



CPUC Docket: A.24-03-011
Exhibit Number: TURN-01
Witness: Jalal Awan

**PREPARED TESTIMONY OF
JALAL AWAN**

**ADDRESSING PG&E'S PROPOSAL FOR COMPREHENSIVE GAS ADVANCED
METERING INFRASTRUCTURE (GAMI) REPLACEMENT PROGRAM**

Submitted on behalf of

THE UTILITY REFORM NETWORK

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Summary of Recommendations:

TURN's **primary recommendation** is as follows:

TURN recommends that the Commission deny this application and instruct PG&E to perform a comprehensive root cause analysis to establish the cause(s) of each type of early failure to avoid recurring failures and conclusively attribute responsibility for early failures.

Alternative Recommendations:

If the Commission approves this application, in whole or in part, it should:

- **Recommendation 1 (Return on Rate Base and Cost Sharing):** Authorize zero return on any stranded assets in rate base, and replacement costs for premature failures should be shared equally between ratepayers and shareholders.
- **Recommendation 2 (Like-for-Like Replacements):** Approve only the minimum necessary required maintenance using the original, legacy modules and disallow lifecycle replacements and/or upgrades to legacy modules.
- **Recommendation 3 (Module-Only Costs):** Remove meter-and-module exchanges and warranty-covered replacements from the cost forecast to achieve a more realistic figure of \$315.6 million for like-for-like required maintenance. This ensures transparency, avoids unnecessary equipment replacements, and accurately reflects module-only failures.
- **Recommendation 4 (Refined Forecast Methodology):** Adopt TURN's simple four-year average of historical failures for forecasting instead of Exponent's Kaplan–Meier estimator-based failure rates. KM estimator over-estimates 2023 and 2024 failures by 20% and 200% respectively across PG&E's 17 divisions.
- **Recommendation 5 (Adjusted Unit Costs):** Limit cost recovery to only baseline module replacements and adopt a recalibrated unit cost of \$65.50 per module, reducing total costs to \$202.284 million.

Introduction:

On July 20, 2006, the California Public Utilities Commission (CPUC) approved a project budget of \$1.7394 billion, inclusive of a Risk Based Allowance, or contingency, of \$128.8 million and \$49 million for pre-deployment costs to install Advanced Metering Infrastructure (SmartMeters) across PG&E's electric and gas system.¹ This project was supposed to retrofit 54% of then-existing electric meters (5.1 million) and 96.1% of gas meters (4.2 million), enhancing capabilities such as remote meter reading, outage pinpointing, and enabling time-varying rates.² Anticipated benefits valued at approximately \$2.007 billion over a 20-year lifespan justified this substantial expenditure. On an annual basis post-implementation, these benefits included, but were not limited to, operational meter reading (2005 \$86.2 million), remote turn-on/shut-off (2005 \$11.5 million), reduced equipment replacement (2011 \$8.5 million), and various other operational, customer, and employee related annual projected benefits.³

The AMI infrastructure comprises three main components: Gas Modules, Gas Data Collection Units (DCUs), and a Head-End Application that interfaces with the IT / Network Communications equipment.⁴ The AMI system was designed to be modular and interoperable to avoid vendor lock-in.

The Gas Module, a battery-operated hardware device attached externally to each customer's gas meter, serves as the core of the Gas AMI 1.0 system. Equipped with a Network Interface Card (NIC), the module collects gas consumption data and transmits it wirelessly to the nearest DCU. These DCUs, which are installed across service areas on assets such as utility poles or municipal building roofs, decode, store, and relay the data to the head-end application for billing.

¹ D.06-07-027, Appendix A

² D.06-07-027, p. 1

³ See D.06-07-027, Table 2 "Stipulated AMI Project Benefits"

⁴ <https://www.hubbell.com/aclara/en/products/rf-3500-gas-mtu/p/12662463>

Issues and Failures in Gas AMI 1.0:

Based on the 20-year expected useful life (EUL) determined during the original 2006-2013 deployment of 4.7 million gas modules, the earliest failures should have occurred no earlier than 2026, and the last failures by 2033. However, the actual system performance has fallen far short of these projections. By 2022, approximately 1.86 million legacy Gas Modules had already been replaced under Required Maintenance, with 842,313 replacements occurring between 2019 and 2022 alone.⁵

The primary issue highlighted since the AMI system's deployment revolves around the early end-of-life of Gas Modules – the so-called “study modules” (██████████, as of December 2022) that failed due to either battery failure, intermittent communication, or non-communication issues. “Non-study modules” (██████████, as of December 2022) were removed due to customer opt-outs, meter/MTU issues, and “other” or unknown causes.⁶ The >1 million removals of working modules deserve scrutiny insofar as they may be used as replacement modules in lieu of early failures. Among other factors, PG&E has attributed the premature failures of “study modules” to environmental factors like high temperatures and precipitation, which TURN finds inconclusive at best as detailed in the following sections.⁷

TURN is concerned that despite the Commission's initial determination of a 20-year EUL of the Gas AMI system, current discussion in PG&E's application is heavily skewed towards replacements, both reactive and proactive, without getting into the “whys” and equity considerations of “who pays” for the modules that failed earlier than their projected benefits, or any refurbishment attempts prior to replacements. Originally, the Commission acknowledged (as PG&E notes in its application) in 2006 that while the system was expected to last 20 years, unforeseen developments could necessitate earlier or later replacements.⁸ However, this potential for extending the system's life beyond 20 years (or much less than 20 years for early failures) is completely overlooked in favor of wholesale replacements and costly system upgrades.

⁵ A.24-03-011, p. 2-12, Table 2-4

⁶ PG&E Response to DR_TURN_004-Q006Atch01CONF

⁷ PG&E Response to DR_TURN_004-Q005Atch01CONF, Slide 15

⁸ A.24-03-011, p. 4-1, lines 27-30

PG&E’s Comprehensive Gas AMI Replacement Proposed Program:

PG&E has approximately 4.7 million gas meters with Gas Modules.^{9 10} Of those, 2.8 million are remaining legacy standard range Gas Modules that PG&E plans to replace between 2023-2030. PG&E currently forecasts replacing approximately 1.7 million Legacy Gas Modules during the 2023-2026 period, with the remaining 1.2 million forecasted from 2027-2030. This application includes 2023-2026 period, with 2027-2030 to be included in 2027 GRC.

PG&E proposes \$11.7 million in operational expenses and \$485.1 million in capital expenditures for 2023–2026, focusing on the replacement of 1.33 million modules under Required Maintenance (\$401.5 million) and 230,432 modules through proactive lifecycle replacements (\$40.8 million).¹¹ Additionally, \$42.8 million will fund IT and network upgrades for the improved Gas AMI 2.0’s implementation. Only 29,387 extended range gas modules are projected to be replaced under the supplier warranty replacements from 2023-2026.¹²

Gas AMI 2.0 is now envisioned as a transformative solution, introducing two-way communication for advanced functionalities like real-time monitoring, remote shutoffs, and over-the-air firmware updates. The upgraded system also includes Aclara Series 3000 Gas Modules, and a modernized Head-End Application, among other improvements from the baseline system deployed between 2006-2013, for improved safety, operations, and two-way communications.

Future integrations in PG&E’s roadmap also include ultrasonic meters (USMs) as opposed to existing mechanical diaphragm meters, as well as Residential Methane Detectors (RMDs) for early leak detection.

