Overview of
Load & Resource Scenario Study Tool
(For Use in Conjunction with Once-Through Cooling Reliability Assessments)

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I. Background

This load and resource scenario study tool assesses local and system capacity needs under a range of possible planning scenarios for the purpose of identifying timeframes when gas-fired generation units using once-through cooling may come offline to retrofit, repower or retire as contemplated by a statewide water quality control policy on the use of coastal and estuarine waters for power plant cooling.[1] Implementation of this policy may cause a shortage of resources in local capacity areas or in larger regions (i.e., NP 26 or SP 26) within the California Independent System Operator Corporation (ISO) Balancing Authority Area. As described in its 2011 transmission study plan, the ISO intends to use this tool in connection with studies in its transmission planning process.

This screening tool incorporates the latest local capacity requirements determined by the ISO and projects local capacity requirements within local capacity areas using a load forecast adopted by the California Energy Commission (CEC).[2] This tool also contains a range of scenarios and assumptions that span a ten-year time horizon and allows users to examine the effect of various assumptions by toggling between various scenarios. The user can select from alternative assumptions to evaluate a hypothetical future demand and resource scenarios. Using this approach, the tool identifies years in which a shortage of resources will likely result from gas-fired generating units using once through cooling coming offline. The ISO intends to undertake additional technical studies (i.e., power flow, post-transient and transient

[1] Further information on this policy, including a listing of affected power plants is available at the following website: http://www.swrcb.ca.gov/water_issues/programs/npdes/cwa316.shtml

[2] The 2011 compliance year CAISO LCR study results can be found at the following link. http://www.caiso.com/1c44/1c44b8e0380a0.html

stability assessment, operational requirements) for the years in which the tool identifies potential resource shortages. The assumptions in this tool are subject to change and the ISO expects to incorporate updates to the assumptions on an annual basis. The ISO recognizes Mr. Donald Brooks and Mr. Simon Eilif Baker of the California Public Utilities Commission (CPUC) and Dr. Michael Jaske and Mr. David Vidaver of the California Energy Commission (CEC) for their significant contributions in the development of this tool.

II. Description of Tool

This screening tool is a Microsoft Excel spreadsheet (Excel 2007 macro enabled format) that identifies a set of scenarios, including forecasted peak loads and resource development between 2011 and 2020. The tool allows users to forecast resources in the ISO's local capacity areas and participating transmission owner service territories if gas fired generation units using once through cooling come off line in future years and will provide useful information to evaluate projected loads and resources. *The ISO will also perform evaluations using power flow, voltage stability and dynamic stability analyses to determine reliability impacts to the ISO balancing authority area based on the date in which a gas-fired generation unit using once-through cooling elects or is required to come off line. The ISO may also augment its analysis with the results of studies of operational requirements.*

III. Description of Scenarios

In consultation with representatives of the CPUC and CEC, the ISO has included three major categories of renewables supply scenarios reflecting 33 percent of energy deliveries by 2020 and three additional demand side resource scenarios in this tool. The CPUC staff developed the renewables scenarios with assistance from its consultant Energy and Environmental Economics, Inc. (E3) and Aspen Environmental Group. Representatives of the CPUC and CEC provided three demand side management scenarios involving load growth projections modified by deployment of energy efficiency measures, combined heat and power resources, and implementation of the renewable distributed generation policies such as the California Solar Initiative. CPUC staff also provided scenario inputs for demand response. Table 1 reflects nine potential scenarios involving renewables supply and demand side resources through the year 2020. Quantities of demand-side resources in Table 1 are incremental to the amounts of demand side resources assumed in the 2009 Integrated Energy Policy Report (IEPR) adopted demand forecast. The ISO intends to update this tool with new information as appropriate.

Table 1 –
Renewable Mix and Incremental Demand-side Preferred Resources Development in 2020[3]

Renewables Scenario (energy goal, target year and mix)	Low Net Load	Mid Net load	High Net Load
1) 33% by 2020 based on current trajectory of utility contracting 2) 33% by 2020 based on high distributed generation 3) 33% by 2020 with emphasis on out of state renewable development	EE 18,000 GWh EE 8,100 MW CHP 3,800 MW CSI 452 MW DR 3,014 MW	EE 13,200 GWh EE 5,000 MW CHP 1,900 MW CSI 0 MW DR 2,619 MW	EE 0 GWh EE 0 MW CHP 0 MW CSI 0 MW DR 2,223 MW

This tool contains a number of inputs that users may change under each scenario, including the following:

- New generation construction: none, under construction, permitted generation[4], and contracted generation[5].

