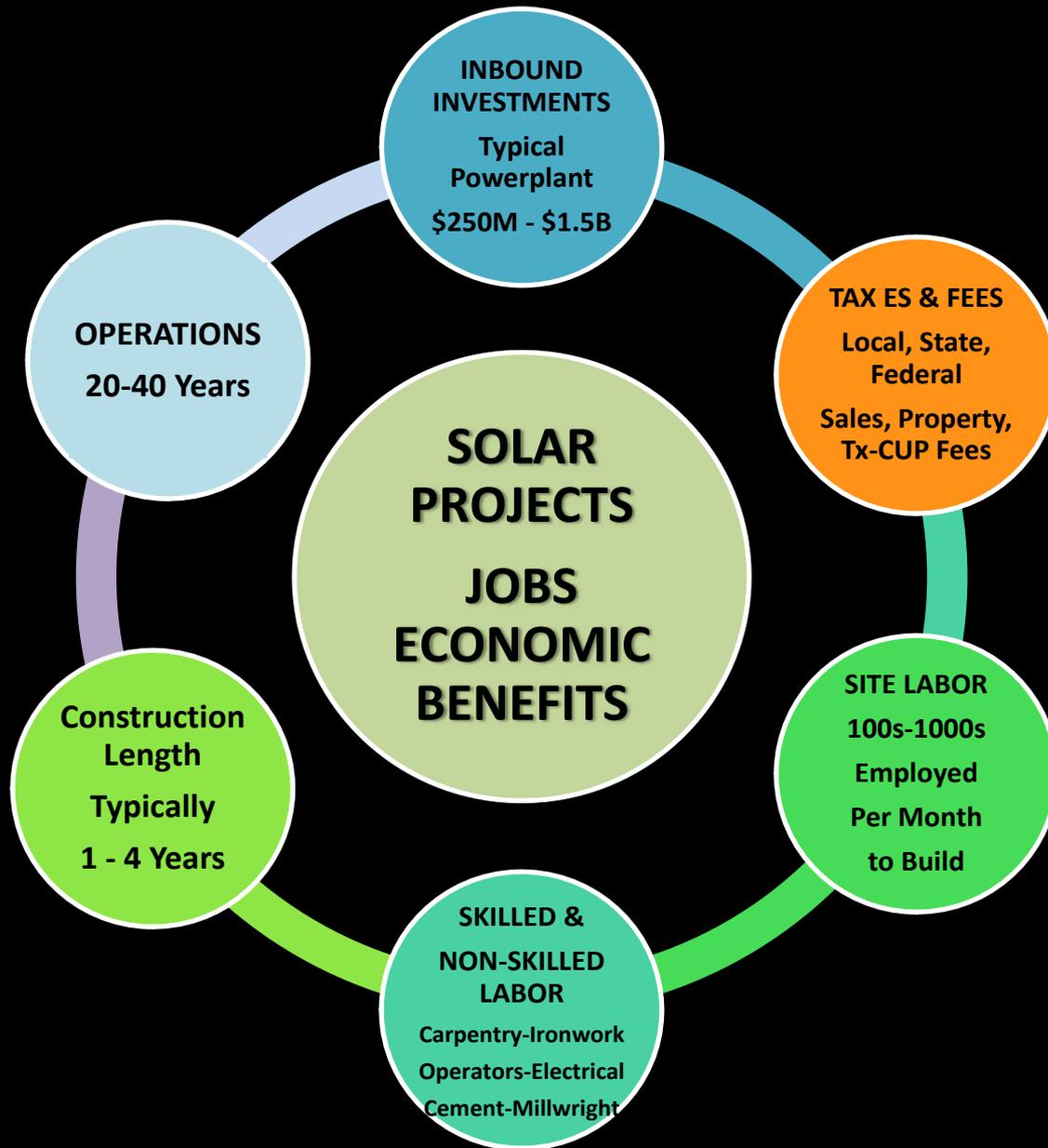
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KEY SOLAR PROJECTS 2010-2011

(PRIORITIZED PERMITTING BY LOCAL, STATE AND/OR FEDERAL AGENCIES)

7,737 MW CAPACITY

TECHNOLOGY	DEVELOPER	PROJECT NAME	LOCATION	MW SIZE
PARABOLIC TROUGH	NextEra	Beacon	California City, San Bernardino County	250
	NextEra	Genesis	Blythe, San Bernardino County	250
	Abengoa	Mojave Solar Project	Harper Dry Lake, Kern	250
	Solar Millennium	Ridgecrest	Ridgecrest, Kern	500
	Solar Millennium	Blythe	Blythe, Riverside County	1000
	Solar Millennium	Palen	Palen Dry Lake, Riverside County	500
STIRLING ENGINE	Teserra Solar	Calico	Barstow, San Bernardino County	850
	Teserra Solar	Imperial Valley Solar	Southern Imperial County	709
PHOTOVOLTAICS	Chevron	Lucerne	Barstow , Kern	45
	First Solar	Topaz Solar Farm	California Valley, San Luis Obispo	550
	First Solar	Monte Vista Solar	Mojave , Kern	126
	First Solar	Desert Sunlight	Desert Center, Riverside	550
	Granville Homes	Maricopa Sun Solar Project	Kern County	700
	NextLight	Antelope Valley	Antelope Valley , East LA County	230
	NextLight	Lost Hills	Lost Hills, Kern	307
	Sempra Generation	Rosamond Solar Project	Rosamond, Kern	120
	SunPower	California Valley Solar Ranch	Carrizo Plains, San Luis Obispo County	250
POWER TOWER	SolarReserve	Rice	Blythe, Riverside	150
	BrightSource	Ivanpah	Needles, San Bernardino	400



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