⁹ WP 1-1, “Current Gas Modules In-Service by Vintages” and A.24-03-011, p.1-4, lines 2-5

¹⁰ Based on TURN’s analysis, as of Dec. 2022, [REDACTED] legacy modules exist, [REDACTED] were removed as part of non-active non-study modules, and [REDACTED] were deemed non-active study modules, for a total of [REDACTED] gas modules.

¹¹ WP 2-6 Detail Capital Expenditure Forecast by Major Work Category, Rows 153 and 163

¹² WP 2-6 Detail Capital Expenditure Forecast by Major Work Category, Row 14

The program’s replacement strategy also includes proactive lifecycle replacements, replacing approximately 60k modules annually, i.e. before failure, each year from 2023-2026, in addition to the proposed required maintenance.¹³ Each instance of Lifecycle Replacement includes the replacement of a Legacy/Original 501 or 506 Series module with a Second-Generation Series 3000 module.¹⁴ The major differences between the Series 501/506 and Series 3000 modules include the Series 3000's extended transmission range up to 3 miles, rear-positioned batteries for potentially longer life, and a higher safety classification.¹⁵ Despite these improvements, TURN remains skeptical about the necessity of transitioning to Series 3000, due to a lack of tangible benefits to customers that justify the higher costs.

PG&E’s required maintenance and lifecycle replacement projections for 2023-2026 are based on external consultant Exponent’s end-of-life study.¹⁶ TURN finds significant concerns regarding the accuracy of PG&E/Exponent’s failure probability models, as analyses for 2023–2024 suggest Exponent’s projections overestimate failure rates, even in the immediate short-term i.e. for 2023 and 2024 – and potentially higher divergence from actual failures in the longer term (i.e. 5-15 years projections). Furthermore, considering the evolving context of an increasingly electrified energy landscape in California, there are serious doubts about the long-term utility of the Gas AMI 2.0 system, given stranded asset risk, affordability, and lack of demand-response benefits similar to the electric system.

In the 2023 GRC Decision (D.23-11-069¹⁷), the Commission denied PG&E’s \$385 million request for Gas AMI module replacements, citing insufficient evidence that proactive replacement would prevent additional costs, concerns over corrective maintenance costs, and the potential for risks to outweigh claimed benefits.

¹³ 50,432 lifecycle or proactive replacements are proposed in 2023, and 60k in later years 2024-2026.

¹⁴ PG&E Response to DR_TURN_004-Q002

¹⁵ PG&E Response to DR_TURN_004-Q001Atch01

¹⁶ WP 2-8 End of Life Study

¹⁷ A.21-06-021 decision pp. 333-334

TURN's Primary Recommendations in View of Current Evidence:

TURN is concerned that the allocation of responsibility, and therefore costs, for premature equipment failures is placed solely on ratepayers, rather than shared by PG&E's shareholders who are still profiting from the initial deployment, despite early failures. TURN does not possess the time or resources to conduct an independent engineering review, including a Failure Mode and Effects Analysis (FMEA) or Root Cause Analysis (RCA), nor to evaluate cost-effective fixes such as battery replacements that have proven viable in certain other cases.¹⁸ Yet, PG&E's proposal includes enhancements over the baseline Gas AMI 1.0 system, prioritizes replacements to the exclusion of potential cost-effective alternatives, and proposes upgrading failing modules with advanced alternatives. This allocation of costs introduces a moral hazard: if PG&E and its shareholders face no financial repercussions for these early failures and in fact benefit from them, PG&E—and by extension other utilities—will have diminished incentives to prevent them. In other words, protecting utilities from the consequences of early failures effectively encourages imprudent behavior, since they can rely on customers to absorb the losses. Moreover, standard ratemaking principles dictate that long-lived assets be depreciated over their expected useful life, ensuring that ratepayers are not burdened with excessive costs beyond the asset's useful life. Ratepayers should only be charged for the used and useful service life of assets, not for premature replacements. Furthermore, TURN notes that PG&E is currently enjoying a full rate of return on failed or removed modules that no longer meet the "used and useful" standard.

Consequently, TURN recommends that it is prudent for the Commission to deny this application in its current form, investigate the early failures more thoroughly, and instruct PG&E to perform a comprehensive root cause analysis to establish the cause(s) of the early failures. This would both ensure non-recurrence of similar module failures, and conclusively attribute responsibility for failures. TURN is willing, to the extent practicable, to participate in such a review. Additionally, it would be more economically sensible for PG&E to explore alternatives, on a

¹⁸ See Itron Gas Module Battery Replacement Procedure here: <https://docs.cpuc.ca.gov/PublishedDocs/SupDoc/A2205015;A2205016/6359/512538927.pdf>

benefit-cost basis, such as reutilizing removed modules, replacing failed batteries, or addressing network communication issues, rather than pursuing a comprehensive system upgrade.

If the Commission does not reject the application, TURN offers the following alternative recommendations, along with their rationale.

Recommendation 1: Return on Rate Base and Cost Sharing

In the Commission does not demand a demonstrable root cause and cost-efficient replacement analysis, it should still not reward PG&E and its shareholders at ratepayer expense. Therefore, TURN recommends that any funding approved be limited solely to the minimum baseline replacements for Gas AMI 1.0, with zero return on any stranded assets in rate base (such as the meters or modules that failed prematurely) and the replacement costs for premature failures be shared equally between ratepayers and shareholders. This approach would ensure that all costs are shared equally—on a 50-50 basis—between ratepayers and shareholders. This unique situation of early failures, and the precedent it could set, warrants a unique regulatory response to avoid the moral hazard that would arise if PG&E or other investor-owned utilities were allowed to profit from premature equipment failures.

PG&E's 2023-2026 Gas Module Probability of Failure and Cost Forecasts Are Unreasonable Without Incorporating TURN's Recommendations

The rationale for replacements centers on early failures attributed to "study events" (e.g., battery depletion, communication failures, and non-communication failures) and "removals due to non-study events" (e.g., opt-outs, Meter/MTU Combo issues, and other removals unrelated to module failures). While battery-related issues in hot divisions like Sacramento and Kern are emphasized, the data shows that most failures are in fact tied to Meter/MTU Combo issues, where malfunctioning meters led to module removals without sufficient justification, context, or explanation.

Recommendation 2: TURN Recommends Approving Only like-for-like Required Replacements at a Unit Cost that is equitable and justifiable

PG&E's proposal effectively locks ratepayers into a 20-year infrastructure commitment for a system that is at odds with California's electrification goals. If the Commission does approve any funding for this application, we recommend that funding be strictly limited to the bare minimum like-for-like replacements necessary to maintain existing service levels, at a unit cost of replacement that is justifiable and equitable. PG&E's testimony refers to a need to go with the Gas AMI 2.0 upgrade in order to avoid obsolescence.¹⁹ However, PG&E has experienced [REDACTED]

[REDACTED]

[REDACTED]²⁰ [REDACTED]

[REDACTED]

[REDACTED] This indicates that the existing Gas AMI system, that was designed to support purported benefits of the Gas AMI 2.0 system, remains functional without necessitating an expensive overhaul. PG&E's testimony highlights that its existing system successfully delivered 29.6 million therms in gas savings in 2023 through its energy efficiency programs, without relying on real-time data.²¹ The interval data collected by the current Gas AMI system (at the current level of granularity) has proven sufficient for managing these programs and calculating energy cost savings. Moreover, PG&E does not use or require provisions for gas demand response controls, unlike electricity systems, where two-way communication and real-time data play a critical role. Given the lack of need or planned implementation for such capabilities in gas infrastructure, there is no demonstrated justification for moving beyond the current system, which adequately meets energy efficiency and cost-saving goals.

