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

December 2010

I. Background

This load and resource scenario study tool assesses local and system capacity needs under a range of planning scenarios as envisioned by the California's Clean Energy Future vision[1] for the purpose of screening and 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.[2] 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 further reliability 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 specific local capacity areas using a load forecast adopted by the California Energy Commission (CEC).[3] 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 various assumptions to evaluate future demand and resource scenarios. Using this approach, the tool identifies specific years in which a shortage of resources may result from gas-fired generating units using once through cooling coming offline. The ISO intends to undertake additional reliability studies (e.g., power flow, post-transient and transient stability assessments) for 2020 time frame and some sensitivity assessments for the years in the SWRCB's policy in which the tool identifies potential resource shortages. The

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[1] http://www.cacleanenergyfuture.org/

[2] Further information on this policy adopted by the State Water Resources Control Board (SWRCB), including a listing of affected power plants, is available at the following website: http://www.swrcb.ca.gov/water_issues/programs/npdes/cwa316.shtml

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

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 and many of the data inputs for renewable and demand side scenarios.

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 zonal areas within ISO balancing authority area 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 in the future to include the results of studies of operational requirements.

III. Description of Scenarios

This tool encompasses multiple levels of demand-reducing and renewable development assumptions that reflect a range of futures from the policies embedded in the California Clean Energy Future vision[4] to baseline planning assumptions that omit the impacts of these policies. In consultation with representatives of the CPUC and CEC, the ISO has included four of the State energy agencies' 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 four of the renewables scenarios with assistance from its consultants Energy and Environmental Economics, Inc. (E3) and Aspen Environmental Group. In addition, the ISO developed a fifth renewables scenario with the assistance of E3, which projects a mixture of instate, out of state and distributed generation resources for 2020 only. This is referred to as the ISO Hybrid Portfolio (2020) in the load and resource

[4] http://www.energy.ca.gov/2010publications/CEC-100-2010-002/CEC-100-2010-002.PDF

screening tool[5]. 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 a total of fifteen 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[6]

Renewables Scenario (all meet 2020 goal)	Low Net Load	Mid Net Load	High Net Load
1) *Trajectory*: emphasis on current trajectory of utility contracting 2) *Environmentally-constrained*: emphasis on resources with the least assumed high-level environmental concern 3) *Cost-constrained*: emphasis on least-cost resources 4) *Time-constrained*: emphasis on resources that can come online quickest	EE 18,000 GWh EE 6,102MW CHP 3,391 MW CSI 393 MW[7] DR 5,355 MW	EE 11,868 GWh EE 5,687 MW CHP 1,638MW CSI 0 MW DR 5,100 MW	EE 0 GWh EE 0 MW CHP 0 MW CSI 0 MW DR 2,581 MW
5) *ISO Hybrid scenario*: mixture of in-state, out of state and			EE 0 GWh

[5] References to the ISO Hybrid portfolio are available at (http://www.caiso.com/286b/286bf0d441a20.pdf) on slide 26.

[6] 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 peak load reduction resulting from rooftop photovoltaic installations pursuant to the California Solar Initiative. The 2009 IEPR treats demand response as a supply resource.

[7] The CEC determined 452 MW of incremental photovoltaic resources was needed to reach the California Solar Initiative goal but the CEC staff believes that some amount of the 452 MW will come from publicly owned utilities within California. The CEC staff therefore allocated 393 MW of these incremental resources to the ISO balancing authority area.

distributed generation for 2020 only a. *In-state total (15,838 MW)* b. *Out-of-State (3,842 MW)* c. *Distributed generation (2,902 MW)*			EE 0 MW CHP 0 MW Distributed Generation (2,902 MW) DR 0 MW

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

- Status of new generation construction: none, under construction, permitted generation,[8] and contracted generation.[9]
- Status of new transmission construction: none, under construction, permitted transmission,[10] ISO-approved transmission,[11] proposed transmission to meet California's Renewables Portfolio Standard (RPS).
- Generation retirement scenarios: 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 RPS scenarios by 2020.[12]
- Ability to extend RPS scenarios to reach 33 percent in 2020, 2022, and 2025.

IV. Description of Assumptions

The tool contains references for each input assumption developed by the CPUC, CEC and ISO. A short overview of the major load and resource assumptions follows. The tool identifies five renewable scenarios with different infrastructure components. For load, the tool relies on the CEC adopted 2009

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

9 Generation under contract by load-serving entities.

10 Transmission that has received siting approval from the CPUC.

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

12 These 33 percent RPS scenarios reflect various regulatory and market barriers.

IEPR demand forecast (1 in 10 peak load conditions), or updated demand forecast as applicable, to reflect projections for energy efficiency, combined heat and power and distributed roof-top solar. In general, the CPUC considers that mid load scenario is representative with the standards under consideration in the CPUC's long term procurement plan proceeding. The low load scenario reflects the optimistic achievement of demand side alternatives and projected RPS construction.

