Technical Committee Meeting
Thursday, June 6, 2019
8:30 A.M.

Charles F. McGlashan Board Room, 1125 Tamalpais Avenue, San Rafael, CA 94901
Mt. Diablo Room, 2300 Clayton Road, Suite 1150, Concord, CA 94520
City of El Cerrito, 10890 San Pablo Avenue, Hillside Conference Room, El Cerrito, CA 94530
City of San Ramon, 7000 Bollinger Canyon Road, Room 256, San Ramon, CA 94583

1. Roll Call/Quorum

2. Board Announcements (Discussion)

3. Public Open Time (Discussion)

4. Report from Chief Executive Officer (Discussion)

5. Consent Calendar (Discussion/Action)
C.1 Approval of 5.2.19 Meeting Minutes

6. De-energizing, Critical Facilities and Emergency Alert Systems (Discussion)

7. Proposed MCE Rate Changes for July 1, 2019 (Discussion/Action)

8. Reducing Greenhouse Gas Emissions in MCE's Resource Adequacy Procurement (Discussion)

9. California Energy Markets and Impacts Related to CCAs (Discussion)

10. Committee Matters & Staff Matters (Discussion)

11. Adjourn

MCE TECHNICAL COMMITTEE MEETING MINUTES
May 2, 2019
8:30 A.M.

Mt. Diablo Room
2300 Clayton Road, Suite 1150
Concord, CA 94520

Charles F. McGlashan Board Room
1125 Tamalpais Avenue
San Rafael, CA 94901

City of El Cerrito
10890 San Pablo Avenue, Hillside Conference Room,
El Cerrito, CA 94530

City of San Ramon
7000 Bollinger Canyon Road, Room 256
San Ramon, CA 94583

Present: Kevin Haroff, City of Larkspur, *San Rafael*
Greg Lyman, City of El Cerrito, *San Rafael*
Scott Perkins, City of San Ramon, *San Ramon*
Kate Sears, County of Marin, *San Rafael*
Ray Withy, City of Sausalito, *San Rafael*

Absent: Rob Schroder, City of Martinez
Justin Wedel, City of Walnut Creek

Staff
& Others: Jesica Brooks, Board Clerk Assistant/Executive Assistant to COO
Sherry Clark, Internal Operations Assistant
Brian Goldstein, Resource Planning & Implementation
Darlene Jackson, Board Clerk/Executive Assistant to CEO
Sam Kang, Resource Planning
Vicken Kasarjian, Chief Operating Officer
Garth Salisbury, Director of Finance
Taylor Sherman, Administrative Services Assistant
Dawn Weisz, Chief Executive Officer

1. **Roll Call**

Chair Sears called the regular Technical Committee meeting to order at 8:30 a.m. with quorum established by roll call.

2. **Board Announcements (Discussion)**

There were none.

3. **Public Open Time (Discussion)**

Chair Sears opened the public comment period and there were no comments.

4. **Report from Chief Executive Officer (Discussion)**

CEO, Dawn Weisz, reported the following:

- Thanked the Board and members of the public for attending April 25th Ribbon Cutting MCE Solar Charge: Grand Opening & Earth Day Celebration
- Thanked Board members and others that attended the American Canyon 3MW Solar Fit Groundbreaking on April 5th
- Save the Date: Early stages of planning for the 2019 Board Retreat have begun. Potential Retreat dates are Wednesday, September 18 or Wednesday September 25th. A calendar invitation will be sent out once a date has been confirmed.

5. **Consent Calendar (Discussion/Action)**

C.1 Approval of 4.4.19 Meeting Minutes

Chair Sears opened the public comment period and there were no comments.

Action: It was M/S/C (Lyman/Haroff) to approve **Consent Calendar**. Motion carried by unanimous vote. (Absent: Directors Schroder and Wedel).

6. **Accelerating Gas Fleet Retirement Through Hybridization with Batteries (Discussion)**

Ed Burgess, Director, Strategen Consulting, Hal Dittmer, President, Wellhead Power Solutions, Joe Hainzmann, Sales Manager, General Electric, Grant McDaniel, Director of New Products, Wellhead Power Solutions and Alex Morris, Vice President, California Energy Storage Alliance presented this item and addressed questions from Committee members.

Chair Sears opened the public comment period and member of the public Megan Matson from Main Street Moms/Table Rock had comments.

Action: No action required.

7. **Energy Risk Management Policy Update (Discussion/Action)**

Garth Salisbury, Director of Finance and Vicken Kasarjian, Chief Operating Officer, presented this item and addressed questions from Committee members.

Chair Sears opened the public comment period and there were no comments.

Action: It was M/S/C (Haroff/Lyman) to **approve the proposed updates to MCE Policy 015: Energy Risk Management Policy** (Absent: Directors Schroder and Wedel).

8. Committee & Staff Matters (Discussion)

Chair Sears opened the public comment period and there were no comments.

9. Adjournment

Chair Sears adjourned the meeting at 10:00 a.m. to the next scheduled Technical Committee Meeting on June 6, 2019.

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Kate Sears, Chair

Attest:

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Dawn Weisz, Secretary

June 6, 2019

TO: MCE Technical Committee

FROM: Justin Kudo, Strategic Analysis and Rates Manager &
John Dalessi, Pacific Energy Advisors

RE: Proposed Rates for Fiscal Year 2019/2020 (Agenda Item #07)

ATTACHMENT: Proposed Rates for FY 2019/2020

Dear Technical Committee:

SUMMARY:
The Marin Clean Energy Community Choice Aggregation Implementation Plan and Statement of Intent ("Implementation Plan") describes the policies and procedures for setting and modifying electric rates for the Marin Clean Energy (MCE) program. As described in the Implementation Plan, the MCE annual ratesetting process is coordinated with the establishment of fiscal year program budgets. MCE rates are typically reviewed on an annual basis once PG&E has made its primary annual rate update to determine whether rate changes are warranted in consideration of the fiscal year's proposed budget, rate competiveness, rate stability, customer understanding, efficiency and equity among customers.

Staff worked with the Ad Hoc Ratesetting Committee of the MCE Board to identify a range of rate scenarios for consideration by the Executive Committee. The Executive Committee evaluated the Ad Hoc Ratesetting Committee proposals and voted to recommend that MCE increase rates to an average of 0.3% below proposed PG&E costs.

Various alternative proposals were considered by the Ad Hoc Ratesetting Committee and the Executive Committee in arriving at the recommended rate proposal. The alternative scenarios included maintaining current MCE rates, adjusting MCE rates to achieve customer cost parity with PG&E, and providing a 2% or 3% discount from PG&E costs. The recommended rate proposal, which sets rates at levels intended to allow for a modest customer savings while maintaining financial stability and achieving existing reserve targets, was identified as the best fit for meeting MCE ratesetting policies.

BACKGROUND – MCE RATESETTING CYCLE, POLICIES AND PROCESS

Ratesetting Cycle

MCE typically adjusts its rates on an annual basis, with initial rates proposed to committees in February and taking effect in early April once approved by the full Board. Ratesetting is usually coordinated with the annual budgeting cycle due to the inherent linkages between the MCE Budget and MCE rates. Rates may also be adjusted more frequently, when necessary, to ensure recovery of all MCE program costs.

This release of the proposed rates initiates a thirty-day public review and comment period. If rate increases are being proposed, the affected MCE customers are provided with notice of said rate increase. Following completion of the thirty-day public review and comment period, final rates are adopted by the Board. Final rates may differ from the initially proposed rates to account for changes in MCE's budget, consideration of public comments received during the aforementioned review period, and/or other factors that may be considered by your Board.

During 2019, PG&E has delayed implementation of its Annual Electric True-Up (AET), their key annual rate change. It is expected that PG&E will implement revised 2019 rates on July 1^{st}, with possible delays to September 1^{st} or beyond. As a result, MCE's ratesetting cycle was initiated at the April 29^{th} Ad Hoc Ratesetting Committee Meeting, with the goal of implementing rate changes by July 1^{st}.

Ratesetting Objectives

MCE has established various objectives that are considered in designing MCE rates. These ratesetting objectives are as follows:

Revenue sufficiency: rates must recover all expenses, debt service and other expenditure requirements, and build prudent reserves; i.e., the "revenue requirement".

Rate competitiveness: rates must allow MCE to successfully compete in the marketplace to retain and attract customers.

Rate stability: rate changes should be minimized to reduce customer bill impacts.

Customer understanding: rates should be simple, transparent and easily understood by customers.

Equity among customers: rate differences among customers should be justified by differences in usage characteristics and/or cost of service.

Efficiency: rates should encourage conservation and efficient use of electricity (e.g., off-peak vehicle charging or time-of-use load shifting).

To the extent that the objectives may be in tension with one another, the rate proposal attempts to strike an appropriate balance. For example, a cost-of-service analysis might suggest that a particular rate should be increased, but the increase might be limited in the interest of rate stability and/or rate competitiveness. In accordance with the Implementation Plan, the policy of revenue sufficiency may not be violated; however, the Board may use discretion in how the other ratesetting objectives are reflected in MCE rates.

Ratesetting Process

The ratesetting cycle begins with a forecast of MCE electric energy sales for the coming fiscal year. The forecast includes the number of customers that are expected to be enrolled and take service on each of the MCE rate schedules as well as the monthly billing quantities expected under each rate schedule. Depending upon the rate schedule in question, billing quantities can include monthly kWh, kWh during specified time-of-use periods (e.g., on-peak, partial peak, off-peak), maximum monthly kW demand and maximum kW demand during specified time-of-use periods. The forecasted billing quantities are used to derive a forecast of revenues at current (and proposed) MCE rates.

The projected revenue at current rates, termed “present rate revenues”, is compared to fiscal year budget items that must be funded through such rates (the “revenue requirement”) to determine whether rate adjustments are warranted for purposes of addressing any projected surplus or deficit. MCE’s budget for the current fiscal year is based on MCE’s current rates with no changes forecast; the rate changes proposed herein would modify that budget revenue forecast.

For rate design purposes, customers are classified based on end-use and other service characteristics in an attempt to represent groups of customers with relatively similar cost-of-service profiles. MCE has established nine customer classes that include: residential (E-1), small commercial (A-1 and A-6), medium commercial (A-10), large commercial (E-19), industrial (E-20), agricultural (Ag), street lighting (SL) and traffic control (TC) end uses. Revenues are allocated based on a cost of service analysis, assessment of rate competitiveness, and other policy considerations.