Moreover, the broader context of California's energy policy underscores the imprudence of this investment. The state's commitment to decarbonization, reflected in legislative efforts such as SB 1221, prioritizes electrification and the decommissioning of gas infrastructure. Investing

¹⁹ A.24-03-011, p.1-2, lines 17-21

²⁰ PG&E's Response to DR_TURN_005-Q001CONF.pdf

²¹ PG&E Response to DR_TURN_005-Q004

approximately \$500 million for an advanced gas metering system, particularly one that does not provide real-time measurement or two-way communication benefits such as demand response, is wholly unjustified. Such an investment represents a clear stranded asset risk, especially in a policy environment that increasingly de-emphasizes natural gas as a long-term energy solution.

TURN recommends that the Commission approve funding strictly for like-for-like replacements of modules that fail within the expected operational parameters under the “Required Maintenance” approach, rather than rewarding PG&E with investment in an advanced Gas AMI 2.0 system. The unit costs for like-for-like replacements should reflect the actual service life utilized by the modules. By adjusting unit costs proportionally to the lifespan utilized (as explained in the following sections), TURN aims to ensure that expenditures are both equitable and justifiable, aligning the financial responsibility and the “used and useful” construct in utility ratemaking. This approach emphasizes fiscal responsibility and seeks to protect ratepayers from incurring costs for underperforming assets.

Recommendation 3: TURN recommends Incorporating Module-Only costs and Removing Meter-and-Module Replacements from PG&E’s Cost Forecast:

PG&E's Comprehensive Gas AMI Replacement Program capital expenditure forecast includes both module-only and meter and module replacements, and 54,066 second generation modules from 2023-2026 as well as 1.2 million legacy modules for required maintenance.²² TURN recommends allowing only standard S501/506 module vintages, and not using any S3000 modules for required maintenance, and rejecting lifecycle replacements. PG&E’s capital forecast of \$485.08 million (2023-2026) includes both module exchanges as well as meter and module exchanges, where the meter is exchanged regardless of the working status of the attached module. This is at odds with the scope of this Application, which is restricted to legacy series 500 modules’ replacement.²³

²² WP 2-6 Detail Capital Expenditure Forecast by Major Work Category, Rows 15-16

²³ PG&E’s Response to DR-TURN-06-Q02.b

PG&E's clarification in response to TURN's data request states that meter replacements are distinct from module-only replacements, as they are driven by the need to replace gas meters in compliance with the Commission's General Order 58-A or for corrective/preventive maintenance, with such replacements involving new meters pre-installed with integrated Second Generation Gas Modules, whose costs, including installation labor, are already covered under the 2023 GRC (A.21-06-021).²⁴

Removing meter and module exchanges, and extended range modules (covered under supplier warranty), TURN finds the capital cost for required maintenance to be \$315.6 million (2023-2026) compared to PG&E's \$485 million, assuming all other factors remain unchanged (*ceteris paribus*).²⁵

TURN argues that the inclusion of meter and module exchanges inflates the cost forecast and that PG&E's analysis should focus strictly on module-only failures and required maintenance to provide a transparent and accurate projection.

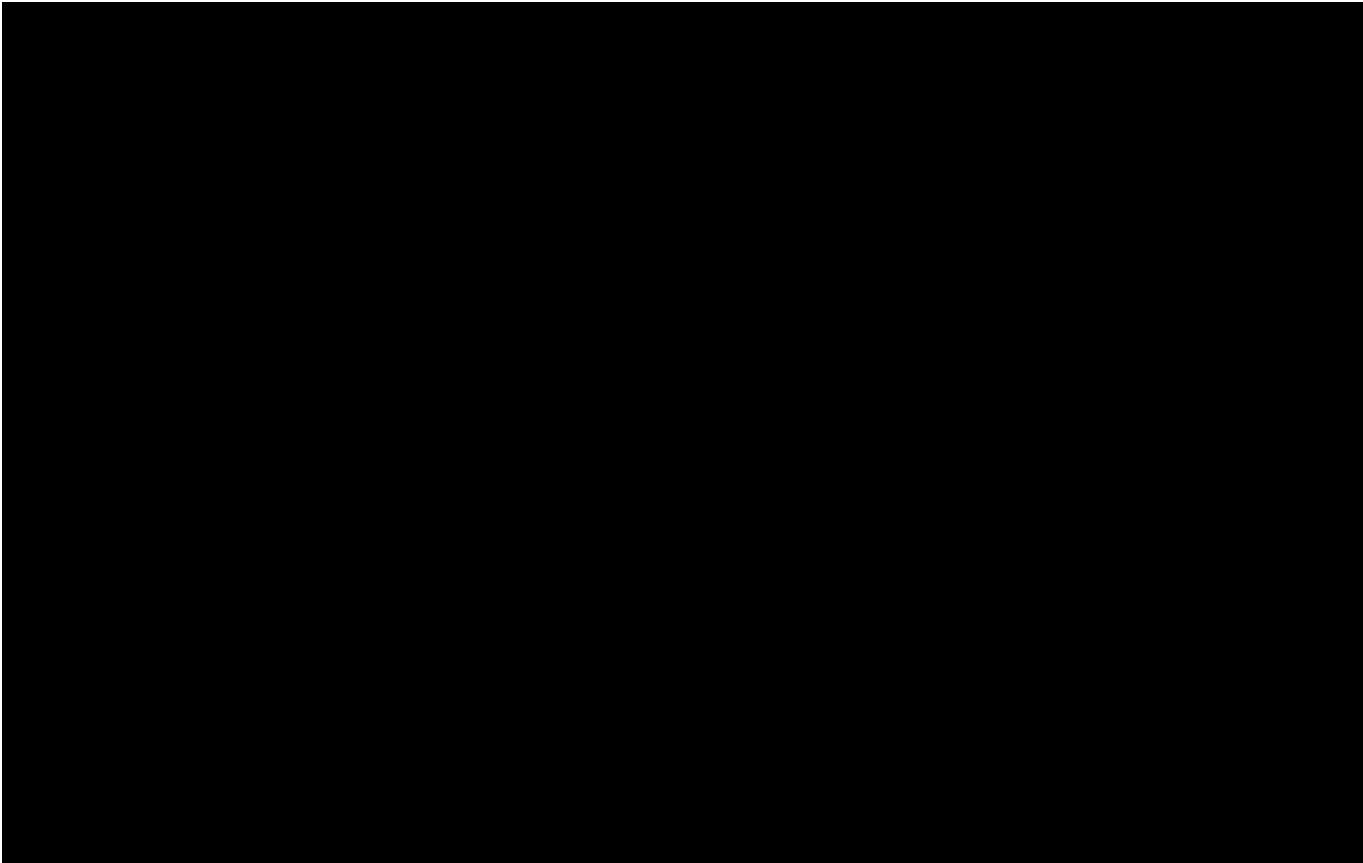
TURN Suggests a Critical Review of Non-Study Event Module Removals and Their Impact on Inventory Needs:

PG&E attributes failures as of Dec 2022 to specific study events, including [REDACTED] units with battery depletion, [REDACTED] units with non-communication failures, and [REDACTED] units with intermittent issues, totaling [REDACTED] module failures. Non-study event removals, such as Meter/MTU Combo replacements ([REDACTED] units), opt-outs ([REDACTED] units), and other non-failure-related removals ([REDACTED] units), add up to [REDACTED] units, approximately [REDACTED] higher than failure-related removals.²⁶ PG&E's application lacks discussion on early removals due to non-study events, failing to account for the whereabouts of removed modules or plans for their utilization in like-for-like replacements.

