

Demand Response (750 MW for 1 hr) and Energy Storage (750 MW for 4 hrs) in 3 Peak months can reduce CO₂ emissions

Resource	Replaces	Charged with	CO2 reduction (million lb. per yr)
DR	Average 2013 fleet generator	-	45
DR	Simple cycle CT	-	79
Storage	Simple cycle CT	Renewables	316
Storage	Simple cycle CT	Combined cycle	57

Demand Response (750 MW for 1 hr) and Energy Storage (750 MW for 4 hrs) in 3 Peak months can reduce CO₂ emissions

1. DR replacing 2013 fleet generators at summer daily peaks would lead to 45 million lb. of CO₂ avoided
2. DR replacing simple cycle combustion turbines can reduce emissions by 79 million lbs. CO₂ per year
3. If storage were charged with zero-emission resources, it could reduce emissions by up 316 million lbs. CO₂ per year
4. However, gas fired combined cycle units would be used to charge storage most of the time
 - Emissions would be reduced by only 57 million lbs. CO₂ per year in this case
 - Losses in storage charge-discharge cycle tend to reduce emission benefits

A range of assumptions about heat rates, emissions, and battery efficiencies could be used

	CAISO ¹	ARB ²	ARB ³	EPRI ⁴	PG&E ⁵	GE ⁶	AIC ⁷
Peaker (BTU/kwh)	10,000				7,815	7,813	10,000
CC (BTU/kwh)	7,000	7,000				6,342	6,500
Emissions (lb CO ₂ /MMBTU)	117	116					
Battery efficiency (%)				85%			
Avoided CO ₂ (MT/MWh)			0.3				

¹ CAISO PLEXOS model, high load scenario (Dec. 2012)

² California Air Resources Board, Technical Support Document: Initial Statement of Reasons for Proposed Rulemaking (Oct. 2007)

³ California Air Resources Board, Climate Action Team, California EPA State Agency Greenhouse Gas Reduction Report Card, pg. 16, [MTCO₂ per MWh = 0.26 PG&E, 0.32 SCE, 0.35 SDG&E] (Jan. 2013)
<http://climatechange.ca.gov/climate-action-team/reports/2013-CalEPA-Report-Card.pdf>

⁴ EPRI, Benjamin Kaun, private communication, Li-ion round trip efficiency (Feb. 7, 2013)

⁵ *Electric Power*, Top Plant: Panoche Energy Center, LMS100 heat rate at 60 F (Sept. 1, 2010)
<http://www.powermag.com/top-plant-panoche-energy-center-firebaugh-california/>

⁶ GE Corp., New High Efficiency Simple Cycle Gas Turbine – GE's LMS100, 53.8% efficiency in combined cycle configuration (2004)

⁷ AIC Labs Emission Reduction Measure Form, submitted to ARB