[3] References in Table 1 are to Net Qualifying Capacity (NQC) and are incremental to projections contained in the 2009 IEPR demand forecast. The 2009 IEPR projects 80,000 GWh and 19,500 MW of peak load reduction from energy efficiency by 2020. The 2009 IEPR also projects 40 MW of nameplate capacity from combined heat and power, and 692 MW of nameplate capacity resulting from the California Solar Initiative. The 2009 IEPR treats demand response as a supply resource.

[4] Generation that has received approval of its Application for Certification (AFC) from the CEC.

[5] Generation under contract by load-serving entities.

- New transmission construction: none, under construction, permitted transmission[6], ISO-approved transmission[7], proposed transmission and Renewables Portfolio Standard transmission.

- Generation retirements: none, retirement of all gas-fired once through cooling units, retirement of all gas-fired once through cooling units and some gas-fired units not using once through cooling.

- 33 percent Renewables Portfolio Standard (RPS) compliance year: 2020, 2022, and 2025.[8]

IV. Description of Assumptions

The tool contains references for each input assumption. A short overview of the major load and resource assumptions follows. For load, the tool relies on the CEC adopted 2009 IEPR demand forecast (1 in 10 peak load conditions) as adjusted to reflect projections for energy efficiency, combined heat and power and distributed roof-top solar. The tool identifies three renewable scenarios with different infrastructure components.

Incremental Energy Efficiency Impacts (not already accounted for in the CEC load forecast)

The 2009 IEPR demand forecast accounts for projected impacts of ***committed*** energy efficiency programs in California. Specifically, the 2009 IEPR adopted demand forecast includes 19,500 MW of energy efficiency program savings and

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[6] Transmission that has received siting approval from the CPUC..

[7] Transmission that has received approval from the ISO Board of Governors or approved as part of the ISO Transmission Plan.

[8] These timeframes are based on the CPUC Energy Division's 33 percent RPS Implementation Analysis and the range of timeframes in which 33 percent RPS might be achieved under various characterizations of regulatory and market barriers. The timeframes have been adjusted to reflect a reduction in the CEC's 2009 IEPR demand forecast relative to the 2007 IEPR used in the original 33 percent RPS Implementation Analysis. The ISO is also considering whether to include a 25 percent RPS scenario by December 31, 2016 consistent with the proposed provisions of Senate Bill 722.

price-response reductions in load.[9] For purposes of this tool, CEC staff has developed additional energy efficiency savings from ***uncommitted*** programs that are incremental to those projected in the CEC's demand forecast. The CEC relied on a technical study prepared by its consultant, Itron, which estimates the capacity impact in high energy efficiency cases over the next ten years.[10] Itron's report was itself based on the CPUC's 2008 energy efficiency goals study, which evaluated various scenarios of energy efficiency impacts. The low net load case reflects the high impact of energy efficiency scenario evaluated in CEC's report. The mid net load case reflects the low impact scenario evaluated in CEC's report. The high net load case assumes ***no incremental*** uncommitted energy efficiency.

Combined Heat and Power Estimates

In compiling the estimates for combined heat and power, CEC staff relied, in part, on estimates from *Combined Heat and Power Market Assessment*, produced by ICF International, Inc. (ICF) for the CEC in mid-2009.[11] The model used by ICF produces estimates of market potential by industry (Standard Industrial Code) based on assumptions regarding the spark spread, cost of combined heat and power equipment, the electric and thermal load characteristics of commercial, industrial and institutional facilities, incentive payments, and customer decisions regarding the economic value that will trigger investment in combined heat and power. In the ICF study, the base case assumes the continuation of existing self-generation incentive program payments for 10 years, and a tariff for facilities up to 20 MW in size. The high case assumed several additional incentives and modifications to the self-generation incentive program. In this tool, the high net load case is equal to the amount of combined heat and power "self generation" embedded in the 2009 IEPR

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[9] CEC, California Energy Demand 2010-2020: Staff Revised Demand forecast, Second Edition, CEC-200-2009-012-SF-REV, November 2009, pp. 236-237. This report can be found at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/CEC-200-2009-012-SF-REV.PDF

[10] A copy CEC's report concerning incremental impact of energy efficiency policy initiatives relative to the 2009 IEPR adopted demand forecast is available at the following website: http://www.energy.ca.gov/2010publications/CEC-200-2010-001/index.html

[11] A copy of ICF's *Combined Heat and Power Market Assessment* is available a the following website: http://www.energy.ca.gov/2009_energypolicy/documents/2009-07-23_workshop/2009-07-15_ICF_CHP_Market_Assessment.pdf

demand forecast (in other words, no incremental program beyond what was in the CEC's demand forecast). The forecast projects the addition of 40 MW nameplate (19 MW peak capacity) over 2009 – 2020, largely through the self generation incentive program. The low net load case is based on the ICF report's "all-in" case, but reduced from 5,964 MW (nameplate) to 4,000 MW (3,800 MW peak capacity) consistent with the California Air Resource Board's (ARB) Assembly Bill 32 Scoping Plan. Energy and capacity was evenly allocated to on-site use and export to the transmission grid, again to be consistent with the ARB Scoping Plan. The CEC staff used the database on candidate projects for combined heat and power compiled by ICF to allocate the capacity to utility service areas and ISO local capacity areas. The mid net load case assumption for combined heat and power is the mid-point between the high net load and low net load cases (2000 MW nameplate, 1,900 MW peak capacity).

