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PREPARED REBUTTAL TESTIMONY OF

DAVID T. BARKER

CHAPTER 7

ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

OCTOBER 17, 2014

TABLE OF CONTENTS

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I. OVERVIEW AND PURPOSE

The sole purpose of my testimony is to rebut the testimony of Kevin Woodruff on behalf of The Utility Reform Network (TURN) regarding greenhouse gases (GHG) and time-of-use (TOU) periods. The primary TURN contention that GHG emissions are not correlated with the SDG&E proposed TOU periods is wrong.

My testimony is organized as follows:

- Section II – Rebuts the TURN premise that loads and GHG are not correlated. If an adjustment is made to consider non-dispatchable renewable energy production, loads are an important driver of GHG emissions.
- Section III – Explains the flaws in the TURN analysis purporting to show coal is on the margin in off-peak periods for SDG&E based on production cost modeling of the Western Electricity Coordinating Council (WECC) region.
- Section IV – Rebuts the TURN premise that coal is on the margin in off-peak periods for SDG&E.
- Section V – Rebuts the implicit premise of TURN that TOU periods should be based primarily on the amount of GHG reductions.
- Section VI – Conclusion.

II. LOADS AND GHG ARE CORRELATED IF NON-DISPATCHABLE RENEWABLES ARE CONSIDERED

The testimony of Mr. Woodruff on behalf of TURN repeatedly states that loads and GHG are not well correlated. These statements occur at page 2, lines 25-26; page 4, line 10; page 9, lines 9-10; and page 17, lines 13-15. TURN's argument is stated in full at page 31, lines 10-18 of the testimony as follows:

> There is neither a strong nor a consistent relationship between incremental CO2 emissions in the Western United States and electric loads in California. A positive link between load and emissions appears to exist during annual peak hours, but is weaker in many other hours of the year and the relationship even turns negative – that is, CO2 emissions *increase* as loads fall – during the spring. In fact,

> incremental CO2 emissions could be higher in off-peak TOU periods than on-peak TOU periods under the utilities' proposals. More generally, this load-missions link is so weak and inconsistent that the Commission should not assume it can reliably contribute to CO2 emission reductions by encouraging of requiring the widespread adoption of TOU rates.

There is a strong relationship between loads and GHG if intermittent renewables are accounted for. Loads cannot be viewed in isolation of the impact of intermittent renewables; there is a strong positive relationship between loads net of must-take renewables (net load) and GHG emissions. In my Rate Design Window Testimony on TOU periods[1], filed in this proceeding as Appendix A to the Supplemental Filing San Diego Gas & Electric made on March 21, 2014, I show that net loads and energy prices are highly correlated. For example, examine the charts DTB-7 and DTB-11 and DTB-13 for the summer period and charts DTB-8 and DTB-12 and DTB-14 for the winter periods from my testimony. These charts show a strong correlation of net load and energy prices. Similarly, net loads and the probable need for capacity are strongly correlated as can determined by visual inspection of charts DTB-11, DTB-13, and DTB-17 of my testimony. One reason SDG&E is proposing to change its TOU periods is the impact of solar generation, both behind the meter and central station, on the periods in which increased loads will cause capacity to be needed and in which energy prices will be high. And as shown later, the TURN assumption that coal is used off-peak is faulty, so that higher electricity prices and shortages of capacity are associated with less efficient generation being in the market and, hence, more GHG emissions.

SDG&E is not the only organization to highlight the implications of changing solar energy on the grid and to use the metric, "net load." The CAISO's now famous "Duck Chart" is a representation of net loads over a typical day in spring in the future. Likewise, there are numerous

[1] Prepared Direct Testimony of David T. Barker in Support of SDG&E's Rate Design Window Application in Application 14-01-027.

academic studies suggesting the appropriate metric is no longer load, but net load when looking at capacity needs and periods of high electricity prices.[2]

Because of solar energy, there will no longer be capacity needs or high energy prices expected in the 11 am – 2 pm time period in the summer. And because of the significant afternoon drop-off of solar generation as the sun sets, incremental customer loads in the 6 pm – 9 pm time period may cause the need for additional generation, transmission, and/or distribution capacity and higher energy prices in the time period. Therefore, SDG&E is proposing to change its Summer On-peak period to 2 pm to 9 pm for all current TOU rate schedules in its Rate Design Window, A.14-01-027. With TOU periods that accurately reflect capacity needs, TOU rates will lead to demand changes that reduce the need for additional generation, transmission and/or distribution capacity.

