Technical Workshop
Modeling Update for Aliso OII

California Public Utilities Commission Hearing Room, 5th Floor

320 W. 4th Street, Los Angeles, CA 90013

Los Angeles, CA

June 20, 2019

Today's Agenda

9:30 a.m. – 9:45 Introduction. Ground Rules, Objective of workshop

Melissa Semcer, ALJ

9:45 – 10:15 Review of Phase II Schedule and order of modeling steps

Donald Brooks, *Program and Project Supervisor*

10:15 – 11:15 Economic Modeling – results of Implied Market Heat Rate

Mounir Fellahi, *Regulatory Analyst*

- 30 min presentation / 30 min discussion

11:15 – 12:30 Hydraulic Modeling – Receipt Point Utilization

Khaled Abdelaziz, Ph.D., *Utilities Engineer*

- 45 min presentation / 30 min discussion

12:30 – 1:45 Lunch Break

1:45 - 2:30 – CAISO Power Flow results for 2020 Summer Peak

David Le, *Engineer, Regional Transmission, CAISO*

- 30 min presentation / 15 min discussion

2:30 – 3:15 - Production Cost Modeling

Donald Brooks, *Program and Project Supervisor*

- 30 min presentation / 15 min discussion

3:13 – 3:45 – Wrap Up/Next Steps

Webex information

[Join Webex]

Meeting ID: 712 940 796

Meeting Password: !Energy1

Call-in Number (Required for Access): 877-820-7831

Passcode: 754-947-5944

Workshop Objectives & Discussion Guidelines

Melissa Semcer

Administrative Law Judge

California Public Utilities Commission

Workshop Objectives

- Information sharing:
  - Provide update to parties on the status of the Energy Division's modeling efforts (hydraulic modeling, econometric modeling, production cost modeling)
  - Any modeling results produced and data developed for modeling
  - Provide update to parties on status of CAISO's power flow modeling
  - Solicit feedback; and
  - Promote open, informal discussion

Workshop Scope

- In scope:
  - Phase II modeling will focus on whether use of Aliso can be eliminated or minimized given the existing gas system and the likely future system given current legislation and demand trends
- Out of scope:
  - Issues addressed in other proceedings or by other agencies
  - Possible changes to the SoCalGas system that could reduce the need for Aliso Canyon

Workshop Format

- Description of model
  - Clarification questions
- Overview of proposed scenarios and assumptions and trends from the comments
- Discussion of proposed scenarios and assumptions


EVACUATION PLAN
IN CASE OF FIRE
USE STAIRWAY FOR EXIT
DO NOT USE ELEVATOR
FIFTH FLOOR
320 W. FOURTH STREET
FIRE DEPARTMENT: 9-911
FOURTH STREET
Stair 3
Roof Access
Stair 4
Roof Access
Stair 1A
No Roof Access
Stair 2
No Roof Access
N
BROADWAY
YOU ARE HERE
EXIT ROUTE
ELEVATOR
STAIRS
FIRE ALARM
FIRE EXTINGUISHER
ALARM LOOKS LIKE: STROBE LIGHT
ALARM SOUNDS LIKE: 3 SLOW WHOOPS AND A VOICE MESSAGE

Discussion Logistics

- Parties to the Proceeding:
  - Please line up at the mic during the comment period.
  - We will stop midway through the discussion to take questions related to the modeling received via email: AlisoCanyonOII@cpuc.ca.gov
- Members of the Public:
  - To speak during the Public Comment period, please sign up with our Public Advisor.

Review of Phase II Schedule and order of modeling steps

Donald Brooks

Program and Project Supervisor

Energy Resource Modeling, Energy Division

Economic Modeling
Results of Implied Market Heat Rate

Mounir Fellahi
Public Utilities Regulatory Analyst
Energy Resource Modeling, Energy Division

Hydraulic Modeling
Receipt Point Utilization

Khaled Abdelaziz, Ph.D.