Renewable Distributed Generation/California Solar Initiative (CSI) Estimates

The high net load and mid net load cases incorporate assumptions for renewable distributed generation (including the California Solar Initiative) that are equal to the amount embedded in the 2009 IEPR demand forecast; these cases include no incremental reductions to the base demand forecast.[12] The 2009 IEPR demand forecast assumes 1,931 MW of nameplate capacity resulting from the California Solar Initiative, which reflects 692 MW of on-peak capacity. CEC Staff used growth in capacity during 2008 and 2009 to estimate growth through 2020. CEC staff allocated capacity from each utility area to individual local capacity areas using the area's peak 2008 load as a share of the utility service area's 2008 peak load. The share of installed capacity available on peak is utility-specific and is based on an Itron assessment of 2004-2008 data from the Self-Generation Incentive Program, modified in response to comments received at workshops during the 2009 IEPR proceeding. The low net load case assumes that 1,260 MW of incremental installed capacity will be on-line by 2020, which reflects 452 MW of on-peak capacity. For purposes of forecasting this amount, the CEC staff kept 2010 and 2011 projections

[12] See California Energy Demand 2010-2020 Adopted Forecast, pp. 29-31, and accompanying tables; available at: www.energy.ca.gov/2009publications/CEC-200-2009-012/index.html. The CEC staff assumed that California Solar Initiative capacity has an on-peak capacity factor of 0.3 in Northern California, 0.5 in San Diego, and 0.4 for the remainder of Southern California.

constant and forecast that one fifth of the difference between the mid net load case and low net load case would accrue in each year from 2012 to 2016 in each of the utility areas and ISO local capacity areas. CEC staff projected that growth in capacity would remain unchanged from the amount forecasted in the 2017 to 2020 period.

Demand Response

CPUC staff derived demand response resource values from a variety of sources. The high net load case values are equal to the current CPUC-approved 2010 demand response values allocated to load serving entities to meet resource adequacy obligations, with no growth assumed between 2011 and 2020. The amounts allocated are the result of application of the CPUC's Load Impact Protocols.[13] The low net load case starts with the 2010 demand response allocations and scales each year by the same factor sufficient to produce demand response impacts equal to 5 percent of peak load in each ISO local capacity area and the ISO balancing authority area by 2020. The factor for demand response to reach 5 percent of total peak load by 2020 varies by local capacity area but equals approximately a 10 percent growth factor in each year. The tool uses values consistent with CPUC Load Impact Protocols, not customer enrollment. The mid net load case is the simple average of demand response load impacts for that year's low net load case and high net load case.

Renewables Portfolio cases

The composition of renewable portfolios to meet the State's 33 percent RPS will be in flux for some time. For purposes of this tool, CPUC staff developed renewable supply portfolios based on the CPUC Energy Division's 33 percent RPS Implementation Analysis, as modified in October 2009, to reflect the new 2009 IEPR load forecast.[14] The renewables supply portfolio cases reflect an economic ranking

[13] These values are posted to the CPUC website and titled "2010 Total IOU Demand Response allocations by Program and Local Area" : http://www.cpuc.ca.gov/PUC/energy/Procurement/RA/ra_guides_2008-09.htm

[14] Detailed documentation of the original June 2009 study is available at the following website www.cpuc.ca.gov/PUC/energy/Renewables/hot/33implementation.htm. The ISO understands that the CPUC has recently updated these projected renewable portfolios and the ISO intends to incorporate these updates into the tool.

methodology. The ranking cost is an all-in delivered cost, including cost of new transmission and integration for intermittent resources, net of energy and capacity revenues. Ranking cost also includes a monetized environmental value to penalize projects with adverse environmental impacts (ranging from $0-$10/MWh). CPUC staff also developed portfolios based on the exercise of its judgment to achieve plausible portfolios that represent a range of possible outcomes. For instance, CPUC staff modified its 33 percent trajectory case to favor selection of transmission zones with known projects.

CPUC staff relied on four principal sources to develop renewables supply portfolios:

- A CPUC database reflecting projects from utility RPS solicitations and bilateral contracts under active negotiations. This database contains confidential information. The CPUC has aggregated this information for purposes of inclusion in the tool.
- Data from the Renewable Energy Transmission Initiative (RETI) Phase 1B effort.
- A greenhouse gas emission calculator prepared by the CPUC's consultant E3 to indentify resources outside of the RETI Phase 1B effort.
- Estimates of renewable distributed generation developed by Black & Veatch for RETI (for 20 MW ground-mounted, proxy projects located in rural areas) and by E3 (for 1-5 MW proxy roof-top or ground-mounted PV projects located in urban areas and for distributed biomass and biogas).