Typical end uses within the commercial customer classes are described below:

Rate Group	Example End Use
E-1	Residential
A-1 and A-6	Small office, small retail
A-10	Bank, restaurant, mixed use retail
E-19	Department store, large office building, grocery store
E-20	Institutional, hospital, college, water treatment facility
Ag	Agricultural
SL-1	Street and area lighting
TC-1	Traffic lights

Rates are designed for the various rate schedules associated with each customer class in order to recover the revenue requirement allocated to that class. There are currently 40 rate schedules and sub rates under which MCE customers may take service subject to the relevant eligibility criteria. MCE determines rate schedule eligibility by mapping each MCE rate schedule to an equivalent PG&E rate schedule; as customers select their PG&E rate, they are automatically placed on a corresponding MCE rate schedule.

FY 2019/20 PROPOSED RATES

The Executive Committee recommends designing MCE generation rates for FY 2019/20 to achieve a specified discount to PG&E’s generation rates, net of applicable surcharges. Under this proposal, costs for MCE customers, on average, would increase by 6.6% and would be at least 0.3% below costs that would be incurred under PG&E service. The 0.3% savings is estimated using the highest PCIA vintage available; typical customer savings would be closer to 1% due to the lower PCIA rates associated with the earlier PCIA vintages applicable to most MCE customers. The proposed rates would yield a projected reserve contribution of $50.3 million during FY 2019/2020, equating to 12.5% of fiscal year revenues.

Revenue Allocation

The rate proposal allocates revenues among customer classes in a manner that brings average rates for all customer classes, inclusive of PG&E surcharges (Power Charge Indifference Adjustment or "PCIA" and the Franchise Fee Surcharge or "FFS"), closer to parity with PG&E. The proposed annualized revenue changes and cost differences relative to PG&E, by customer class are shown in Table 1:

Table 1: Proposed Rate Comparative Analysis Summary (Annualized for Twelve Month Period)

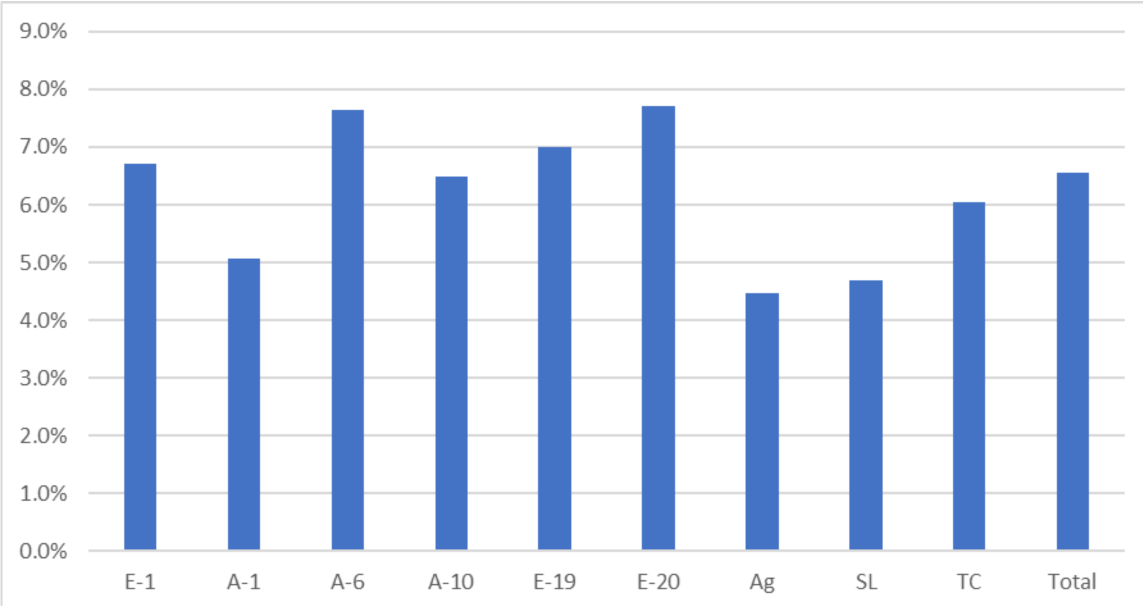
Rate Group	Present MCE Generation + PG&E Charges[1]	Proposed MCE Generation + PG&E Charges[2]	Revenue at PG&E Bundled Rates[3]	Total Cost Difference	Cost Difference
E-1	482,236,289	523,368,232	524,756,651	(1,388,419)	-0.3%
A-1	141,955,387	146,311,459	146,641,367	(329,907)	-0.2%
A-6	25,577,813	27,004,234	27,071,417	(67,184)	-0.2%
A-10	141,223,222	146,393,495	146,783,739	(390,244)	-0.3%
E-19	138,930,528	142,962,557	143,362,651	(400,093)	-0.3%
E-20	75,375,833	77,591,583	77,834,489	(242,906)	-0.3%
Ag	6,558,750	6,807,426	6,823,835	(16,410)	-0.2%
SL	6,690,786	6,495,046	6,507,495	(12,449)	-0.2%
TC	953,342	990,586	992,715	(2,129)	-0.2%
Total	1,019,501,950	1,077,924,618	1,080,774,359	(2,849,741)	-0.3%

The cost figures in Table 1 represent total delivered electricity costs over a twelve-month period, inclusive of generation charges, distribution and other delivery charges, and, for MCE customers, the PCIA and Franchise Fee surcharges. As can be seen from Table 1, the proposed rate changes are not uniform across the different customer classes served by MCE. The proposed differential rate adjustments were made based on a comparative rate analysis and designed to bring average MCE customer costs for all customer classes below what the costs would be under bundled PG&E rates.

Customer electric bill are expected to increase by an average of 6.6% due to a combination of MCE rate changes and changes to PG&E's PCIA rates. Figure 1 illustrates the estimated customer bill impacts for typical customers across customer classes.

[1] Includes current MCE charges and PG&E delivery and PCIA/Franchise Fee Surcharges for 2019 vintage. PG&E rates are expected as of July 1st, 2019, per AL 5527-E.
[2] Includes MCE charges and PG&E delivery and PCIA/Franchise Fee surcharges for 2019 vintage. PG&E rates are expected as of July 1st, 2019, per AL 5527-E.
[3] Includes PG&E generation and delivery charges.

Figure 1: Average Monthly Bill Impacts



Rate Design

The individual rate components on each rate schedule were examined in relation to the costs of providing electric service as well as how they compare to the corresponding PG&E rate, after taking PCIA surcharges into consideration. Generally speaking, each rate component reflects a similar percentage discount relative to the PG&E rate structure. As a result of CPUC approved changes to the PCIA methodology, the residential PCIA is decreasing while other PCIA rates are increasing. To maintain steady rates and a similar overall rate change to all customer classes, residential rates are increasing more than other classes. However, the overall on-bill change would be consistent with other customer classes. A comparison of current and proposed rates is included in Attachment A.

EV2 Rates

PG&E has submitted filings to implement an EV (Electric Vehicle) rate successor tariff, EV2, which if approved would replace EV for most customers in October. The Executive Committee has recommended that your Board direct staff to implement an EV2 rate as PG&E's final EV2 rate becomes available, following the same savings of approximately 0.3% of total bill for MCE customers.

EV2 is structured similarly to EV but follows the new peak period of 4 p.m. to 9 p.m. (rather than the current peak of 2 p.m. to 9 p.m.). Rate pricing will be updated by PG&E to match marginal costs associated with the new hours. Residential solar customers – benefitting from the additional peak hours of 2 p.m. to 4 p.m. and associated rates – will be able to keep the current EV rate structure for up to five years.

Customers with very annual high usage – just under 500% of the typical household usage – will be ineligible to continue on the EV2 rate schedule. PG&E has indicated that this is intended to prevent current utilization of the rate for non-EV purposes, particularly residential marijuana cultivation. Affected customers will receive a notification of potential disqualification from the EV2 rate before being moved to a different residential rate (E-TOU-B).

Standby Rates

Standby is a rare rate schedule used to serve customers under certain conditions, often customers supplied by electricity from self-generation or non-utility sources. MCE does not currently have an established Standby rate. The Executive Committee has recommended that your Board direct staff to implement a Standby rate as part of the current ratesetting process following the same savings of approximately 0.3% of total bill for MCE customers. The MCE Standby rate would apply to a very small number of existing customers.

New Commercial Rates

Across California, most utilities are restructuring the time-of-use periods applied in rate setting. As part of this effort PG&E will be introducing new optional commercial rate schedules similar to existing commercial rate structures, but with their peak period shifted from the current 12 p.m. to 6 p.m. period to a 4 p.m. to 9 p.m. period. Corresponding partial-peak and off-peak periods will be adjusted, peak seasons will be shortened, and a new "super off peak" rate will be introduced during the Spring. The Executive Committee has recommended that your Board direct staff to implement a similar rate structure for MCE as soon as possible once PG&E's rates become available. The rate structure would follow the same savings of approximately 0.3% of total bill for MCE customers.

The goal of these new rates is to incentivize shifting of load away from periods of peak grid strain and to better match rates with the cost of serving load. The current peak period of 12 p.m. to 6 p.m. is no longer consistent with the current shape and pricing of power on California's power grid. Current energy prices tend to decrease in the middle of the day and increase in the evening as solar goes offline, causing a phenomenon commonly referred to as the "duck curve".

While these rates are expected to be available from PG&E in October of 2019, they will be optional for the first year. In October 2020 they are expected to become mandatory for most customer classes – with exceptions for certain solar-friendly rates.

Customer Outreach

MCE customer outreach efforts were initiated following the Executive Committee decision to move forward with the proposed rate adjustments. Customer notifications were initiated through on-bill messages starting with the May 7th billing cycle, via our website and through rate documents available at MCE's front desks. MCE's contact center was also provided with detailed information on the rate change, with direction to track and escalate inquiries where appropriate.

MCE's Notice of Proposed Rate Adjustment was also run as a newspaper advertisement in each of MCE's four counties, with ads running on May 15th and June 5th. The notices are 1/6th of a page and provide general information on the rate increase, as well as where and how comments can be submitted. These notices were printed in the East Bay Times, the Marin Independent Journal, the Napa Valley Register, and the Benicia Herald.

Staff initiated direct outreach to MCE's largest customers to notify them of the rate changes and answer any concerns they might have about MCE or PG&E's upcoming rate changes. Additionally, staff provided a summary of the rate change to municipal agencies through its May update.