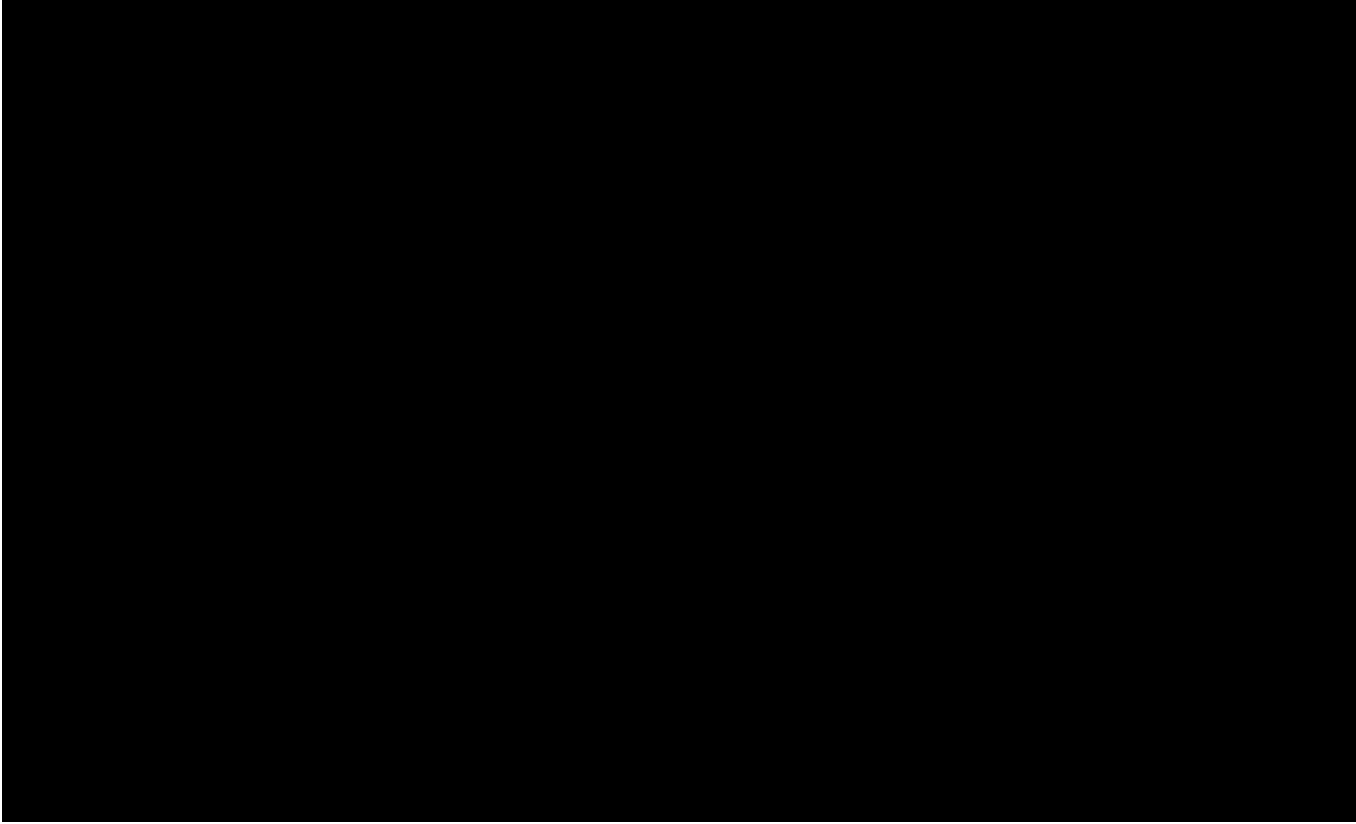
²⁴ PG&E response to TURN-DR-05, Q008

²⁵ WP 2-6 Detail Capital Expenditure Forecast by Major Work Category_TURN-01

²⁶ PG&E's response to DR_TURN_004-Q006Atch01CONF



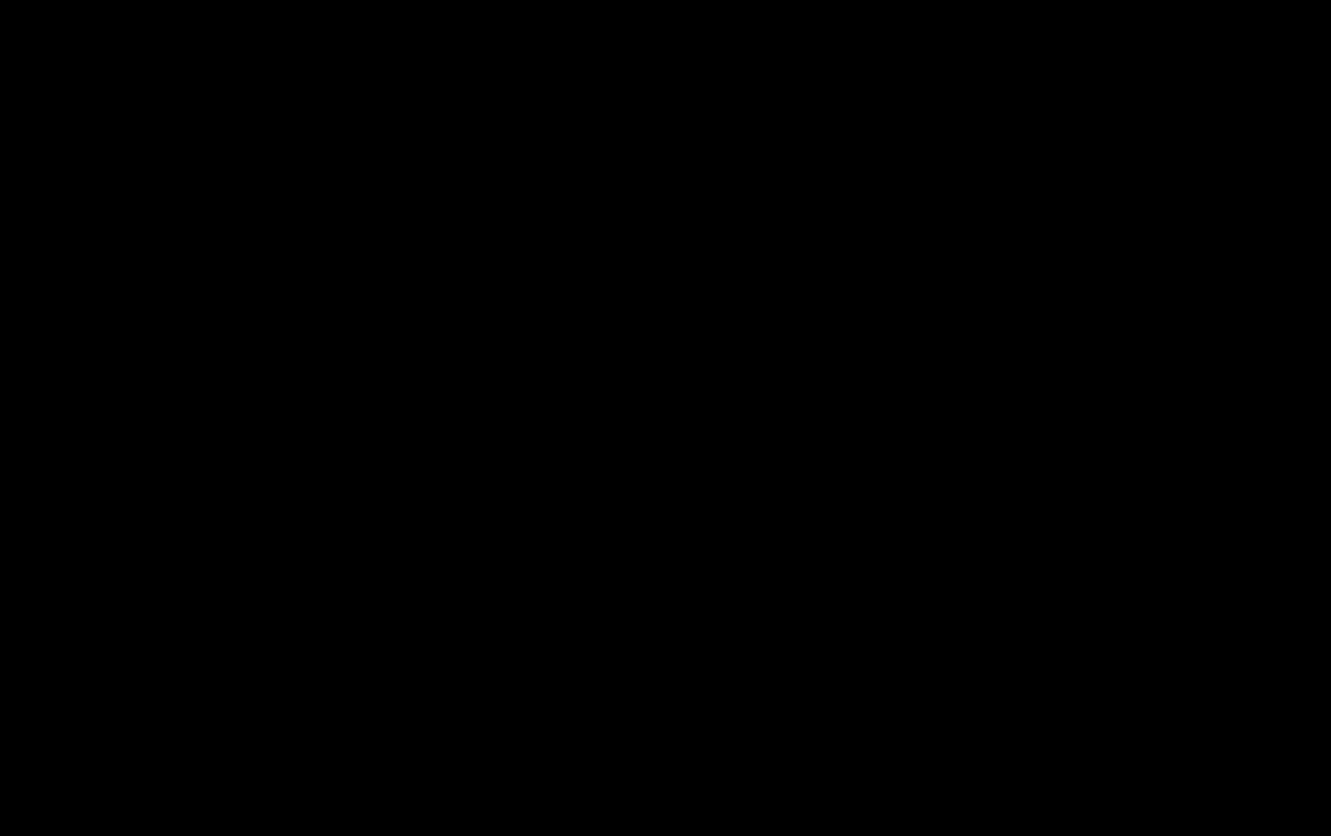
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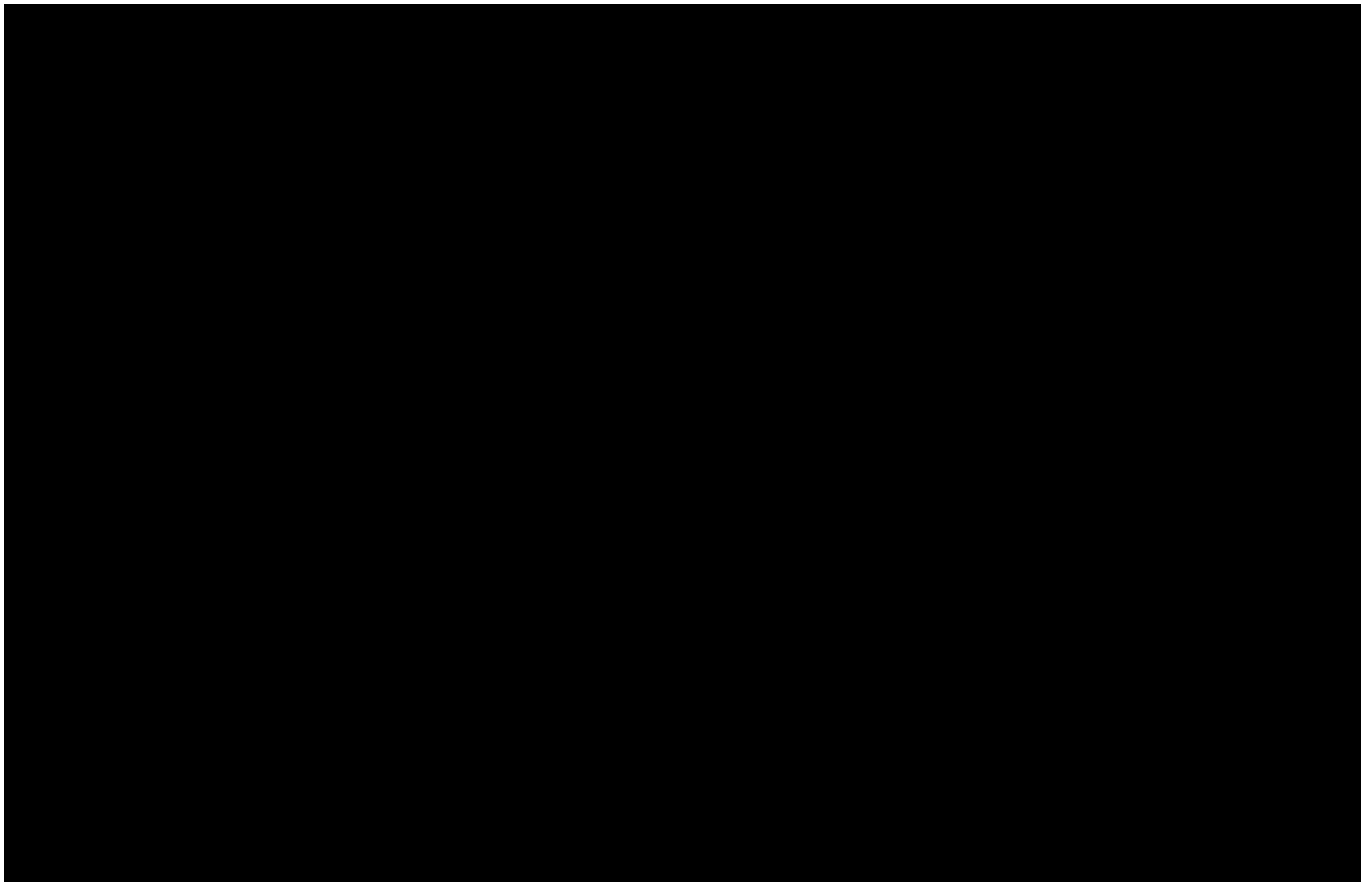
PG&E's Application Lacks Comprehensive Root Cause Analysis of Failures and Overemphasizes Battery Depletion Events

PG&E's analysis predominantly attributes module failures to battery depletion, which accounts for [REDACTED] of all failures across the 17 divisions. However, a deeper review highlights that the largest proportion of removals—nearly [REDACTED]—is tied to "non-study events," specifically Meter/MTU Combo replacements.²⁷ This distribution underscores the need for PG&E to expand its focus beyond battery-related issues and perform a detailed investigation into the widespread occurrence of Meter/MTU Combo failures.

²⁷ PG&E's response to DR_TURN_004-Q006Aatch01CONF