Utilities Engineer

Energy Resource Modeling, Energy Division

CAISO Power Flow results for 2020 Summer Peak

David Le, *Engineer*

Regional Transmission, CAISO

Production Cost Modeling
Status of Developing the Model Dataset

Donald Brooks
Program and Project Supervisor
Energy Resource Modeling, Energy Division

Objectives of Production Cost Modeling

- Production Cost Modeling (PCM) is used to evaluate the reliability impacts (in terms of Loss of Load Expectation or LOLE) of a given profile of electric generation and customer demand.
  - Does the curtailment or closure of Aliso Canyon produce significant and undesirable increases in LOLE (1 event in ten years) compared to the pre-existing gas storage and supply situation?
- PCM is also used to evaluate the cost impacts (in terms of total dollars of production cost from fuel, variable O&M and GHG costs) of a given profile of electric generation and customer demand.
  - Does the curtailment or closure of Aliso Canyon produce significant and undesirable increases in production costs compared to the pre-existing gas storage and supply situation?
- General methods and guidelines for Production Cost Modeling laid out in Commission ruling adopting the *Guide to Production Cost Modeling in IRP*

High Level Modeling Method

- Staff is using a PCM approach to produce a plan of what generators will be existing and what the range of electric demand will be served in three study years in the future (2020, 2025, 2030).

- Staff will build off the work already being done in the Integrated Resource Plan (IRP) proceeding. The IRP proceeding will develop a Reference System Plan (RSP) which represents expected electric generation, electric demand, and electric system conditions in the future.

- When the RSP is completed, staff will perform additional sensitivities beyond the IRP work to fulfill the needs of the Aliso proceeding and produce scenarios to rest in hydraulic modeling (Minimum Local Generation and Unconstrained Gas scenarios)

- Staff is in the process of creating the RSP. Staff is updating the baseline data that goes into the model.

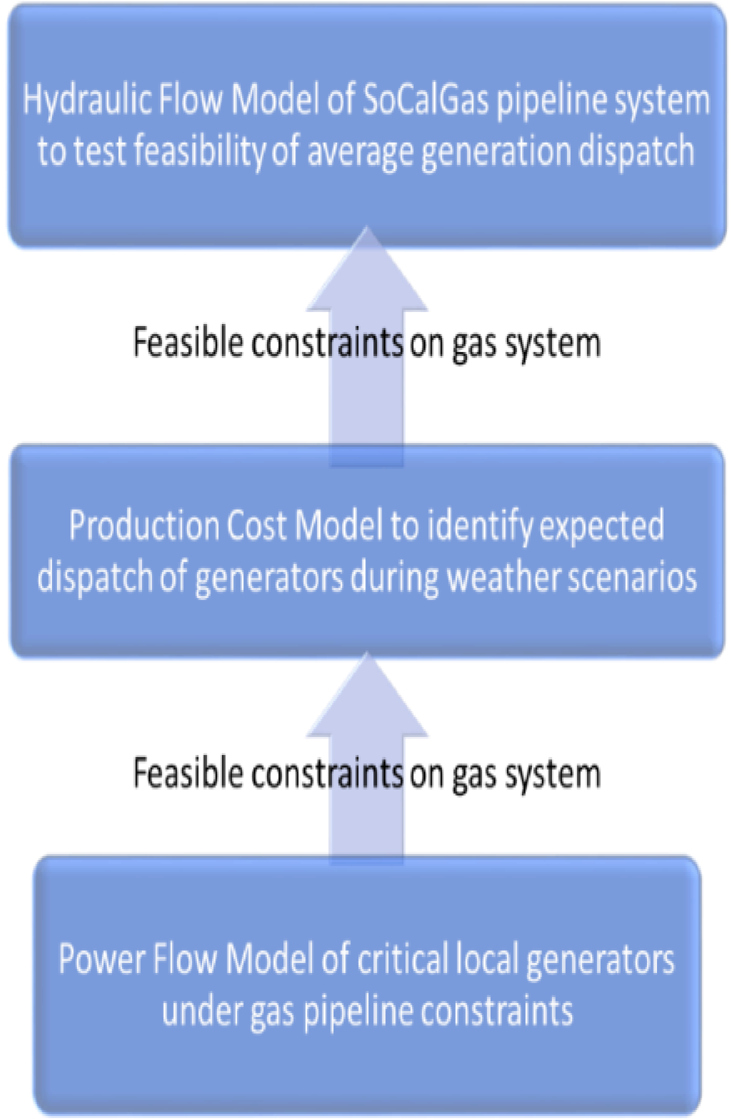
Bottom up Approach

PCM fits in between Power Flow studies (Minimum Local Gen scenario) and Hydraulic Modeling