Termination Fees

MCE's rates and charges include a Termination Fee applicable to customers departing MCE service after the initial sixty-day post enrollment opt-out period. The Termination Fee is proposed to remain unchanged for FY 2019/20. The Administrative Fee component of the Termination Fee would remain at $5 for residential customers and $25 for non-residential customers. The Cost Recovery Charge component of the Termination Fee, which would apply in the event MCE is unable to recover the costs of supply commitments attributable to the customer that is terminating service, would remain at zero.

Recommendation: Information only.

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
RESIDENTIAL CUSTOMERS										
E-1, EL-1, EM, EML, ES, ESL, ESR, ESRL, ET, ETL	**E-1**									
	ENERGY CHARGE ($/KWH)	All Energy	0.06800	0.03443	0.10243	0.08500	0.03058	0.11558	0.11639	-0.70%
E-6, EL-6	**E-6**									
	ENERGY CHARGE ($/KWH)									
		Summer Peak	0.18600	0.03443	0.22043	0.22700	0.03058	0.25758	0.25912	-0.59%
		Summer Part Peak	0.08200	0.03443	0.11643	0.10500	0.03058	0.13558	0.13612	-0.40%
		Summer Off-Peak	0.04300	0.03443	0.07743	0.05500	0.03058	0.08558	0.08591	-0.38%
		Winter Partial Peak	0.06500	0.03443	0.09943	0.08300	0.03058	0.11358	0.11379	-0.18%
		Winter Off-Peak	0.05200	0.03443	0.08643	0.06900	0.03058	0.09958	0.09998	-0.40%
EV-A, EV-B	**EV**									
	ENERGY CHARGE ($/KWH)									
		Summer Peak	0.21200	0.03443	0.24643	0.24400	0.03058	0.27458	0.27567	-0.40%
		Summer Part Peak	0.07000	0.03443	0.10443	0.10200	0.03058	0.13258	0.13285	-0.20%
		Summer Off-Peak	0.02200	0.03443	0.05643	0.03600	0.03058	0.06658	0.06676	-0.27%
		Winter Peak	0.05700	0.03443	0.09143	0.07200	0.03058	0.10258	0.10301	-0.42%
		Winter Partial Peak	0.02300	0.03443	0.05743	0.03300	0.03058	0.06358	0.06436	-1.21%
		Winter Off-Peak	0.02300	0.03443	0.05743	0.03800	0.03058	0.06858	0.06915	-0.82%
E-TOU-A, EL-TOU-A	**E-TOU-A**									
	ENERGY CHARGE ($/KWH)									
		Summer Peak	0.15300	0.03443	0.18743	0.16800	0.03058	0.19858	0.19995	-0.69%
		Summer Off-Peak	0.07800	0.03443	0.11243	0.09300	0.03058	0.12358	0.12438	-0.64%
		Winter Peak	0.06600	0.03443	0.10043	0.08100	0.03058	0.11158	0.11261	-0.91%
		Winter Off-Peak	0.05200	0.03443	0.08643	0.06700	0.03058	0.09758	0.09832	-0.75%
E-TOU-B, EL-TOU-B	**E-TOU-B**									
	ENERGY CHARGE ($/KWH)									
		Summer Peak	0.17800	0.03443	0.21243	0.19000	0.03058	0.22058	0.22185	-0.57%
		Summer Off-Peak	0.07200	0.03443	0.10643	0.08800	0.03058	0.11858	0.11879	-0.18%
		Winter Peak	0.06900	0.03443	0.10343	0.08400	0.03058	0.11458	0.11501	-0.37%
		Winter Off-Peak	0.04900	0.03443	0.08343	0.06500	0.03058	0.09558	0.09621	-0.65%
E-TOU-C3	**E-TOU-C3**									
	ENERGY CHARGE ($/KWH)									
		Summer Peak	0.12700	0.03443	0.16143	0.14300	0.03058	0.17358	0.17493	-0.77%
		Summer Off-Peak	0.06300	0.03443	0.09743	0.08000	0.03058	0.11058	0.11149	-0.82%
		Winter Peak	0.07000	0.03443	0.10443	0.08700	0.03058	0.11758	0.11847	-0.75%
		Winter Off-Peak	0.05300	0.03443	0.08743	0.07000	0.03058	0.10058	0.10114	-0.55%

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
COMMERCIAL, INDUSTRIAL AND GENERAL SERVICE CUSTOMERS										
A-1-A	**A-1-A**									
	ENERGY CHARGE ($/KWH)									
		SUMMER	0.09200	0.02559	0.11759	0.10200	0.02993	0.13193	0.13258	-0.49%
		WINTER	0.05700	0.02559	0.08259	0.06100	0.02993	0.09093	0.09121	-0.31%
A-1-B	**A-1-B**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.10800	0.02559	0.13359	0.11600	0.02993	0.14593	0.14664	-0.48%
		PART-PEAK	0.08600	0.02559	0.11159	0.09200	0.02993	0.12193	0.12298	-0.85%
		OFF-PEAK	0.05700	0.02559	0.08259	0.06500	0.02993	0.09493	0.09563	-0.73%
		WINTER								
		PART-PEAK	0.08400	0.02559	0.10959	0.09200	0.02993	0.12193	0.12279	-0.70%
		OFF-PEAK	0.06300	0.02559	0.08859	0.07100	0.02993	0.10093	0.10188	-0.93%
A-6	**A-6**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.34000	0.02559	0.36559	0.35500	0.02993	0.38493	0.38637	-0.37%
		PART-PEAK	0.10200	0.02559	0.12759	0.11600	0.02993	0.14593	0.14679	-0.59%
		OFF-PEAK	0.04500	0.02559	0.07059	0.05800	0.02993	0.08793	0.08849	-0.63%
		WINTER								
		PART-PEAK	0.07100	0.02559	0.09659	0.08300	0.02993	0.11293	0.11396	-0.90%
		OFF-PEAK	0.05200	0.02559	0.07759	0.06600	0.02993	0.09593	0.09646	-0.55%