Furthermore, age-at-failure data reveals key trends. The youngest modules removed are linked to opt-outs, with an average age of [REDACTED], followed closely by Meter/MTU Combo failures at an average age of [REDACTED]. In contrast, modules experiencing battery failures were removed at an average age of [REDACTED], while intermittent and non-communication failures occurred at [REDACTED] and [REDACTED], respectively. These findings suggest that many of the modules removed under "non-study events" may still have functional potential and could be repurposed or repaired rather than replaced outright, as proposed in PG&E's current plan.

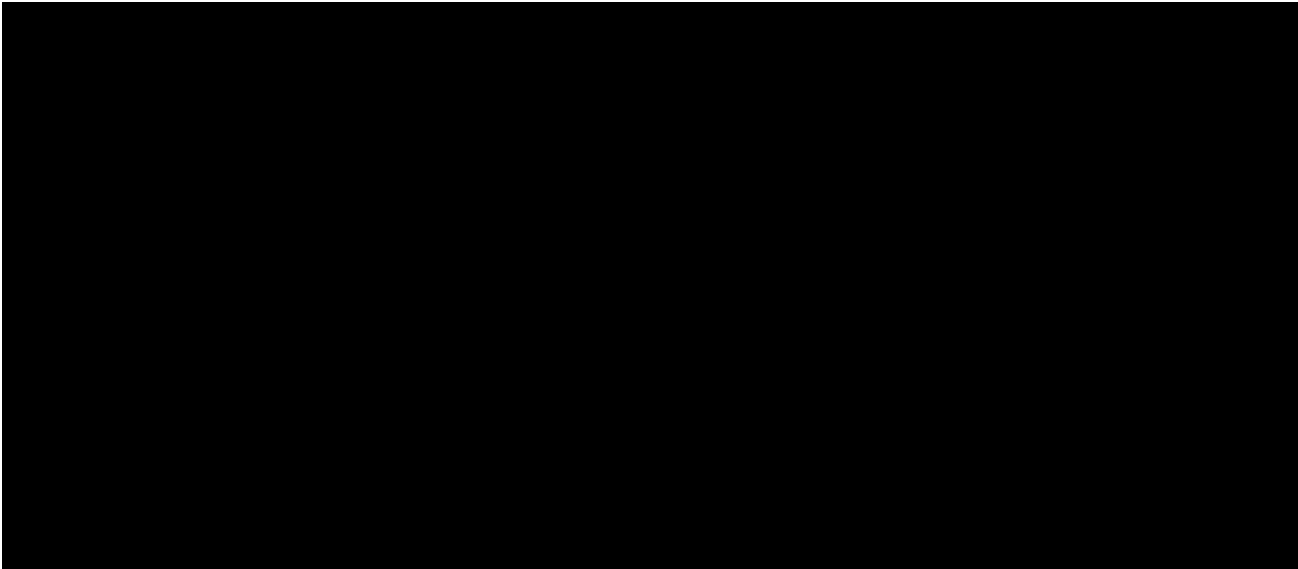


For intermittent communication failures specifically, the lack of a structured root cause analysis raises further concerns. PG&E has not explored whether these failures might be repairable (e.g. by replacing the NIC card, or by troubleshooting DCU-related communication issues), missing an opportunity to reduce replacement costs. This omission reflects a broader issue with the program's failure to adequately assess alternative hypotheses and develop targeted, cost-effective solutions. A more rigorous evaluation is necessary to ensure that modules with repairable issues are not prematurely replaced, thereby enhancing the overall cost efficiency of the replacement strategy.