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 price-response reductions in load.[13] The 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 of three energy efficiency cases over the next ten years.[14] 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 energy efficiency scenario evaluated in CEC's report with the Big Bold Energy Efficiency Strategies from the mid impact case.[15] The mid net load case reflects the mid impact scenario evaluated in CEC's report with the Big Bold Energy Efficiency Strategies from the low impact case. 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 and CPUC staff relied, in part, on estimates from *Combined Heat and Power Market Assessment*, produced by ICF International, Inc.

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[13] 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

[14] 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

[15] *See* CPUC Decisions 08-07-047 and 07-10-032 for a description of the Big Bold Energy Efficiency Strategies.

(ICF) for the CEC in mid-2009.[16] 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 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. For combined heat and power, the mid net load case assumes a midpoint between the high and low load cases. The CPUC's Energy Division staff developed this assumption. The load and resource scenario study tool lists demand side combined heat and power projections for each area then adds an equivalent amount to the row of existing NQC for each area (representing a 50 percent split between supply side and demand side combined heat and power). The mid load case represents the mid-point between the high net load and low net load cases (2000 MW nameplate capacity, 1,900 MW peak capacity**).**

Renewable Distributed Generation/California Solar Initiative Estimates

For the CPUC's four renewable scenarios, the high net load and mid net load cases assume no incremental development of renewable distributed generation (including the California Solar Initiative) beyond the amount embedded in the 2009 IEPR demand forecast.[17] The 2009 IEPR demand forecast

[16] 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

[17] 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

assumes 1,931 MW of nameplate rooftop photovoltaic capacity resulting from the California Solar Initiative, which reflects 692 MW of on-peak load reduction. The CEC staff used growth in installed 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. The CEC staff believes that some amount of this 452 MW will come from publicly owned utilities within California and has allocated 393 MW of these incremental resources to the ISO balancing authority area. For purposes of forecasting this amount, the CEC staff kept 2010 and 2011 projections 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.

For the ISO Hybrid portfolio, which was developed in conjunction with its consultant, E3, distributed generation accounts for about 2,902 MW, which is treated as load modifier adjustment in the reliability assessment. The break-downs between NP26 and SP26 regions are 48.4% and 51.6%, respectively.

Imports into NP26 and SP26

The CPUC Energy Division staff calculated net interchange import values for NP26 and SP26 based on the ISO's *Maximum RA Import Capability for year 2011*, with modifications to identify the transmission lines by service area.[18] The load and resource scenarios study tool identifies each transmission by which service area it leads into and sums the maximum available import capability (Column F) from that document to create the import amount.

Demand Response

CPUC Energy Division staff derived demand response resource values from a variety of sources. The high load case values are equal to the current CPUC-approved 2011 demand response values allocated to load serving entities to meet resource adequacy obligations, with no growth assumed

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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.

[18] http://www.caiso.com/27c6/27c675b81c230.pdf

between 2011 and 2020. The amounts allocated are the result of application of the CPUC's Load Impact Protocols.[19] The mid load case adds in supplemental Demand Response resources incremental to that which is included in the CEC IEPR forecast (such as non-event based resources and AMI resources that were not part of the CEC analysis). The low load case adds 5 % to the mid load case. The tool uses values consistent with CPUC Load Impact Protocols, not customer enrollment. These values are also modified by a distribution loss factor, consistent with CPUC Decision 10-06-036. The particulars of the Distribution Loss Factor are explained in the 2011 DR allocations document referenced in footnote 17.

Current NQC of Existing Generation and New Generation Additions

For purposes of this tool, existing generation refers to the sum of NQC listed on the now final 2011 NQC list, as posted on the CPUC website.[20] In addition to the NQC list, there is also an assortment of projects under construction that are taken from the CEC "Status of all Projects" list[21] or a list of under construction projects under 50MW from the ISO interconnection queue. RPS projects listed as holding approved CEC were included in the RPS scenarios and are not double listed. Thus, the list of plants in the NewTXandGX tab does not include all plants on the CEC "Status of all Projects" list.