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
A-10-A	**A-10-A**									
	ENERGY CHARGE ($/KWH)									
		SUMMER	0.08100	0.02599	0.10699	0.09000	0.03130	0.12130	0.12184	-0.44%
		WINTER	0.05800	0.02599	0.08399	0.06200	0.03130	0.09330	0.09354	-0.26%
	DEMAND CHARGE ($/KW)									
		SUMMER MAX	4.85000			5.65000			5.68000	-0.53%
	A-10-A-P									
	ENERGY CHARGE ($/KWH)									
		SUMMER	0.07776	0.02599	0.10375	0.08000	0.03130	0.11130	0.11184	-0.48%
		WINTER	0.05568	0.02599	0.08167	0.05500	0.03130	0.08630	0.08722	-1.05%
	DEMAND CHARGE ($/KW)									
		SUMMER MAX	4.65600			4.93000			4.93000	0.00%
A-10-B	**A-10-B**									
	ENERGY CHARGE ($/KWH)									
		<u>SUMMER</u>								
		PEAK	0.13500	0.02599	0.16099	0.14300	0.03130	0.17430	0.17512	-0.47%
		PART-PEAK	0.08200	0.02599	0.10799	0.08800	0.03130	0.11930	0.11999	-0.58%
		OFF-PEAK	0.05400	0.02599	0.07999	0.06000	0.03130	0.09130	0.09192	-0.67%
		<u>WINTER</u>								
		PART-PEAK	0.06500	0.02599	0.09099	0.07200	0.03130	0.10330	0.10405	-0.72%
		OFF-PEAK	0.04900	0.02599	0.07499	0.05500	0.03130	0.08630	0.08698	-0.78%
	DEMAND CHARGE ($/KW)									
		SUMMER MAX	4.85000			5.65000		5.68000	5.68000	-0.53%
	A-10-B-P									
	ENERGY CHARGE ($/KWH)									
		<u>SUMMER</u>								
		PEAK	0.12960	0.02599	0.15559	0.13100	0.03130	0.16230	0.16285	-0.34%
		PART-PEAK	0.07872	0.02599	0.10471	0.08000	0.03130	0.11130	0.11228	-0.87%
		OFF-PEAK	0.05184	0.02599	0.07783	0.05400	0.03130	0.08530	0.08566	-0.42%
		<u>WINTER</u>								
		PART-PEAK	0.06240	0.02599	0.08839	0.06700	0.03130	0.09830	0.09859	-0.29%
		OFF-PEAK	0.04704	0.02599	0.07303	0.05100	0.03130	0.08230	0.08271	-0.50%
	DEMAND CHARGE ($/KW)									
		SUMMER MAX	4.65600			4.93000			4.95000	-0.40%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
E-19-S, V	**E-19-S**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.10500	0.02192	0.12692	0.11700	0.02880	0.14580	0.14610	-0.21%
		PART-PEAK	0.06500	0.02192	0.08692	0.07000	0.02880	0.09880	0.09896	-0.16%
		OFF-PEAK	0.04000	0.02192	0.06192	0.03900	0.02880	0.06780	0.06773	0.10%
		WINTER								
		PART-PEAK	0.05900	0.02192	0.08092	0.06300	0.02880	0.09180	0.09250	-0.76%
		OFF-PEAK	0.04500	0.02192	0.06692	0.04600	0.02880	0.07480	0.07548	-0.90%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	12.60000			14.64000			14.71000	-0.48%
		PART-PEAK	3.10000			3.61000			3.63000	-0.55%
E-19-P, V	**E-19-P**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.09700	0.02192	0.11892	0.10500	0.02880	0.13380	0.13493	-0.84%
		PART-PEAK	0.05800	0.02192	0.07992	0.06100	0.02880	0.08980	0.09043	-0.70%
		OFF-PEAK	0.03500	0.02192	0.05692	0.03300	0.02880	0.06180	0.06183	-0.05%
		WINTER								
		PART-PEAK	0.05300	0.02192	0.07492	0.05500	0.02880	0.08380	0.08442	-0.73%
		OFF-PEAK	0.04000	0.02192	0.06192	0.04000	0.02880	0.06880	0.06890	-0.15%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	11.25000			13.02000			13.09000	-0.53%
		PART-PEAK	2.75000			3.17000			3.19000	-0.63%
E-19-T, V	**E-19-T**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.06000	0.02192	0.08192	0.06400	0.02880	0.09280	0.09306	-0.28%
		PART-PEAK	0.04800	0.02192	0.06992	0.04900	0.02880	0.07780	0.07846	-0.84%
		OFF-PEAK	0.03400	0.02192	0.05592	0.03000	0.02880	0.05880	0.05914	-0.57%
		WINTER								
		PART-PEAK	0.05000	0.02192	0.07192	0.05200	0.02880	0.08080	0.08076	0.05%
		OFF-PEAK	0.03800	0.02192	0.05992	0.03700	0.02880	0.06580	0.06592	-0.18%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	12.40000			14.32000			14.39000	-0.49%
		PART-PEAK	3.10000			3.59000			3.61000	-0.55%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
E-19-R-S, V-R-S	**E-19-R-S**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.24000	0.02192	0.26192	0.30600	0.02880	0.33480	0.33654	-0.52%
		PART-PEAK	0.09500	0.02192	0.11692	0.10700	0.02880	0.13580	0.13646	-0.48%
		OFF-PEAK	0.03900	0.02192	0.06092	0.03900	0.02880	0.06780	0.06773	0.10%
		WINTER								
		PART-PEAK	0.06000	0.02192	0.08192	0.06300	0.02880	0.09180	0.09250	-0.76%
		OFF-PEAK	0.04500	0.02192	0.06692	0.04600	0.02880	0.07480	0.07548	-0.90%
E-19-R-P, V-R-P	**E-19-R-P**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.23000	0.02192	0.25192	0.29600	0.02880	0.32480	0.32673	-0.59%
		PART-PEAK	0.08800	0.02192	0.10992	0.09800	0.02880	0.12680	0.12728	-0.38%
		OFF-PEAK	0.03400	0.02192	0.05592	0.03300	0.02880	0.06180	0.06183	-0.05%
		WINTER								
		PART-PEAK	0.05300	0.02192	0.07492	0.05500	0.02880	0.08380	0.08442	-0.73%
		OFF-PEAK	0.04000	0.02192	0.06192	0.04000	0.02880	0.06880	0.0689	-0.15%
E-19-R-T, V-R-T	**E-19-R-T**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.23000	0.02192	0.25192	0.31000	0.02880	0.33880	0.34024	-0.42%
		PART-PEAK	0.08500	0.02192	0.10692	0.10200	0.02880	0.13080	0.13194	-0.86%
		OFF-PEAK	0.03200	0.02192	0.05392	0.03000	0.02880	0.05880	0.05914	-0.57%
		WINTER								
		PART-PEAK	0.05000	0.02192	0.07192	0.05200	0.02880	0.08080	0.08076	0.05%
		OFF-PEAK	0.03800	0.02192	0.05992	0.03700	0.02880	0.06580	0.06592	-0.18%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
E-20-S	**E-20-S**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.09500	0.02107	0.11607	0.10800	0.02744	0.13544	0.13597	-0.39%
		PART-PEAK	0.06000	0.02107	0.08107	0.06500	0.02744	0.09244	0.09304	-0.64%
		OFF-PEAK	0.03600	0.02107	0.05707	0.03600	0.02744	0.06344	0.06356	-0.19%
		WINTER								
		PART-PEAK	0.05500	0.02107	0.07607	0.05900	0.02744	0.08644	0.08680	-0.41%
		OFF-PEAK	0.04100	0.02107	0.06207	0.04300	0.02744	0.07044	0.07083	-0.55%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	12.20000			14.20000			14.27000	-0.49%
		PART-PEAK	3.00000			3.50000			3.52000	-0.57%
E-20-P	**E-20-P**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.10200	0.01967	0.12167	0.11200	0.02616	0.13816	0.13876	-0.43%
		PART-PEAK	0.06100	0.01967	0.08067	0.06500	0.02616	0.09116	0.09153	-0.40%
		OFF-PEAK	0.03700	0.01967	0.05667	0.03600	0.02616	0.06216	0.06247	-0.50%
		WINTER								
		PART-PEAK	0.05600	0.01967	0.07567	0.05900	0.02616	0.08516	0.08530	-0.16%
		OFF-PEAK	0.04200	0.01967	0.06167	0.04300	0.02616	0.06916	0.06961	-0.65%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	13.40000			15.55000			15.63000	-0.51%
		PART-PEAK	3.15000			3.68000			3.70000	-0.54%
E-20-T	**E-20-T**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.06200	0.01808	0.08008	0.06600	0.02447	0.09047	0.09137	-0.99%
		PART-PEAK	0.04900	0.01808	0.06708	0.05200	0.02447	0.07647	0.07704	-0.74%
		OFF-PEAK	0.03400	0.01808	0.05208	0.03300	0.02447	0.05747	0.05807	-1.03%
		WINTER								
		PART-PEAK	0.05100	0.01808	0.06908	0.05400	0.02447	0.07847	0.07929	-1.03%
		OFF-PEAK	0.03900	0.01808	0.05708	0.04000	0.02447	0.06447	0.06472	-0.39%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	15.85000			18.53000			18.62000	-0.48%
		PART-PEAK	3.75000			4.42000			4.44000	-0.45%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
E-20-R-S	**E-20-R-S**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.22000	0.02107	0.24107	0.27200	0.02744	0.29944	0.30078	-0.45%
		PART-PEAK	0.09000	0.02107	0.11107	0.10100	0.02744	0.12844	0.12873	-0.23%
		OFF-PEAK	0.03700	0.02107	0.05807	0.03600	0.02744	0.06344	0.06356	-0.19%
		WINTER								
		PART-PEAK	0.05500	0.02107	0.07607	0.05900	0.02744	0.08644	0.08680	-0.41%
		OFF-PEAK	0.04200	0.02107	0.06307	0.04300	0.02744	0.07044	0.07083	-0.55%
E-20-R-P	**E-20-R-P**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.24000	0.01967	0.25967	0.29200	0.02616	0.31816	0.31955	-0.43%
		PART-PEAK	0.08900	0.01967	0.10867	0.10000	0.02616	0.12616	0.12684	-0.54%
		OFF-PEAK	0.03700	0.01967	0.05667	0.03600	0.02616	0.06216	0.06247	-0.50%
		WINTER								
		PART-PEAK	0.05500	0.01967	0.07467	0.05900	0.02616	0.08516	0.08530	-0.16%
		OFF-PEAK	0.04200	0.01967	0.06167	0.04300	0.02616	0.06916	0.06961	-0.65%
E-20-R-T	**E-20-R-T**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.23000	0.01808	0.24808	0.27700	0.02447	0.30147	0.30301	-0.51%
		PART-PEAK	0.08400	0.01808	0.10208	0.09500	0.02447	0.11947	0.12026	-0.66%
		OFF-PEAK	0.03500	0.01808	0.05308	0.03300	0.02447	0.05747	0.05807	-1.03%
		WINTER								
		PART-PEAK	0.05100	0.01808	0.06908	0.05400	0.02447	0.07847	0.07929	-1.03%
		OFF-PEAK	0.04000	0.01808	0.05808	0.04000	0.02447	0.06447	0.06472	-0.39%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
STOUS	**STOUS**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	NA	0.01261	0.01261	0.09600	0.02234	0.11834	0.11892	-0.49%
		PART-PEAK	NA	0.01261	0.01261	0.07700	0.02234	0.09934	0.10005	-0.71%
		OFF-PEAK	NA	0.01261	0.01261	0.05300	0.02234	0.07534	0.07536	-0.03%
		WINTER								
		PART-PEAK	NA	0.01261	0.01261	0.08000	0.02234	0.10234	0.10306	-0.70%
		OFF-PEAK	NA	0.01261	0.01261	0.06100	0.02234	0.08334	0.08393	-0.70%
	RESERVATION CHARGE ($/KW)		NA			0.46000			0.46000	0.00%
STOUP	**STOUP**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	NA	0.01261	0.01261	0.09600	0.02234	0.11834	0.11892	-0.49%
		PART-PEAK	NA	0.01261	0.01261	0.07700	0.02234	0.09934	0.10005	-0.71%
		OFF-PEAK	NA	0.01261	0.01261	0.05300	0.02234	0.07534	0.07536	-0.03%
		WINTER								
		PART-PEAK	NA	0.01261	0.01261	0.08000	0.02234	0.10234	0.10306	-0.70%
		OFF-PEAK	NA	0.01261	0.01261	0.06100	0.02234	0.08334	0.08393	-0.70%
	RESERVATION CHARGE ($/KW)		NA			0.46000			0.46000	0.00%
STOUT	**STOUT**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	NA	0.01261	0.01261	0.07600	0.02234	0.09834	0.09907	-0.74%
		PART-PEAK	NA	0.01261	0.01261	0.06100	0.02234	0.08334	0.08352	-0.22%
		OFF-PEAK	NA	0.01261	0.01261	0.04000	0.02234	0.06234	0.06296	-0.98%
		WINTER								
		PART-PEAK	NA	0.01261	0.01261	0.06300	0.02234	0.08534	0.08597	-0.73%
		OFF-PEAK	NA	0.01261	0.01261	0.04700	0.02234	0.06934	0.07017	-1.18%
	RESERVATION CHARGE ($/KW)		NA			0.38000			0.38000	0.00%
AGRICULTURAL CUSTOMERS										
AG-1-A	**AG-1-A**									
	ENERGY CHARGE ($/KWH)									
		SUMMER	0.07700	0.02546	0.10246	0.08500	0.02652	0.11152	0.11235	-0.74%
		WINTER	0.05800	0.02546	0.08346	0.06300	0.02652	0.08952	0.09011	-0.65%
	CONNECTED LOAD ($/HP)									
		SUMMER MAX	1.35000			1.53000			1.54000	-0.65%
		WINTER MAX	-			-				
AG-1-B	**AG-1-B**									
	ENERGY CHARGE ($/KWH)									
		SUMMER	0.08000	0.02546	0.10546	0.08900	0.02652	0.11552	0.11606	-0.47%
		WINTER	0.05700	0.02546	0.08246	0.06300	0.02652	0.08952	0.09047	-1.05%
	DEMAND CHARGE ($/KW)									
		SUMMER MAX	2.00000			2.31000			2.31000	0.00%
		WINTER MAX	-			-				
AG-RA	**AG-RA**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.24200	0.02546	0.26746	0.28200	0.02652	0.30852	0.30989	-0.44%
		OFF-PEAK	0.04500	0.02546	0.07046	0.05100	0.02652	0.07752	0.07805	-0.68%