PG&E and Exponent's Analysis Fails to Establish Meaningful Root Cause Analysis (RCA) Across Divisions

Module Failure and Temp Correlations:

The correlation between temperature and battery failures, as analyzed by PG&E and Exponent, demonstrates statistically meaningful significance only in Sacramento. Across other divisions, the relationship is weak or absent [REDACTED], suggesting randomness rather than a clear temperature-driven trend), and indicating that battery failures cannot uniformly be attributed to temperature effects without further validation. This lack of robust correlation underscores the need for a more nuanced and thorough root cause analysis (RCA) of battery-related and other failures.²⁸

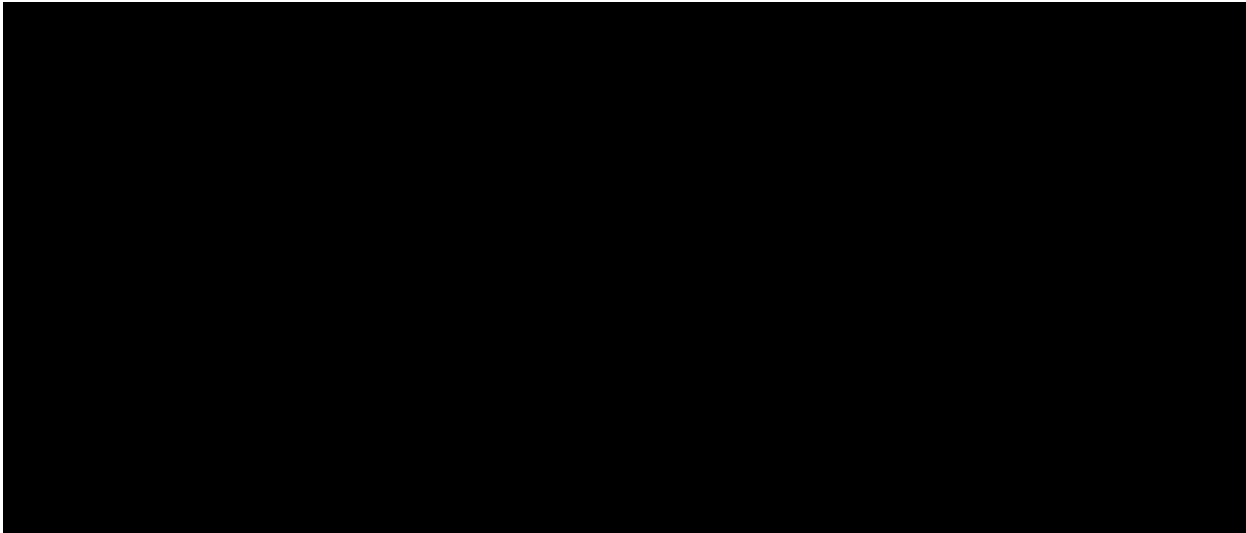


Module Failure and Precipitation Correlation:

Similarly, the assertion that precipitation causes battery failure in PG&E's gas modules is not substantiated by the data from 2022, which shows a negative correlation between precipitation metrics and module failures. Specifically, the Pearson correlation coefficient for average precipitation across divisions is [REDACTED], and for average days with more than 0.01 inches of precipitation, it is [REDACTED].²⁹ These statistics indicate that higher precipitation does not lead to more failures; in fact, the relationship suggests the opposite. This evidence contradicts PG&E's claims linking water intrusion to battery failures and underscores a significant gap in their analysis. The lack of a positive correlation calls into question the validity of their failure assessments and

²⁸ [REDACTED]

suggests a deficiency in thorough engineering reviews, such as Failure Mode and Effects Analysis (FMEA) or Root Cause Analysis (RCA), which would typically identify and mitigate such recurrent issues. This oversight highlights the need for more rigorous evaluations to ensure that the stated causes of failures align with observed data.



Exponent’s Probabilistic Failure Analysis Fails to Measure Up in the Closest Years i.e. 2023 and 2024:

PG&E's lifecycle replacement and required maintenance programs rely heavily on Exponent's Kaplan–Meier (KM) probability analysis to forecast gas module failures. These programs, framed as proactive (lifecycle) and reactive (required) approaches, focus on replacing aging standard range legacy modules, with approximately 1.26 million replacements planned between 2023 and 2026. However, TURN finds significant flaws in the KM-based failure estimates, particularly their inability to provide accurate short-term predictions, raising questions about their reliability for longer-term forecasts.

PG&E’s proposed Lifecycle Replacement Program aims to proactively replace legacy gas modules in high-failure regions, such as Kern and Sacramento, at a cost of \$91 per unit. This contrasts with the more reactive Required Maintenance Program, which replaces failed modules on a geographically dispersed basis, at a higher cost of \$169 per unit. While PG&E argues that

proactive replacements improve efficiency and customer experience, TURN highlights several flaws in the underlying probabilistic failure forecasts.

TURN's Critique of the Kaplan–Meier Analysis

Exponent's Kaplan–Meier estimator forms the backbone of gas module failure probability model, which is the basis for PG&E's required and lifecycle replacement forecasts.³⁰ While the KM method is widely used for survival analysis, TURN identifies critical shortcomings in its application here:

1. **Failure of ~100% of gas modules at the end of 15 years:** Exponent's analysis predicts that nearly 100% of gas modules will fail within 15 years due to study events (battery, intermittent, or non-communication issues), leaving only ■ modules from the initial 4.7 million.³¹ This conclusion is flawed, as it concludes universal failure by 15 years. In-field data and the initial expected useful life (EUL) of 20 years, show many in-field modules continue to function beyond 15 years without encountering study events.
2. **No Accuracy Tests or Sensitivity Analysis:** PG&E and Exponent provide no evidence of validation through accuracy testing or sensitivity analysis.³² This absence undermines confidence in the robustness of KM-derived forecasts and puts a question mark on the analysis.
3. **Failure to Compare Against Simpler Methods:** Exponent's KM estimates are complex but fail to deliver superior accuracy compared to simpler approaches. TURN's analysis demonstrates that a straightforward four-year average of historical failures provides better predictive accuracy for the near term.
4. **Exaggerated Predictions for 2023 and 2024:** TURN's evaluation reveals that Exponent's KM model overestimated module failures for:
 - 2023 by 20%.
 - 2024 by 200%.