PCM provides two products that are used:

1. Average unconstrained dispatch hourly electric generator gas demand profiles

2. Constrained Minimum Local Gen hourly gas demand profiles



Staff are using two different models to develop the RSP

- RESOLVE is an optimal investment and operational model
  - Co-optimizes fixed-costs of new investments and costs of operating the CAISO system within the broader footprint of the WECC electricity system over a multi-year horizon
  - Simplifies temporal and spatial resolution to manage model complexity and run-time
    - 37 independent representative days are simulated, each weighted such that daily outputs can be summed up to represent an operating year
    - Units are aggregated into classes, WECC transmission topology is aggregated into 6 regions, with 4 representing CA
  - Simplifications or averaging of operating performance of generation
  - Designed to solve for an optimal portfolio of new investments while satisfying a range of policy and operational constraints
- SERVM is a probabilistic reliability and production cost model
  - Optimizes least-cost unit commitment and dispatch of entire WECC
  - Over wide range of conditions (many different realizations of one chosen study year)
  - Simulates full sequential 8760 hours of a year
  - Requires generating fleet and load forecast to be pre-determined for the study year
  - Unit-level dispatch, WECC transmission topology is aggregated into 24 regions, with 8 representing CA
  - Operating performance of generation more detailed and by unit

Staff will use SERVM Production Cost Software

- Staff use the Strategic Electric Risk Valuation Model (SERVM) for the PCM work in this proceeding and IRP.

- A system-level reliability planning and PCM model designed to analyze the capabilities of an electric system during a variety of conditions under thousands of different scenarios. The current dataset includes:
  - 35 historical weather year distribution (1980-2014)
  - 35 x 5 = 175 probability-weighted ***cases***
  - Each ***case*** represents one realization of a year (8760 hours) of grid operations
  - The dataset is used for probabilistic loss-of-load studies, effective load-carrying capability (ELCC) studies, and forecasting production costs and market prices in the Integrated Resource Planning (IRP) and Resource Adequacy (RA) proceedings