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
		WINTER								
		PART-PEAK	0.05200	0.02546	0.07746	0.05900	0.02652	0.08552	0.0863	-0.90%
		OFF-PEAK	0.04200	0.02546	0.06746	0.04700	0.02652	0.07352	0.07347	0.07%
	CONNECTED LOAD ($/HP)									
		SUMMER	1.3000			1.5100			1.52	-0.66%
		WINTER	-			-				
AG-RB	**AG-RB**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.21500	0.02546	0.24046	0.25300	0.02652	0.27952	0.28078	-0.45%
		OFF-PEAK	0.04500	0.02546	0.07046	0.05100	0.02652	0.07752	0.07773	-0.27%
		WINTER								
		PART-PEAK	0.04100	0.02546	0.06646	0.04400	0.02652	0.07052	0.0713	-1.09%
		OFF-PEAK	0.03500	0.02546	0.06046	0.03400	0.02652	0.06052	0.06073	-0.35%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		MAX	1.9000			2.2500			2.26	-0.44%
		PEAK	2.1500			2.5300			2.52	0.40%
		WINTER	-			-				

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PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
AG-VA	**AG-VA**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.21000	0.02546	0.23546	0.24300	0.02652	0.26952	0.27113	-0.59%
		OFF-PEAK	0.04300	0.02546	0.06846	0.04800	0.02652	0.07452	0.07489	-0.49%
		WINTER								
		PART-PEAK	0.05100	0.02546	0.07646	0.05800	0.02652	0.08452	0.08454	-0.02%
		OFF-PEAK	0.04000	0.02546	0.06546	0.04500	0.02652	0.07152	0.07196	-0.61%
	CONNECTED LOAD ($/HP)									
		SUMMER	1.3500			1.5800			1.59	-0.63%
		WINTER	-			-				
AG-VB	**AG-VB**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.18500	0.02546	0.21046	0.22600	0.02652	0.25252	0.25382	-0.51%
		OFF-PEAK	0.04400	0.02546	0.06946	0.04900	0.02652	0.07552	0.0764	-1.15%
		WINTER								
		PART-PEAK	0.03900	0.02546	0.06446	0.04500	0.02652	0.07152	0.07231	-1.09%
		OFF-PEAK	0.03500	0.02546	0.06046	0.03500	0.02652	0.06152	0.06157	-0.08%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		MAX	1.7500			2.0800			2.09	-0.48%
		PEAK	2.2500			2.6800			2.69	-0.37%
		WINTER	-			-				

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
AG-4-A, AG-4-D	**AG-4-A**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.13700	0.02546	0.16246	0.15600	0.02652	0.18252	0.18347	-0.52%
		OFF-PEAK	0.04600	0.02546	0.07146	0.05200	0.02652	0.07852	0.07921	-0.87%
		WINTER								
		PART-PEAK	0.05100	0.02546	0.07646	0.05700	0.02652	0.08352	0.08394	-0.50%
		OFF-PEAK	0.04000	0.02546	0.06546	0.04500	0.02652	0.07152	0.07152	0.00%
	CONNECTED LOAD ($/HP)									
		SUMMER	1.35000			1.55000			1.56	-0.64%
		WINTER	-			-				
AG-4-B, AG-4-E	**AG-4-B**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.09900	0.02546	0.12446	0.11300	0.02652	0.13952	0.13991	-0.28%
		OFF-PEAK	0.04900	0.02546	0.07446	0.05400	0.02652	0.08052	0.0812	-0.84%
		WINTER								
		PART-PEAK	0.04600	0.02546	0.07146	0.05200	0.02652	0.07852	0.07918	-0.83%
		OFF-PEAK	0.03900	0.02546	0.06446	0.04100	0.02652	0.06752	0.06738	0.21%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		MAX	2.35000			2.74000			2.75	-0.36%
		PEAK	2.50000			2.91000			2.92	-0.34%
		WINTER	-			-				
AG-4-C, AG-4-F	**AG-4-C**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.11600	0.02546	0.14146	0.13500	0.02652	0.16152	0.16183	-0.19%
		PART-PEAK	0.05600	0.02546	0.08146	0.06500	0.02652	0.09152	0.09162	-0.11%
		OFF-PEAK	0.03800	0.02546	0.06346	0.03900	0.02652	0.06552	0.0661	-0.88%
		WINTER								
		PART-PEAK	0.04100	0.02546	0.06646	0.04600	0.02652	0.07252	0.07334	-1.12%
		OFF-PEAK	0.03700	0.02546	0.06246	0.03600	0.02652	0.06252	0.06239	0.21%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	5.90000			6.76000			6.79	-0.44%
		PART-PEAK	1.00000			1.15000			1.16	-0.86%
		WINTER	-			-				

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
AG-5-A, AG-5-D	**AG-5-A**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.12600	0.02546	0.15146	0.14300	0.02652	0.16952	0.17023	-0.42%
		OFF-PEAK	0.05100	0.02546	0.07646	0.05700	0.02652	0.08352	0.08417	-0.77%
		WINTER								
		PART-PEAK	0.05500	0.02546	0.08046	0.06100	0.02652	0.08752	0.08815	-0.71%
		OFF-PEAK	0.04400	0.02546	0.06946	0.04800	0.02652	0.07452	0.07518	-0.88%
	CONNECTED LOAD ($/HP)									
		SUMMER	3.70000			4.22000			4.24	-0.47%
		WINTER	-			-				
AG-5-B, AG-5-E	**AG-5-B**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.11000	0.02546	0.13546	0.14100	0.02652	0.16752	0.16834	-0.49%
		OFF-PEAK	0.03200	0.02546	0.05746	0.03000	0.02652	0.05652	0.05659	-0.12%
		WINTER								
		PART-PEAK	0.04500	0.02546	0.07046	0.05300	0.02652	0.07952	0.07989	-0.46%
		OFF-PEAK	0.02800	0.02546	0.05346	0.02000	0.02652	0.04652	0.04696	-0.94%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		MAX	4.45000			5.13000			5.16	-0.58%
		PEAK	5.55000			6.42000			6.45	-0.47%
		WINTER	-			-				
AG-5-C, AG-5-F	**AG-5-C**									
	ENERGY CHARGE ($/KWH)									
		SUMMER								
		PEAK	0.09000	0.02546	0.11546	0.11200	0.02652	0.13852	0.13949	-0.70%
		PART-PEAK	0.04500	0.02546	0.07046	0.05400	0.02652	0.08052	0.08054	-0.02%
		OFF-PEAK	0.03200	0.02546	0.05746	0.03200	0.02652	0.05852	0.0586	-0.14%
		WINTER								
		PART-PEAK	0.03700	0.02546	0.06246	0.03800	0.02652	0.06452	0.06518	-1.01%
		OFF-PEAK	0.03000	0.02546	0.05546	0.02800	0.02652	0.05452	0.0552	-1.23%
	DEMAND CHARGE ($/KW)									
		SUMMER								
		PEAK	10.30000			11.91000			11.97	-0.50%
		PART-PEAK	1.90000			2.24000			2.25	-0.44%
		WINTER	-			-				

MARIN CLEAN ENERGY

PROPOSED RATES AS OF JULY 1, 2019

PG&E EQUIVALENT SCHEDULE	MCE RATE SCHEDULE	UNIT/PERIOD	CURRENT MCE GENERATION RATE	CURRENT PG&E FEES (PCIA & FF)	CURRENT EFFECTIVE GENERATION RATE	PROPOSED MCE GENERATION RATE	PROPOSED PG&E FEES (PCIA & FF)	PROPOSED EFFECTIVE GENERATION RATE	PROPOSED PG&E GENERATION RATE	MCE GENERATION & PG&E FEES VS. PG&E GENERATION (negative % indicates savings with MCE)
STREET AND OUTDOOR LIGHTING										
LS-1, LS-2, LS-3, OL-1	**SL**									
	ENERGY CHARGE ($/KWH)		0.07500	0.00658	0.08158	0.06800	0.02461	0.09261	0.09278	-0.18%
TC-1	**TC-1**									
	ENERGY CHARGE ($/KWH)		0.06400	0.02559	0.08959	0.07300	0.02993	0.10293	0.10350	-0.55%

DEEP GREEN OPTION

Customers electing the Deep Green service option will pay the applicable rate for the Light Green service option plus the Deep Green Energy Charge.

	CURRENT MCE GENERATION RATE	PROPOSED MCE GENERATION RATE
ENERGY CHARGE ($/KWH)	0.01000	0.01000

LOCAL SOL OPTION

For customers taking service under the Local Sol service option, the MCE generation charges of the participating customer's otherwise applicable tariff will be replaced with the following Local Sol Rate:

	CURRENT MCE GENERATION RATE	PROPOSED MCE GENERATION RATE
ENERGY CHARGE ($/KWH)	0.14200	0.14200

Voltage Discount

For rate schedules not segregated by service voltage, each component of the standard rate shall be discounted for primary or higher service voltage. Current: 4% Proposed: 4%

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A1-101

CIGRE 2018

Hybridizing Gas Turbine with Battery Energy Storage: Performance and Economics

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SUMMARY

The dramatic growth of variable, renewable-generating resources, particularly wind and solar power, has substantively changed the operating and economic constraints on gas-fired generation. Systems around the world are adding high-flexibility, open-cycle gas turbines to provide a wide range of necessary functions for successful grid operation. Technologically advanced, open-cycle gas turbines provide fast-starting and rapid power-ramping functions necessary to accommodate high penetrations of power from wind and solar sources. Gas turbines also provide essential reliability services, including adding system inertia and accepting secondary frequency control (a.k.a. automatic generation controls). However, delivery of these essential services requires a continuous, committed gas turbine for power generation. When the cost of the power produced by the unit exceeds the marginal value of electricity, there is a significant economic penalty to operation, even at minimum load.

In this paper, we present a gas turbine plant, hybridized with a Battery Energy Storage System. The incorporation of battery storage addresses the need for continuity of service, including attributes associated with operating an open-cycle gas turbine at minimum load without the need for the unit to operate in a continuous synchronized state. The sophisticated coordination of generator, gas turbine and battery controls allows for a range of performance advantages that are unique to the fully-integrated hybrid arrangement. We present some details of the first commercial installation of this Electric Gas Turbine (EGT*), along with discussion of the economics and dynamic performance.

KEYWORDS

Hybrid Generation, Battery-Gas Generation Systems, Frequency Control, Ancillary Services.

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1. INTRODUCTION: GLEXIBILITY REQUIREMENTS IN MODEREN GRIDS

As the amount of variable, renewable generation in power systems has dramatically expanded globally, the power industry has focused on the requirement of the entire power system to have operational flexibility. Market pressures caused by changing generation portfolios and energy consumption patterns are driving many traditional, inflexible “baseload” generators out of business. Simple cycle (a.k.a. open-cycle) gas turbines have historically been used as “peaking units,” and as occasional resources for meeting unexpected power shortages, for example those caused by equipment outages or extreme weather.