³⁰ WP 2-6 Detail Capital Expenditure Forecast by Major Work Category (Row 15, 16)

³¹ GasAMIRplacement_DR_TURN-004-Q005Supp01Atch02CONF

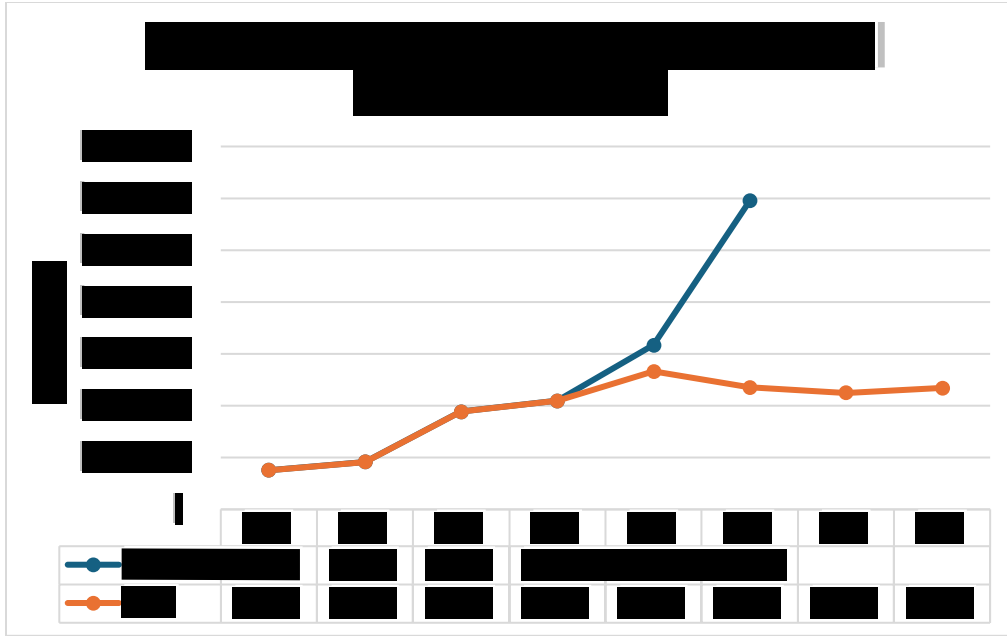
These substantial deviations, and potentially even higher deviations beyond the first two years, illustrate the estimator's inaccuracy in short-term predictions, let alone its claimed ability to predict failures up to 16 years in the future.

Recommendation 4: TURN's Recommended Approach for Failure Forecasts

The Kaplan–Meier estimator, although frequently used in patient survival post-treatment in the public health context, fails to deliver accurate short-term predictions for gas module failure probability analysis.³³ TURN recommends shifting to a straightforward averaging method for forecasting failures, ensuring that replacement programs are based on realistic assumptions rather than inflated failure probabilities. This change would align investment with actual need, delivering cost savings to PG&E and its ratepayers while maintaining operational reliability.

TURN proposes four-year average of historical failures as the basis for forecasting required and lifecycle replacements is grounded in observed data, avoids the pitfalls of KM analysis and provides a cleaner, more reliable framework for planning replacements. Using this method, TURN suggests reducing module replacement volumes and costs as follows to better reflect actual failure trends.

³³ <https://pmc.ncbi.nlm.nih.gov/articles/PMC3059453/>



2019-2022 Exponent/TURN Total Failures reference: WP 2-10 Gas Module Lifecycle Replacement Program_Errata2-CLEAN, Table 1 (conservatively assuming all required maintenance corresponds to modules requiring replacement due to study event failures).

2023-2024 Exponent reference: DR_TURN_004-Q005ACh01CONF, Slide 15 (predicted total for 2023 and 2024 YTD Nov. 2024) * Note that TURN used average failures in the last two months of 2024 to assume failures post Nov. 2024 in TURN's prediction model.)

2023-2024 TURN reference: DR_TURN_007-Q001dACh01CONF (Actual total for failures in 2023-2024 YTD Nov. 2024)

2025-2026 TURN reference: Simple average of failures in previous 4 years i.e. 2021-2024 average for 2025 and 2022-2025 average for 2026.

Using TURN's 2023-2026 standard range legacy module failures for required maintenance yields total capital cost of \$308,898 million for the replacement of [REDACTED] gas modules projected to fail between 2023-2026. ³⁴

³⁴ WP 2-6 Detail Capital Expenditure Forecast by Major Work Category_TURN-03

Recommendation 5: Adjusted Proposed Unit Cost:

The age-at-failure data from PG&E indicates a premature failure of gas modules: Opt-outs fail the youngest at [REDACTED], followed by Meter/MTU Combo failures at [REDACTED]. Among the so-called “study events”, included in Exponent’s failure probability analysis, battery failures, intermittent, and non-communication issues occur at average ages of [REDACTED], and [REDACTED] respectively.³⁵ Originally installed between 2006 and 2013, these modules were expected to have a 20-year useful life. However, the actual age-at-failure data paints a different picture, suggesting a premature decline in module functionality, which calls into question the reasonableness of \$136.66/unit cost for module replacement.³⁶

Given the premature age of failure, the current unit cost of \$136.66 per module for required maintenance does not align with the principles of fiscal responsibility or fairness to ratepayers. There is a clear lack of root cause analysis provided by PG&E, and an apparent rush towards wholesale replacement without sufficient consideration of repurposing or repairing modules that may still have functional utility.

	Module Failures (Study Event)			
Division	Battery Depletion	Non-Comm	Intermittent	Total Failures
Totals	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Avg. Age at Failure	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Based on the age at failure and the number of failures for each type of module issue, TURN proposes recalibrating the unit cost model to align with actual usage as shown below:

The cost for each failure type is adjusted to reflect the proportion of the lifespan utilized. For instance:

- Battery Depletion: [REDACTED] per module
- Non-Communication: [REDACTED] per module

³⁵ PG&E's response to DR_TURN_004-Q006Atch01CONF

³⁶ WP 2-10 Gas Module Lifecycle Replacement Program_Errata2-CLEAN, Table 2

- Intermittent: [REDACTED] per module

This approach yields a weighted average unit cost of \$65.50 per module, ensuring that PG&E bears a portion of the financial burden for the premature failures. The new unit cost reduces TURN's proposed \$308.8 million required maintenance cost to \$202,284 million.³⁷

Attachments:

DR_TURN_004-Q005Atch01CONF

DR_TURN_007-Q001dAtch01CONF

DR_TURN_004-Q006Atch01CONF

DR_TURN_004-Q002

DR_TURN_004-Q001Atch01

DR_TURN_005-Q001CONF.pdf

DR_TURN_005-Q004

DR_TURN-004-Q005Supp01Atch02CONF

³⁷ WP 2-6 Detail Capital Expenditure Forecast by Major Work Category_TURN-04

Statement of Qualifications of Jalal Awan, Ph.D.

I am a full-time Energy and Climate Policy Analyst at The Utility Reform Network (TURN) since November 2023 and have co-sponsored testimony in various proceedings on behalf of TURN. Prior to joining TURN, I worked as an Assistant Policy Researcher at the RAND Corporation in Santa Monica (2017-2023) and as an electrical projects engineer at Engro Corporation in Pakistan (2010-2014 and 2016-2017).

As a policy researcher, I have developed technical reports, presented findings to a diverse range of stakeholders, and volunteered on three panels with the U.S. National Academy of Sciences. I completed my B.S in electrical power systems engineering from the University of Engineering and Technology, Lahore (Pakistan) from 2006-2010, my M.S. in green technologies from the University of Southern California (Viterbi School of Engineering) in December 2015 as a Fulbright Scholar, and my M.Phil. and Ph.D. in Policy Analysis at the Pardee RAND Graduate School in 2019 and 2023, respectively. I am a member of IEEE, Six Sigma Green Belt from the American Society for Quality (ASQ) and hold the U.S. Green Building Council certification in Leadership in Energy & Environmental Design (LEED).