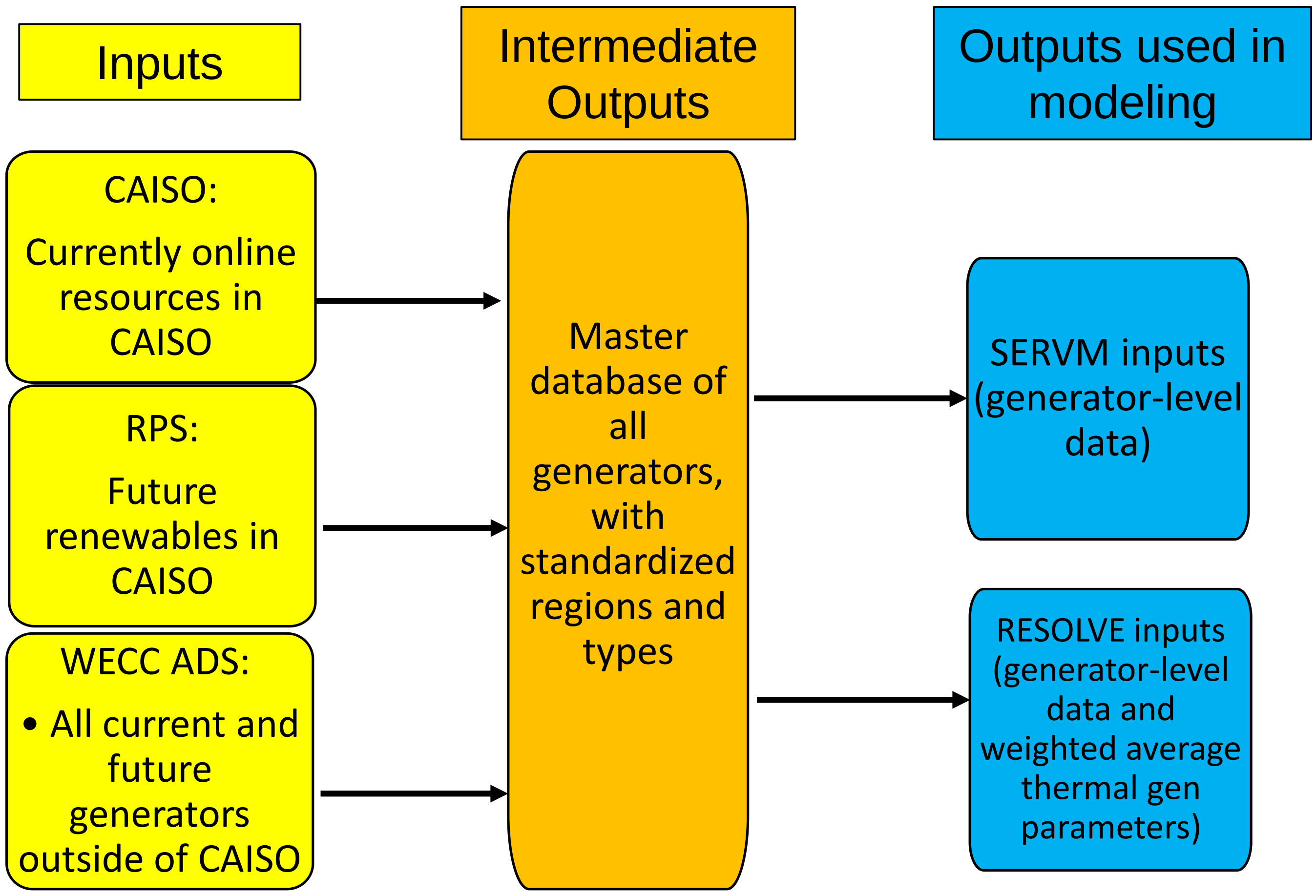
Multiple components of PCM modeling dataset

- Staff has developed the baseline dataset. The following data has been completed and will be posted to the CPUC website within a week
  - Generator unit data
  - Electric Demand forecast
  - Fuel and carbon prices
  - Load, wind, solar, and hydro shapes
  - Transmission topology and constraints
  - System operating constraints

Generator Unit Data

- CAISO Masterfile
  - Generator capacity, location, and operating costs and attributes
  - Unit-specific heat rates, ramp rates, startup profiles, minimum up/down times
- WECC 2028 Anchor Data Set
  - Used to populate non-CAISO generation data
  - New units under construction or units retired by study years (2020, 2024, 2030)
- RPS contracts database
  - Planned projects not yet in CAISO Masterfile
- RESOLVE model output portfolio consistent with IRP modeling
  - Incremental resource portfolio based on IRP Reference System Plan 42 MMT scenario calibrated with the 2017 IEPR forecast
- Generator Availability Data System (GADS) database
  - Planned and forced outage data

Creating master WECC-wide generator list: process diagram



- Boxes represent datasets, arrows represent Python scripts that process the data
- Taken together, the yellow boxes represent the complete set of current and future resources in the WECC
- CAISO and WECC data is vintage March-April 2019
- Data will be posted for stakeholder review to the CPUC website within a week