With so many challenges to secure system operation and changes to the ways in which traditional, fossil-based generation resources respond to energy and ancillary service markets, the need for greater flexibility and adaptability are paramount. In particular, periods of large amounts of wind and solar generation will prove more cost effective, and therefore lessen the need for synchronous generation. From an energy market perspective; renewables become the preferred power supply.

With less power demand from the burning of fossil fuels during the intervals of wind and solar production, the fossil power is displaced. This takes two forms: units are either

(a) decommitted (stopped), or

(b) dispatched down, often to the minimum.

This dichotomy presents challenges for operation. With incorporation of the very low-cost wind and solar renewable resources, traditional units can be decommitted. Utilizing these cheaper alternatives means that other short-term benefits of operation are lost. While constantly available synchronous power provides substantial reliability, it is less cost-effective. With downward dispatch, units continue to have the ability to deliver other services, but they also continue to consume fuel at less-efficient dispatch levels and deliver power that can be uneconomic. Ultimately, the choice between running (i.e., being committed and dispatched at minimum power) and being decommitted (i.e., being stopped, disconnected from the grid, and ready to start) has enormous consequences – both in terms of grid economics and reliability. The broader economic benefit of the increased flexibility provided by the EGT can be seen in reductions in both wholesale market clearing prices and system production costs for energy. By avoiding suboptimal economic dispatch of energy resources to provide reserves, the wholesale market clearing price and generation production costs tend to be reduced. This produces economic benefits to the entire grid, and places downward pressure on end-user rates. For individual plant owners, many of the economic challenges derive from these operational constraints in conjunction with other competitive forces. Plant owners are faced with an environment of:

- Flat systemic load energy growth
- Requirements for faster ramps and higher peaks
- Multiple starts per day
- Frequent dispatch to minimum
- Close scrutiny to primary frequency response, and frequency response obligation
- Increased need for spinning and other short-term reserves
- System synchronous inertia and fast-frequency response requirements
- Tighter emissions requirements

2. THE CALIFORNIA DUCK CURVE EXAMPLE

The well-publicized California "duck" curve[2] provides a quantitative illustration of the challenges facing grids around the world. Four traces produced by California ISO (CAISO) circa 2012 appear in Figure 1. The duck curve was intended to illustrate the challenges emerging with the growth of solar generation. The four traces ("1" in the figure) showed a worrisome projected outlook for the year 2020, when CAISO predicted the following for net loads:

- The midday minimum net load (i.e., net of customer demand minus wind and solar generation) would drop on some days to about 12GW,
- Then it would rise rapidly with the evening load rise,
- It would come with sunset to a peak above 26GW.
- The steeper ramp from 5:00 to 8:00 PM would be 14GW: a substantial challenge.

CAISO's predictions proved somewhat inaccurate: the problems anticipated to occur by 2020 materialized early, in 2016. On the day recorded (yellow trace), the actual net-load minimum was about 11GW ("2"), the rise about 12GW over five hours ("3"), and the evening peak about 23GW ("4").

The need to minimize unwanted generation during the middle of the day (the belly of the duck), and then rapidly ramp-up and provide needed generation for the evening peak is completely apparent in this figure. Grids around the world face similar challenges.

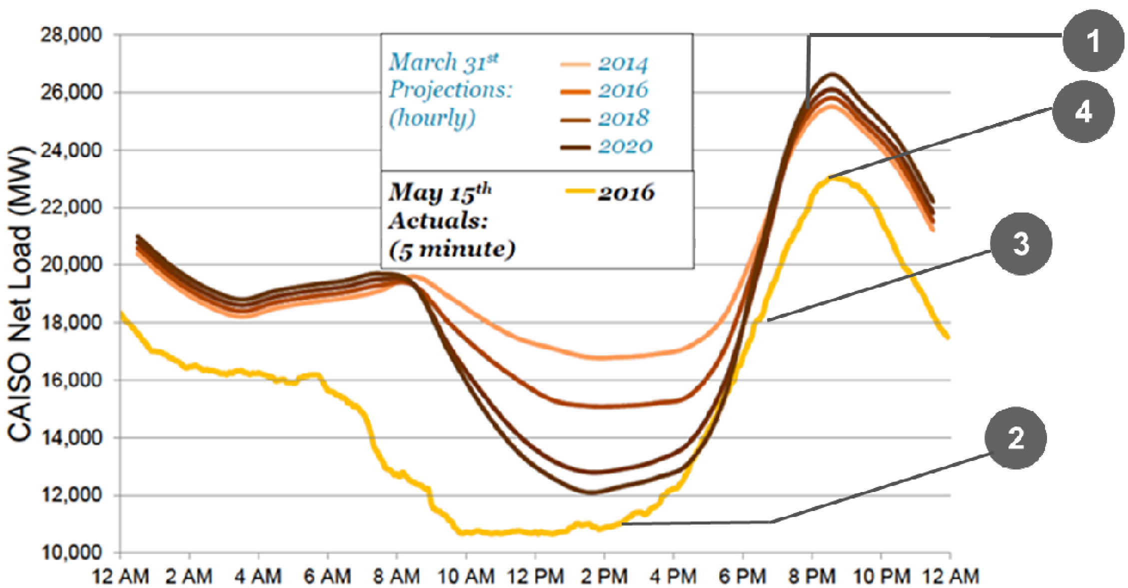

Figure 1 California "Duck" Curve

3. ALWAYS ON: A HYBRID BATTER-GAS TURBINE SYSTEM

With regard to the challenge of the choice outlined above, to run or to decommit: it would be ideal (if it were possible) to have all benefits of having the gas turbine committed without burning any fuel and producing unwanted electricity. But, gas turbines have minimum dispatch levels as dictated by firing stability, emissions control and a host of other practical limitations. GTs alone simply cannot be run at zero power.

GE's EGT™, a fully integrated combination of an aero-derivative gas turbine-generator and a Battery Energy Storage System (BESS), provides a practical and economic solution to this dilemma. The constituents of the plant are an aero-derivative gas turbine (GE LM6000[1] - nominal 50MW rating), and a 10MW packaged battery energy storage system. The gas turbine features state-of-the-art controls with 5 min fast start, fast synchronization, and improved NOx controls at ultra-low output. The battery system is fully integrated controls, with 4-quadrant self-commutating inverters, and complementary balance-of-plant.

Operational Characteristics of Power Plant

The power plant's operational characteristics are particularly well suited to systems in which there is:

- **(a)** frequent or even continuous need for primary frequency response, secondary frequency response ("reg"), inertia, fast-frequency response, short-circuit current contribution, and voltage support, **and**
- **(b)** less frequent demand for energy, with most production being needed to meet power ramps and sharp peaks (like the California duck curve), **and**
- **(c)** synchronized reserves for system contingencies and weather extremes.

The concept is to provide the greater operational flexibility in a single integrated package. The grid operator sees a discrete, valuable and flexible resource to meet reliability needs. The plant owner is positioned to respond efficiently to a broad range of market signals, including opportunities to provide paid essential reliability services without the constraint of (non-zero) minimum power dispatch, as well as realize energy sales during periods of scarcity and capacity payments. In the following sections, we will examine some specific aspects of the system design and performance.

4. FOUR INCREASINGLY SCARCE SERVICES TOGETHER

A great deal of attention is being given around the world to ensure that grids, especially those with high levels of wind and solar generation, maintain adequate levels of essential reliability services[1], for example, during the net load minimum shown in the California plots above. Notice the language here: historically many of these services have been referred to as "ancillary services". But, there is nothing "ancillary" about them: the grid cannot run without them. The definitions of the services are evolving as the industry refines practices and introduces new market mechanisms to ensure adequate and economic power supplies at all times. Those services that have historically been derived from committed, synchronous generation are of concern, because of the forces noted above.

The EGT configuration provides a unique combination of essential services that are hugely valuable in systems where the power supply is dominated by inverter-based generation (i.e., wind and solar PV). These systems are the subject of great concern to the industry, and they increasingly represent limits to system operation. Risks encountered by systems approaching zero-inertia and zero-synchronous short-circuit contribution[3,4] include: curtailment of renewables, poor frequency response, poor performance of conventional protective relays, and instability of high-bandwidth inverters.

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[1] LM6000 is a registered trademark of General Electric Company, USA.

Even when the gas turbine is not operating, the generator with excitation system continues in parallel operation with the BESS. Together:

- The generator provides synchronous short-circuit strength and synchronous inertia to the grid;
- The high response excitation system continues in service, providing fast, tight voltage regulation;
- The parallel operation of the BESS, provides fast-frequency response that can be customized to the specific requirements of the host grid, as well as the rapid, finely controlled reactive power that comes from the self-commutating four-quadrant converter interface.

Thus, in this operating mode the EGT provides:

- Synchronous Inertia
- Fast frequency response
- Short-circuit contribution
- Dynamic voltage support

Each of these essential reliability service produces economic and reliability benefits for the host grid, especially for those approaching high levels of inverter-based resources. However, market constructs (i.e. ancillary service markets, bilateral interconnection bonuses, or evaluation criteria) are largely absent. Fully regulated, vertically-integrated systems can evaluate holistic benefits from these functions, but other market based systems require that the asset owner realize benefits from existing market structures. In the following sections, we examine how the Southern California project creates value for the owner.

5. A VALUABLE UTILITY ASSET

As noted above, the hybridization of the gas turbine with energy storage allows the plant to be dispatched at zero MW, while still providing the functionality normally associated with a synchronized gas turbine. A significant aspect of the functionality is the spinning reserve service provided. No uniform language and definitions of short-term reserves exist throughout the industry. However, "spinning reserve" and various 10-minute reserves have historically been based on the assumption that the plant providing these services will be able to:

(a) Start responding instantly to either a frequency event or the external instruction (e.g., from the grid operator) to increase output, and

(b) Fully meet the instruction within 10-minutes (e.g., increase output by the amount obliged).

Since there is a finite start time, no conventional fossil-fuel generator, even a quick-start gas turbine, can meet the first requirement without being operating and synchronized. Consequently, the synchronized unit must be dispatched at least at its minimum power. In which case, the amount of spinning reserve provided is no greater than the difference between this minimum and the full output of the machine. As a simple example, consider a 50MW stand-alone gas turbine with a minimum (continuous) dispatch of 50%. Operation for the purpose of providing spinning reserve will result in:

(a) 25 MW of out-of-merit generation, causing curtailment of other very low marginal cost renewables, and

(b) 25 MW of spinning reserve service.