ATTACHMENTS

- *DR_TURN_004-Q001Atch01*
- *DR_TURN_004-Q002*
- *DR_TURN_005-Q004*

Series S501/S506 and Series 3000 Supplemental Information

- A.** Aclara Series 501/506 and Series 3000 side by side
- B.** General Specifications for S501/S506 and S3000 by Aclara
- C.** Circuit Board Comparison by PG&E

Aclara Series 501/506 and Series 3000 side by side

Series 501/506

Series 3000



GENERAL SPECIFICATIONS for S501/S506 and S3000 by Aclara

Transmission range	Up to 3 miles depending on environment.
Transmitter type	Powerful, narrow-band, FCC Part 90 certified
Frequency	Licensed UHF channel, 450 to 470 MHz, 12.5kHz spacing.
Environmental	-30°C to +85°C – units are typically hermetically sealed or located within the meter (for certain electric applications)
Power	Internal ultra long-life battery.
Battery Life.....	Calculated to 20 years with 4 readings per day at 70°F.
Account Number.....	Up to 12 numerical digits.
Meter Reading	S501 MTU up to 6 numerical digits, S3000 MTU up to 8 numerical digits
Scale Factor.....	Programmable from 1:1 to 2000:1.
Read/Transmit Interval	Programmable from once per minute to once per day.
Proving factor (for gas)	Selectable for 0.05 to 1000 cu. ft. proving hands
Compatibility.....	Generator, pulse, switch, encoder, or electronic meters.

SYSTEM SPECIFICATIONS

Maximum MTU Density	30,000 per square mile
DCU spacing	½ to 2 miles, depending on terrain, MTU types and locations.
Network Communication	Open architecture allows use of many wide area networks, including: Ethernet, Wi-Fi, fiber-optic, wired telephone, and CDMA tri-mode cellular phones.
System Capacity.....	Unlimited

OPERATION

STAR® MTUs support meter-reading for multiple utilities as well as auxiliary services such as TOU, demand control, tamper detection, alarm functions, data logging, outage detection, and facility monitoring.

Circuit Board Comparison by PG&E

PG&E Comparison	Series 501/506	Series 3000
1. Circuit Board supports two identical batteries	✓	✓
2. Circuit Board uses two charging capacitors	✓	✓
3. Uses programing coil for module communication	✓	✓
4. Capacity for 12-meter readings in low power mode (transmits usage 6x daily)	✓	✓
5. Transmits at the same power level for standard (23 dBm) and extended (29 dBm) range modules	✓	✓
6. Circuitry meets Class1 Div1 Grp D safety rating		✓
7. Batteries and capacitors now on back of circuit board		✓
8. Higher bandwidth transmissions in shorter durations		✓
9. Charging & transmission circuitry improves battery life expectancy		✓
10. Overall improved circuit board design provides improved energy consumption		✓
11. More functionality in module firmware (including two-way comm's)		✓
12. Case Integrity Design Improvements		✓

PACIFIC GAS AND ELECTRIC COMPANY
Gas AMI Replacement
Application 24-03-011
Data Response

PG&E Data Request No.:	TURN_004-Q002		
PG&E File Name:	GasAMIRepacement_DR_TURN_004-Q002		
Request Date:	June 11, 2024	Requester DR No.:	004
Date Sent:	June 25, 2024	Requesting Party:	The Utility Reform Network
PG&E Witness:	David Console	Requester:	Jalal Awan/ Bob Finkelstein/ Reina Yanagiba

QUESTION 002

Please refer to WP 2-6 Row 18: Lifecycle Replacements from 2023-2026.

- a) Does each instance of “Lifecycle Replacement” include replacement of Legacy/Original 506 Series with Second-Generation Series 3000? Please identify and briefly explain exceptions, if any.
- b) Please describe the basis for replacement frequency from 2024-26 (i.e., 60k replacements per year). Please provide any necessary calculations and/or workpapers applicable.

ANSWER 002

- a) Yes, each instance of Lifecycle Replacement includes the replacement of a Legacy/Original 501 or 506 Series module with a Second-Generation Series 3000 module.
- b) In the 2023 GRC, based on data available at the time, PG&E had contemplated replacing Legacy gas modules nearing the end of their useful lives on a system-wide basis from 2023 - 2027.

As described in this application’s testimony, specifically Chapter 1, pages 1-4 to 1-7 and Chapter 2, pages 2-12 to 2-13 and 2-15 to 2-17, PG&E now proposes a more focused and targeted approach, based on feedback from the Commission and intervenors, as well as updated failure analyses done at the Division level. The oldest vintages of gas modules and the highest end-of-life/failure rates are currently in the Kern and Sacramento divisions (please refer to workpaper 2-8, End of Life Study), which is where PG&E plans to focus Lifecycle Replacement activities from 2023 - 2026. Additionally, the level of 60k Lifecycle replacements per year in PG&E’s plan from 2024-2026 (PG&E interpreted the term replacement frequency as its Lifecycle replacement volume plan) was chosen taking into account resource capacity in the spring and summer months, as well as the number of remaining legacy modules in the Sacramento and Kern divisions. Please see workpaper 2-10 for additional discussion on the Gas Module Lifecycle Replacement program.

PACIFIC GAS AND ELECTRIC COMPANY
Gas AMI Replacement
Application 24-03-011
Data Response

PG&E Data Request No.:	TURN_005-Q004		
PG&E File Name:	GasAMIRepacement_DR_TURN_005-Q004		
Request Date:	July 30, 2024	Requester DR No.:	005
Date Sent:	August 16, 2024	Requesting Party:	The Utility Reform Network
PG&E Witness:	David Console	Requester:	Bob Finkelstein

QUESTION 004

At page 1-9 of PG&E’s testimony, PG&E refers to the role that timely and accurate gas data play in the provision of energy cost savings and monitoring of gas usage to approximately 2.5 million customers enrolled in 21 energy efficiency gas programs that saved approximately 26.3 million therms in 2023.

- a. Please identify the energy efficiency gas programs for which the energy cost savings require the use of real-time data, as opposed to data for an entire billing period or some other period.
- b. Does PG&E have provisions for gas demand response control in its energy efficiency programs? If so, please identify and briefly describe each program that has such provisions.
- c. For each energy efficiency gas program for which the energy cost savings require the use of real-time data, please provide the number of customers who were enrolled in the program in 2023 (broken out between core and non-core customers), and the amount of therms saved in 2023.

ANSWER 004

PG&E’s testimony on page 1-9 states that gas-related energy efficiency programs rendered savings to customers of approximately 29.6 million therms in 2023, not 26.3 million therms as stated in the Question 004 preface above.

With that clarification, PG&E responds as follows:

- a. While gas meter data is not used instantaneously to determine energy savings in real time, PG&E uses interval data (as opposed to real time data) to manage its gas energy efficiency programs and calculate energy costs savings. Energy efficiency programs requiring the use of gas interval data to calculate energy cost savings are identified in the table furnished in “*GasAMIRepacement_DR_TURN_005-Q004Atch01.xlsx*”.
- b. PG&E does not have provisions for gas demand response control in its energy efficiency programs.

- c. Please see "*GasAMIRplacement_DR_TURN_005-Q004Atch01.xlsx*" for the number of core and non-core customers enrolled in gas energy efficiency programs in 2023 for which energy cost savings require AMI gas interval data (but not real-time data as stated above in response to subpart a) and the amount of therms saved in those programs in 2023.