WECC Installed Capacity by Resource Type and RESOLVE Zone in 2030, MW

	BANC	CAISO	IID	LDWP	NW	SW	Other WECC [5]	**TOTAL**
Biogas [1]	0	272	0	0	0	0	0	**272**
Biomass	18	576	77	0	630	113	1,211	**2,625**
Combined Cycle	1,863	15,076	255	2,755	9,573	19,741	10,194	**59,457**
Cogen [2]	0	2,237	0	0	0	0	3,487	**6,941**
Coal	0	0	0	0	7,364	6,266	8,420	**22,049**
Geothermal	0	1,613	792	0	142	704	677	**3,928**
Hydro	2,765	7,244	84	290	34,378	2,680	21,572	**69,013**
Nuclear	0	635	0	407	1,757	3,000	0	**6,329**
Peaker [2]	867	8,030	327	1,647	2,993	6,808	7,208	**27,880**
Pumped Hydro [3] [6]	0	1,858	0	1,460	500	220	543	**4,580**
Reciprocating Engine [2]	0	255	0	0	0	0	287	**542**
Solar [4]	146	11,389	119	948	2,661	1,936	1,140	**18,338**
Steam [2]	0	0	0	371	0	1,202	3,098	**4,671**
Wind	0	5,564	0	725	12,488	2,127	7,501	**28,405**
TOTAL	**5,659**	**55,966**	**1,654**	**8,602**	**72,485**	**45,326**	**65,338**	**255,031**

Notes:
[1] Biogas is grouped with biomass for non-CAISO areas to reduce model complexity.
[2] Certain non-CAISO area gas generator types are grouped with Peaker types to reduce complexity (see next slide).
[3] This table does not include baseline battery storage. See the end of this section for details on baseline battery storage assumptions.
[4] BTM solar PV is not represented in the table above and will be presented in the demand-side inputs section.
[5] “Other WECC” refers to areas that are within WECC but are not represented in RESOLVE, such as Alberta, British Columbia, and Colorado (however, RESOLVE does represent specified hydro from BC since significant amounts go to CAISO entities). SERVM does model these areas explicitly.
[6] RESOLVE does not model pumped hydro in non-CAISO areas to reduce model complexity.

Demand forecast is a core modeling input

- Electric demand forecast is a core input to any electric system planning analysis
  - California electric planning agencies (CAISO, CEC, CPUC, CARB) have agreed to abide by a single set of electric demand inputs for forward planning and GHG emission targets (Single Forecast Set).
  - Per the Single Forecast Set agreement,* CPUC staff will be using the Energy Commission’s 2018 Integrated Energy Policy Report (IEPR) Update Forecast as a core input
- Any planning exercise must also consider uncertainty. CPUC’s electric planning models consider uncertainty by studying:
  - A range of future weather scenarios through stochastic production cost modeling (SERVM)
  - A range of future electric system resource portfolios, electric demand, and policies through scenarios/sensitivities in capacity expansion modeling (RESOLVE)
- IEPR forecast must be translated into the range of inputs needed by CPUC’s electric planning models

* See: [Final 2018 Integrated Energy Policy Report Update, Volume II- Clean Version]

Decomposition of IEPR demand forecast

- To individually model demand modifiers, the IEPR demand forecast must be decomposed into constituent parts in terms of annual energy, peak impact including any shifting effect, and hourly profiles
  - Multiple IEPR work products are required to conduct the analysis, including:
    - Load Serving Entity and Balancing Area forecast tables
    - Load modifier breakout tables for the 3 large IOU areas
    - Hourly profiles for the CAISO planning areas

- In the RESOLVE and SERVM models:
  - Additional Achievable Energy Efficiency (AAEE), Time-Of-Use (TOU) rate effects, and Light-Duty Electric Vehicle (LDEV) load are each modeled individually with fixed hourly profiles
  - BTM PV (baseline committed + Additional Achievable PV) and BTM storage are modeled as resources with installed capacity
  - Other demand modifier components in the IEPR are left embedded in demand (Other Electrification, Climate Change, BTM CHP, Load-Modifying Demand Response (LMDR))

Using the IEPR to develop a range of RESOLVE scenarios

- RESOLVE's core demand forecast starts with the IEPR's Single Forecast Set
- The IEPR includes low, mid, and high cases which can be combined into a range of different scenarios that RESOLVE can study

Electric demand component	IEPR cases programmed into RESOLVE		
Baseline consumption		Mid	High
Light-duty electric vehicles	Low	Mid	High
Committed BTM PV	Low	Mid	High
Additional Achievable PV	High-Low	Mid-Mid	Low-High
Time-Of-Use rate effects		Mid	
Additional Achievable EE	High-Low	Mid-Mid	Low-High