In the case of the EGT, the battery system provides all instantaneous response, allowing the plant to meet the first requirement without having the unit running. When the grid calls upon the plant to provide the service, the gas turbine starts, and the power output of the battery plus the starting gas turbine are coordinated to meet the system need and the letter of the service requirement. Where there is an abundance of variable-, low- or zero- marginal cost wind and solar power, the systemic need for short time-frame reserves, necessitates this type of flexibility. This condition is increasingly becoming the norm, rather than an occasional exception, in grids around the world. A window of operation for the EGT™ in such an environment is shown in Figure 2. Start-up and shutdown are in the unshaded periods at either end of the trace, and both resources are running in fully coordinated mode in the blue shaded area. This is a significant revenue opportunity for the SCE project, as will be shown below.

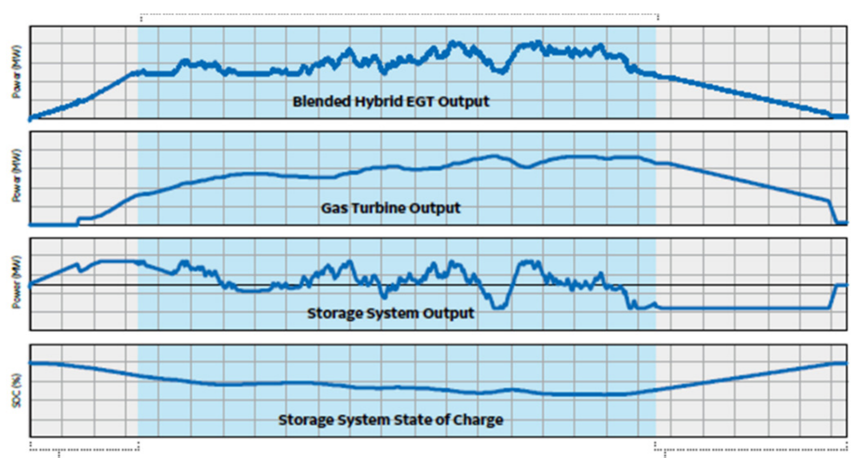


Figure 2 Illustration of total EGT performance for a system event

The broader economic benefit of the increased flexibility provided by the EGT can be seen in reductions in both wholesale market clearing prices and system production costs for energy. Within organized electricity markets, where operational reserves are procured through market mechanisms, the primary economic beneficiaries of the EGT's capabilities are generation owners who receive ancillary market payments as described above. Secondary beneficiaries include utilities who serve load and end-use electricity customers through reduced market clearing prices. In many hours of operation, the EGT replaces spinning reserve provided by inexpensive thermal generation allowing increased dispatch for that energy. This released power displaces power produced by higher marginal cost peaking units.

In a regulated utility, where a centralized balancing authority owns generation and serves load, economic benefits of an EGT are realized by both the utility and end-use customers through a reduction in electricity production costs. The two contributing factors to production cost reductions are 1.) the dispatch of thermal assets closer to their most efficient power point (typically maximum power) and, 2.) the de-commitment of thermal assets held online to provide spinning reserves. For example, Figure 3 and Figure 4 below show the projected decommitment of an expensive steam turbine after the addition of an EGT.

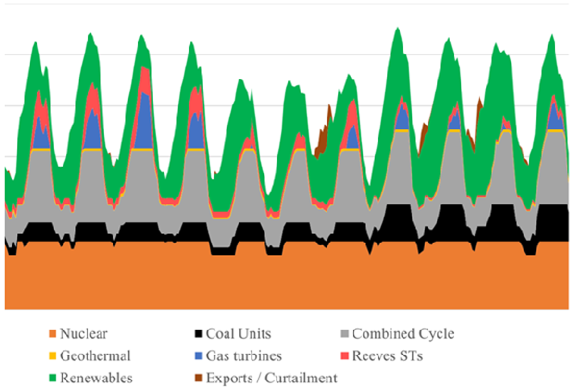


Figure 3 Hourly System Dispatch by Type without EGT

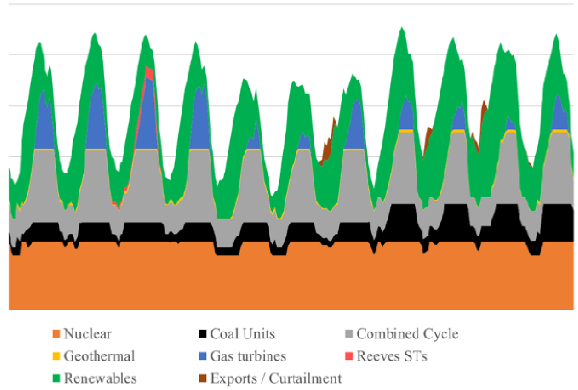


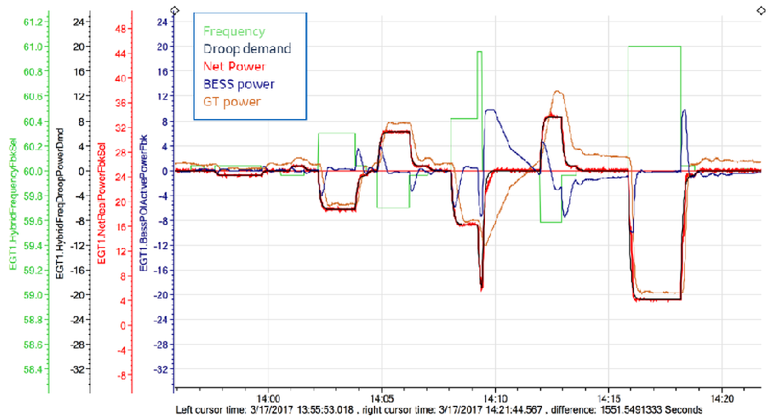
Figure 4 Hourly System Dispatch by Type with EGT

In Figure 3, which does not include an EGT, the Steam Turbine (ST) is online for the entirety of the week and dispatched at levels varying with load. It is evident that during low-load periods the ST is dispatched at, or near, its minimum power point. At these times, the ST is specifically being committed to provide spinning reserves. In Figure 4, which shows the same time period but with one EGT modeled, the ST is de-committed for a large majority of the week with its energy replaced with combined-cycle and gas turbine generators. The EGT addition reduced the system production cost over the interval evaluated.

6. SOUTHERN CALIFORNIA EDISON CASE STUDY

The hybrid battery and gas-turbine system described in this paper is in commercial operation today, through a joint project between Southern California Edison (SCE) and GE. The Center Peaker Plant EGT project in Norwalk, CA, with GE Hybrid LM6000 EGT™, as shown in Figure 5, has been in operation since March 30, 2017. The second EGT conversion exists at the Grapeland Peaker Plant in Rancho Cucamonga, CA and was commissioned on the same day. Commissioning tests, such as the Primary Frequency Response for Norwalk EGT™ shown in Figure 6, have demonstrated a full range of capabilities.

Figure 5 GE Hybrid LM6000 EGT Norwalk, CA
(Photo Courtesy of Southern California Edison)



Test results 30 sec after delta f:

Delta F, Hz	Expected Power, MW	Actual Power, MW (avg)
0.03599	0	0
0.0361	0.752	-0.75
-0.0361	0.752	0.75
0.3	-6.25	-6.25
-0.3	6.25	6.25
0.4167	-8.68	-8.68
0.4167	8.68	8.68
1	-20.83	-20.83

Configuration:
- 4% droop
- +/- 36 mHz deadband
- 49.9MW rated power
- Full contribution by 25 sec

Figure 6 Site Testing – Primary Frequency Response for Norwalk EGT

SCE has used their EGT units to more efficiently operate their peaker units and to create additional revenue streams in the CAISO market. Operationally, SCE projects a decrease in both the generator start-ups and run hours of the peaker plants with an EGT upgrade as depicted in Figure 7. The annual number of starts deceases approximately 50% and run hours by 60%. Figure 8 depicts the expected CAISO energy and ancillary market awards for the EGT plants. Prior to the EGT enhancement, each peaker plant could only qualify for the non-spinning reserve ancillary market, where the majority of the operation and revenue was realized. Each plant operated in the energy market as a peaker plant under peak load and emergency conditions where market clearing prices justified operation. After the installation of hybrid capabilities, the units generally continue their use in the energy market but now operate in the spinning reserve market a majority of the year, with some operation in the regulation market.

SCE's operational projections for their EGT peaker plants have aligned with actual operation as shown in Figure 9. Differences are generally attributed to real-time market conditions. Market clearing prices for spinning reserve are substantially higher than prices in the non-spinning reserve market. The ability to participate in the spinning reserve market gives an opportunity to increase revenue. The increased revenue potential realized by SCE is exemplified in Figure 10, where a single day of hourly reserve clearing prices is shown. Figure 11 shows the projected reduction in emissions before and after the EGT upgrade. The post-EGT upgrade operation is projected to produce two million gallons of de-mineralized water usage reductions per year at the peaker plants. This represents a substantial savings in California where water usage is a significant concern.

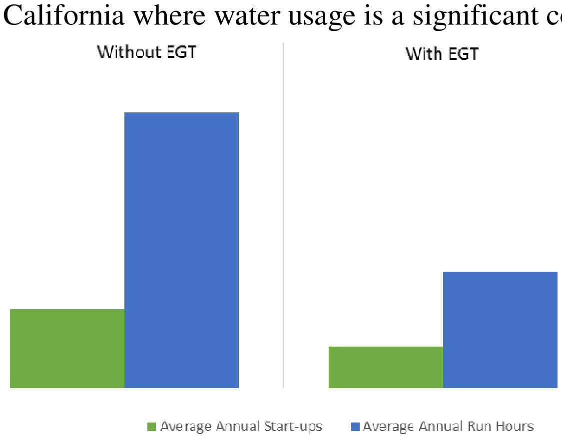


Figure 7 Projected Starts & Run Hours

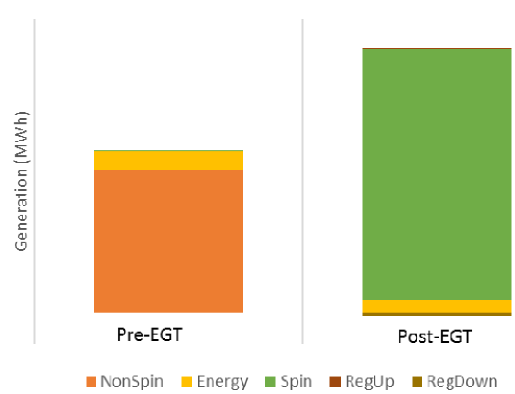
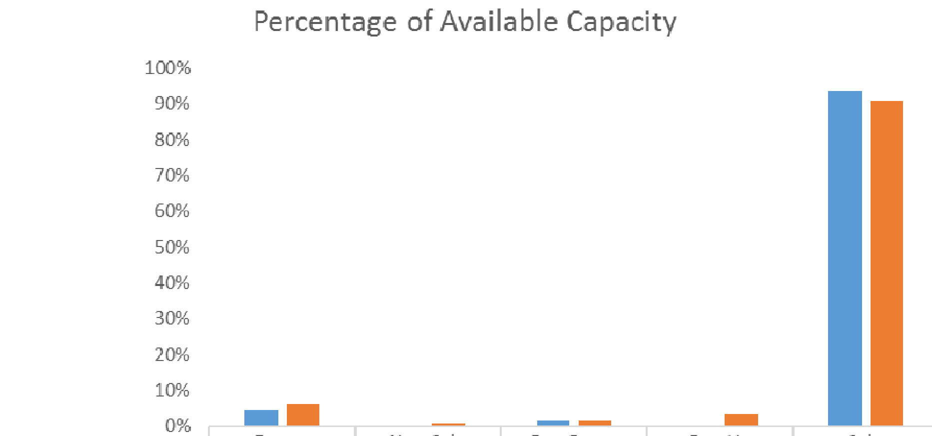