CPUC staff has included commercial on-line dates for renewable resources based on projected online dates assumed for projects within competitive renewable energy zones in the 33 percent RPS Implementation Analysis, as well as locational data by ISO zone (SP26/NP26) and ISO local capacity area pursuant to an analysis of substations to which new transmission would likely connect. CPUC staff derated the capacity of these resources by the CPUC's counting conventions for particular types of intermittent renewable resources. For instance, CPUC staff derated solar and wind resources pursuant to the exceedence methodology adopted in CPUC Decision 08-06-031, while biomass and geothermal plants received NQC values close to their nameplate capacity assuming they are dispatchable. CPUC staff annualized the NQC information for inclusion in this screening tool.

Since the development of this data base, CPUC has promulgated updated 33 percent RPS renewable resource portfolios for purposes of long-term procurement planning,[15] and other entities engaged in resource and transmission planning have also provided perspective on likely portfolios.[16] The tool can be updated as needed to reflect the best estimates of renewable resource technologies and locations.

V. Results by Local Capacity Areas and System Areas

This screening tool assesses whether an ISO local capacity area has a surplus or deficiency of resources at the time that a gas-fired generator using once-through cooling comes offline to retrofit, repower or retire. The ISO emphasizes that additional analyses are necessary to determine if resources provide sufficient voltage and dynamic stability. The tool reflects the ISO's 2011 Local Capacity Requirement (LCR) study results. For future years, the tool provides an estimate of future LCR as follows:

$$LCR_{i+1} = (Load_{i+1} - Load_i) + LCR_i - TX_{i+1}$$

Where,

LCR_{i+1} = Local Capacity Requirement for the following future year

LCR_i = Local Capacity Requirement for the present year (this is the latest result of ISO LCR study)

$Load_{i+1}$ = CEC's projected demand for the following year

$Load_i$ = CEC's forecast for peak demand of the present year

TX_{i+1} = Transmission improvement that would have affected LCR

[15] See presentations and documents at http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/ltpp_history.htm.

[16] See for example, the various renewable portfolios developed for the California Transmission Planning Group at http://www.ctpg.us/.

a. Total NQC MW: based on 2010 totals and any new additions from generation addition scenarios

b. Renewable generation construction scenarios, derated to NQC as specified above.

c. Incremental Demand Side (preferred resources) scenarios.

d. Generation retirements: generation taken out of service.

The tool calculates a surplus or deficiency of local resources as follows:

$$S/D_{L.R} = [\sum (C_{NQC} + G_{RENEW} + IPDSM+DR)] – [\sum (LCR + G_{RT})]$$

Where,

$S/D_{L.R}$ = Resulting Surplus or Deficiency of Local Resources

C_{NQC} = Net Qualifying Capacity Resources

G_{RENEW} = Renewable Generation Additions

IPDSM = Incremental Preferred Demand Side Management

DR = Incremental Demand Resources

LCR = Local Capacity Requirement

G_{RT} = Retired Generation

The tool also assess whether a system or load zone (i.e., NP26 or SP26) has adequate or inadequate resources at the time that a gas-fired generator using once-through cooling comes offline to retrofit, repower or retire. The tool calculates a surplus or deficiency of system resources as follows:

$$S/D_{Z} = [\sum (C_{NQC} + G_{RENEW} + IPDSM+DR)] + Imports – [\sum (D + G_{RT})]$$

Where,

S/D_{Z} = Resulting Surplus or Deficiency of Load Zone (NP26 or SP26)

C_{NQC} = Net Qualifying Capacity Resources

G_{RENEW} = Renewable Generation Additions

IPDSM = Incremental Preferred Demand Side Management

DR = Incremental Demand Resources

Imports = Imports to Subject Area

D = CEC Forecasted Peak Demand

G_{RT} = Retired Generation

VI. Generation Characteristics for any Replacement Capacity

The ISO is evaluating the operational requirements as well as the associated generation characteristics for capacity needed to support the 33 percent RPS target in 2020 as well as renewable integration in interim years.[17] These requirements include unit characteristics that support faster ramp, more frequent starts, stops and cycling, increased regulating ranges, and lower minimum operating levels. The ISO expects to incorporate the results of that evaluation into these study efforts. To the extent that results identify amounts of capacity that should have particular characteristics, then those requirements will supplement this effort.

[17] For more information about the ISO's integration of renewable resources program go to the following website: http://www.caiso.com/23bb/23bbc01d7bd0.html.