Generation retirements

For the first round of analyses, a book-end scenario is performed to determine maximum reliability concerns with all plants using once through cooling were assumed to retire on their final compliance dates from the SWRCB policy.[22] The exceptions to this assumption are those plants where agency staff has a reason to believe the plant will retire, repower or replace with other generating units earlier than the final compliance dates set forth in the SWRCB policy. Those plants include El Segundo, Huntington Beach, South Bay, and Potrero. In addition to the plants using once through cooling, there are a number of other plants that are included in the scenario analysis tool. These plants are taken from

[19] These values are posted to the CPUC website and titled "2011 Total IOU Demand Response allocations by Program and Local Area " : http://www.cpuc.ca.gov/NR/rdonlyres/786A98AC-9F92-4D8D-A071-6A8065944CCE/0/2011IOUDRProgramTotalsFinal728.xls

[20] A copy of the final 2011 NQC list is available at the following website: http://www.cpuc.ca.gov/NR/rdonlyres/A017578D-7420-4ABD-A0F6-2BF5EE335F10/0/CPUCFinal2011NQClist.xlsx

[21] The CEC's Status of all Projects list is available at the following website:: http://www.energy.ca.gov/sitingcases/all_projects.html

[22] The ISO intends to update these assumptions based on implementation plans submitted to the SWRCB by generator owners under the statewide policy for the use of coastal and estuarine waters for power plant cooling.

the CEC Aging Plants study from 2008 IEPR update, Appendix A.[23] The user can insert alternative retirement dates to modify assumptions about retirement. The ISO and agency staff believe that more meaningful analyses will take place upon receiving detailed implementation plans from the generator owners after April 1, 2011 time frame. The ISO will incorporate the latest implementation plans in its future reliability analyses for determining potential reliability impacts of the once-through cooling plants' in its compliance to the SWRCB policy.

Renewables Portfolio cases

The precise projects that will meet the State's 33 percent RPS goal will not be known for some time. For purposes of this tool, CPUC staff relied upon the renewable supply portfolios developed for the long-term renewable resource planning standards in the 2010 long-term procurement plan proceeding. The four scenarios from the CPUC – Trajectory, Environmentally-constrained, Cost-constrained and Time-constrained – fill the net short needed to achieve a 33 percent RPS in 2020. These scenarios reflect both contracted and fairly certain projects, but also generic renewable projects that perform best according to the metric used to rank resources for that scenario – commercial interest, high-level environmental concern, cost,[24] and time to deployment, respectively. The ISO has also included a hybrid renewable portfolio scenario that forecasts a mix of in-state, out-of-state and distributed generation resources for the RPS compliance year 2020. For further information on the ISO's assumptions on the hybrid renewable portfolio, please see the ISO's presentation on December 2, 2010 at http://www.caiso.com/286b/286bf0d441a20.pdf.

The CPUC's Energy Division staff generated a "low load" and "high load" case and ran the E3 calculator to generate RPS build outs under those load levels. In order to develop plausible scenarios that accounted for the significant number of RPS contracts already signed or under negotiation by the utilities, all of the scenarios also include a "discounted core" of projects in a relatively advanced stage of development. The load and resource scenarios tool holds this discounted core of projects constant across all of the RPS scenarios, as it comprised a group of projects with a high likelihood of achieving commercial operation by 2020.

23 Appendix A to the 2008 IEPR is available at the following website: http://www.energy.ca.gov/2008publications/CEC-100-2008-008/CEC-100-2008-008-CMF.PDF

24 The CPUC Energy Division staff use an all-in delivered cost, including cost of new transmission and integration for intermittent resources, net of energy and capacity revenues.

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 contract or negotiation. This database contains confidential information that the CPUC has aggregated for purposes of inclusion in the scenarios.
- Data from the Renewable Energy Transmission Initiative (RETI).
- A greenhouse gas emission calculator prepared by the CPUC's consultant E3 to the extent that it provided information about resources not evaluated by RETI.
- Estimates of potential for wholesale distributed PV generation – 1-20 MW rooftop and ground-mounted projects – developed by Black & Veatch and E3.

CPUC staff has included commercial on-line dates for renewable resources based on contracted or projected online dates, as well as locational data by ISO zone (SP26/NP26) and ISO local capacity area pursuant to an analysis of substations to which new projects would likely connect. The E3 model derated the delivered 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. The E3 model also provided expected year by year buildouts of both resources connecting to existing transmission and resources connecting to major new transmission for each year between 2010 and 2020, to enable planning for fulfillment of the 2020 goals. Over the course of the 2010 long-term procurement plan proceeding, the CPUC may consider alternative 33 percent RPS renewable resource portfolios.[25] Other entities engaged in resource and transmission planning may also provide additional perspectives on likely RPS portfolios.[26] To this end, the ISO has included a fifth scenario with the assistance of E3, which projects a mixture of instate, out of state and distributed generation resources for 2020 only. 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

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

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

This screening tool assesses whether an ISO local capacity area has a surplus or deficiency of resources compared to projected local capacity area requirements using the complete set of assumptions that the user has specified. The ISO emphasizes that additional technical analyses (i.e., reliability studies) 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

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 compared to projected requirements using the complete set of assumptions that the user has specified.[27] 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.[28] 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 determine

27 The equation for zonal capacity surpluses or deficiencies does not escalate expected peak demand by a planning reserve margin, now set by the CPUC at 15-17%.

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

additional capacity requirements for renewable integration efforts. To the extent that results identify amounts of capacity that should have particular characteristics, then those requirements will supplement this effort.