Figure 8 Expected CAISO Market Awards Pre/Post EGT



	Energy	Non-Spin	Reg-Down	Reg-Up	Spin
Forecasted post-EGT	5%	0%	1%	0%	94%
Actual post-EGT	6%	1%	2%	3%	91%

Figure 9 Forecasted vs Actual EGT Capacity Usage

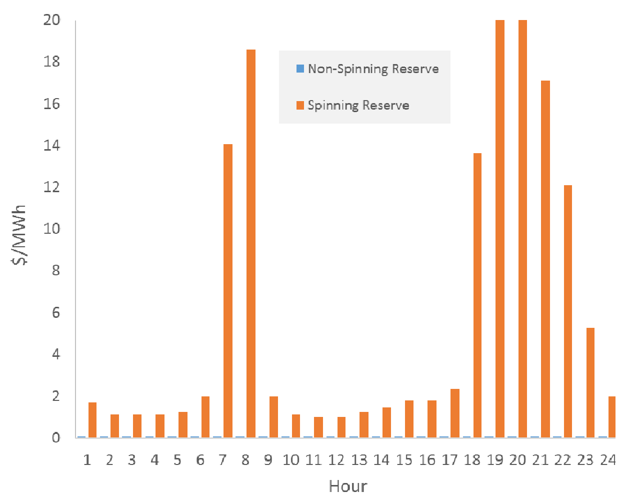


Figure 10 Example of Recent CAISO Hourly Reserve Prices

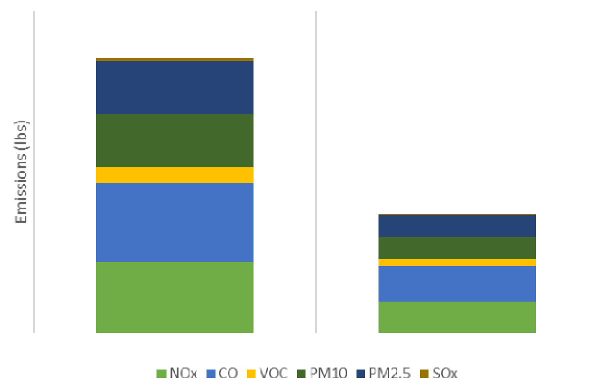


Figure 11 Projected Emissions Pre/Post EGT

7. SUMMARY

The hybridization of a flexible peaking open cycle gas turbine with a battery energy system is now an option for grids to realize needed operational flexibility that will reduce operating costs, renewable curtailment, emissions, water usage, and variable operating costs.

BIBLIOGRAPHY

1. [1 NERC. "Frequency Response Initiative Report". Draft. September 30. http://www.nerc.com/docs/pc/FRI%20Report%209-30-12%20Clean.pdf
2. CAISO, https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf
3. Kroposky, Benjamin; et.al. "Achieving a 100% renewable Grid", IEEE power & energy magazine, March/April 2017.

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead®

HYBRID ENHANCED GAS TURBINE TECHNOLOGY

Unlocking value to the grid while cleaning the air

Grapeland Peaker Plant, Rancho Cucamonga, CA

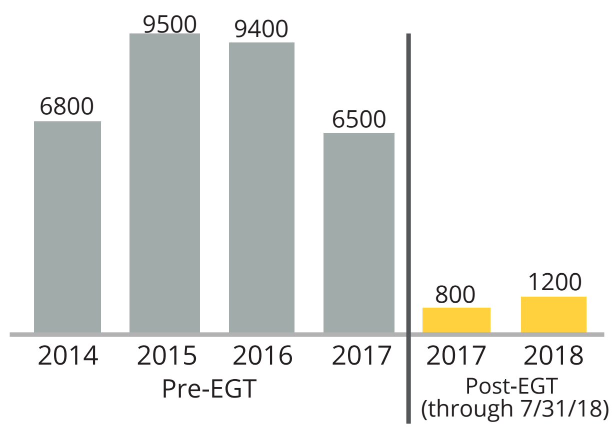
Center Peaker Plant, Norwalk, CA

The world's first Hybrid Enhanced Gas Turbine projects add a battery energy storage system, an upgraded emissions control system and a new control system to existing peaker plants. This creates value for customers and the grid, saves water, and reduces GHG emissions and particulate matter.

GROUNDBREAKING INTEGRATION

By tying battery storage directly to peaker plants, the peaker plants can be off-line but still available at a moment's notice. This is accomplished by using the new battery system to bridge the time gap between when the peaker is needed and when it can be fully ramped up and ready to provide power. When the California Independent System Operator (CAISO) signals that it needs additional power from the peaker plants, the batteries can instantly provide energy for the five minutes it takes for the peaker plant to come online. This way, the peakers don't need to come online in anticipation of being needed later.

The Hybrid EGT at Center Peaker Plant reduced stacked emissions by 78% (by lbs. of emissions)



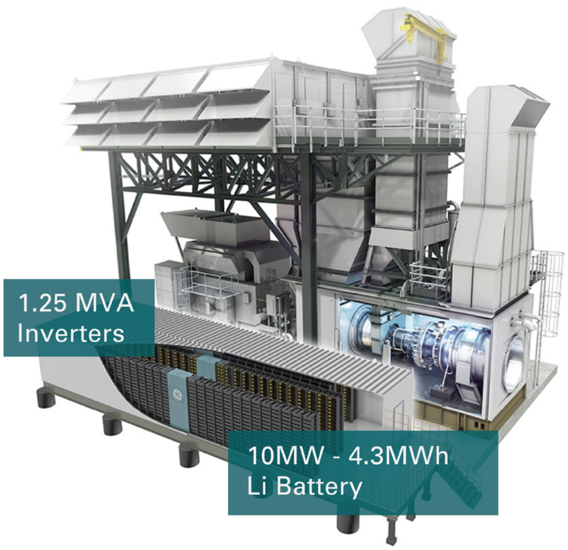
EXCEPTIONAL PERFORMANCE

The Hybrid EGT has met or exceeded all performance expectations.

- Greenhouse gas emissions reduced by 60%
- Particulate emissions reduced by 78%
- Water usage reduced by 80%
- 50% fewer starts
- 60% fewer run hours
- Operates over entire load range of 0-50MW (no longer "all or none" offer)
- Up to 500 frequency droop corrections per day
- Significant increase in market value
- Higher capacity utilization

Future plant upgrades are under consideration for five additional units.

In Service Date:
- Energy storage systems: December 30, 2016
- Control systems and upgrades: March 30, 2017



NEW TECHNOLOGY

The award-winning technology includes three new elements:

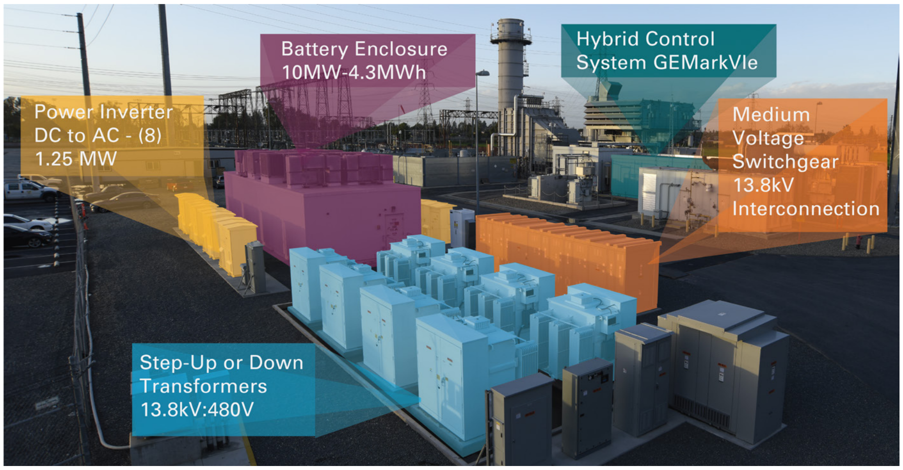
- 10MW/4.3MWh lithium ion battery system
- Hybrid control system to integrate the gas peaker and battery. The system optimizes the blend between the battery and the gas turbine.
- Emissions control system that allows the gas turbines to operate at a partial load and still remain emissions compliant (previously it could only operate at a full load.) This reduces fuel consumption.

SITING

For construction and permitting efficiency, each Hybrid EGT fits within the current footprint of its associated peaker plant. Within the existing site, the battery storage system and the ancillary equipment fit within an approximately 9,500 foot self-contained area.

Components:

- 4 battery enclosures on concrete foundations with HVAC and fire protection system.
- 8 inverters on concrete foundations
- 8 isolation transformers on concrete foundations or piers with spill prevention control and countermeasures
- Switchgear equipment enclosure on concrete foundation
- Auxiliary equipment transformer and control equipment enclosure on concrete foundation
- Hybrid control system mounted in the turbine control panel or the energy storage control panel



INNOVATION AT ITS BEST

The two Hybrid EGTs that have come online have won multiple awards for their pioneering approach to using a new technology—battery storage—to reduce the environmental impact of a traditional resource—the peaker plant. Awards from Edison Electric Institute, POWER Magazine, Energy Storage North America and the South Coast Air Quality Management District attest to the success of the new technology.