Using the IEPR to calibrate SERVM's hourly profiles

- SERVM uses a historical weather-based distribution of hourly profiles in order to consider a range of future weather conditions

- IEPR demand and demand modifier data are used to build up the hourly profiles used in SERVM
  - Annual peak and energy consumption are calculated from the IEPR data and used to calibrate SERVM's historical weather-based distribution of hourly demand profiles. SERVM does not directly use the single average hourly demand profile included with the IEPR.
  - BTM PV installed capacity from the IEPR is used to calibrate SERVM's weather-based hourly solar profiles
  - Other demand modifiers are assumed weather independent and SERVM uses the IEPR hourly profiles for these modifiers directly

Using the IEPR to calibrate SERVM's hourly profiles

Distribution of 20 years historical weather-based hourly consumption demand (normalized)

IEPR forecast year 2030:
Peak consumption MW
Annual consumption GWh

Calibrate by peak and energy

20 versions of 2030 hourly consumption demand

Distribution of 20 years historical weather-based hourly BTM solar production (normalized)

IEPR forecast year 2030:
BTM PV installed capacity MW
Avg. annual capacity factor 0.21

Calibrate by installed capacity and capacity factor

20 versions of 2030 hourly BTM PV production

Hourly electric demand and generation profiles

	How developed	Sources
Electric Demand	Based on relationship between historical hourly load and weather	CAISO EMS, FERC Form 714, EIA Form 861, National Climatic Data Center hourly weather
Wind	Based on relationship between historical hourly production and wind speed	NREL Western Wind Resources Dataset, National Climatic Data Center
Solar	Calculated production from historical irradiance and assumed technology configuration	NREL PVWatts tool, NREL National Solar Radiation Database; Operational parameters derived from RPS database
Hydro	Based on historical production	Form EIA-923: Power Plant Operations Report, CEC historical hourly monitoring
Load-modifiers	Used as-is	2018 IEPR update hourly shapes for EV charging, TOU rates, AAEE savings

Summary of SERVM CAISO area demand forecast inputs

Planning Area	PG&E		SCE		SDG&E	
Electric Demand Component [1]	2020	2030	2020	2030	2020	2030
Consumption, MW peak	22,838	25,760	25,353	28,753	4,825	5,517
Consumption, GWh load	111,274	123,640	110,047	123,337	22,123	24,691
Light-duty electric vehicles, GWh load	2,528	7,531	1,851	5,398	562	1,662
Time of use rate effects, GWh load [2]	-	23	-	13	0.03	2
Additional Achievable EE, GWh savings	2,939	12,949	2,881	14,108	572	3,029
Committed BTM PV installed cap MW	5,493	10,269	3,476	7,292	1,504	2,458
Additional Achievable PV installed cap MW	63	720	67	740	14	168
BTM storage installed cap MW [3]	122	469	167	566	65	198

[1] All values are at the system level (includes gross up for losses)
[2] TOU effects have a tiny increase in annual energy while decreasing hourly demand during peak hours
[3] BTM storage capacity represents the amount reported from the IEPR. Reconciling with responses from a recent CPUC data request to LSEs will moderately elevate this projection.

Other IEPR or related inputs necessary for modeling

- Both RESOLVE and SERVM will also use the following as core model inputs:
  - For outside California loads, use electric demand forecasts from the WECC's Anchor Data Set 2028 Phase 2 V1.2
  - For CARB cap and trade GHG allowance price projections, use the CEC's 2019 IEPR Preliminary projection here: https://efiling.energy.ca.gov/GetDocument.aspx?tn=227328&DocumentContentId=58424
  - For natural gas burner tip price forecasts, use the CEC's 2019 IEPR Preliminary model found here: https://www.energy.ca.gov/2014publications/CEC-200-2014-008/April_2019_Model_CEC-200-2014-008.xlsm

Wrap up – Next Steps

Questions?

Contact for more information:

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Donald Brooks: donald.brooks@cpuc.ca.gov

Thank you!
For Additional Information please visit
the CPUC Aliso Canyon webpage:

http://cpuc.ca.gov/aliso/

and the investigation webpage:

http://www.cpuc.ca.gov/AlisoOII/