III. TURN'S PRODUCTION COST MODELING ANALYSIS IS FLAWED

A. TURN's Results are likely due to "Noise"

TURN consistently makes the statement that increased load in the off-peak period is being met by coal generation including at page 8, line 21 – page 9, line 1; page 10, lines 19-21; page 11, lines 26-29, page 27, lines 2-4; and page 28, lines 24-26. However, the TURN analysis of the data is flawed and that the results more likely the consequence of "noise" in the data.

Production cost models can include a number of factors that can be randomly determined, though the overall annual figures will be the same. These variables include loads, forced outages, the amount solar energy in any hour, and the amount of wind energy in any hour. If these factors are allowed to vary between production cost model runs, overall average results for model outputs such as likely loss of load probability or amount of renewable curtailments will be relatively unaffected. But at the same time, output results for individual hours may be greatly impacted. For example, if a

[2] Prepared Direct Testimony of David T. Barker in Support of SDG&E's Rate Design Window Application in Application 14-01-027, pages 5-14.

forced outage of non-emitting nuclear plant occurred in the first run in July, but in the second run the forced outage occurred in May, it may appear that May emissions rate increased because of coal generation when in fact it was the timing of the forced outage that caused additional GHG in addition to the incremental gas generation.

One study cited in the TURN Appendix B-3, the Synapse study, addressed the "noise" issue. Their findings note that:

> Emissions reductions from energy efficiency/renewable energy occur from generating units at the margin, or units which are least economic at any given time. **These same units are highly influenced by small changes in electrical dispatch due to forced outages at large units: therefore, modeling research at this scale and detail necessarily requires an extensive and detailed analysis of error and uncertainty.** In this research, it was found that uncertainty can equal or exceed the magnitude of displaced energy and emissions, suggesting that all patterns in similar studies should be examined for relevance relative to error and uncertainty. When uncertainty, or noise, exceeds displaced energy or emissions, the results are termed "non- meaningful" in this research.[3] [Emphasis added]

This noise is the likely the cause of off-peak emissions increasing when load is reduced in the TURN analysis, a non-meaningful result.[4] Synapse had similar odd results and found that, "The large variance in many of these values indicates just how deeply interconnected the WECC region is; small changes in forced outages throughout the region can steeply vary where generation is displaced, in many cases even exceeding the amount of generation that is displaced by a large new renewable energy or efficiency program."[5] Forced outages were likely randomly determined in the production cost modeling underlying TURN's analysis, likely causing much of the volatility in hourly GHG emissions across months. Another fact that suggests this is the case is that the overall

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[3] Synapse Energy Economics, Inc.,"Emissions Reductions from Renewable Energy and Energy Efficiency in California Air Quality Management Districts", prepared for California Energy Commission, November 2011, CEC-500-2011-xxx, p. 6.

[4] TURN, page 2, line 28 – page 3, line 1.

[5] Synapse Energy Economics, Inc.,"Emissions Reductions from Renewable Energy and Energy Efficiency in California Air Quality Management Districts", prepared for California Energy Commission, November 2011, CEC-500-2011-xxx, p. 39.

average emissions increase in the CAISO 2024 Study was 923 pounds per MWh, indicating that gas was on the margin since load-following combined cycle generation is in the range of 800-850 lbs./MWh while peaking combustion turbine generation is in the 1000-1100 lbs./MWh range.[6] Visual inspection of Table 1 suggests a similar result for the PG&E Study.

TURN's analysis also requires that coal plants cycle on a daily basis in order to generate the patterns shown in figures D-2, D-3, D-4, D-5, E-1, E-2, E-3, E-4, F-2, F-3, F-4, and F-5. This assumption is questionable given how few coal plants actually do cycle. An analysis by Environmental Protection Agency (EPA) found only about 4 percent of coal plants actually cycle on less than a monthly basis. The EPA analysis further showed that the number of starts for coal plants over the past 10 years on average was 11 per year.[7] The EPA data reflects that some coal-fired units operate in a load following capacity, but these plants are responsible for less than 4% of total coal generation in any study year.[8] Significantly, the EPA modeled the reduced capacity factor of coal plants in the WECC as retirements as opposed to a conversion to load following.[9] The WECC likewise modeled the reduced capacity factor of coal plants due to EPA's proposed regulation as retirements stating, "WECC converted the EPA reduction energy to a capacity (MW) parameter by assuming an 85 percent capacity factor for coal generation."[10] Both agencies modeled coal to maintain an 85 percent capacity factor when analyzing reductions in coal use and did not assume they would be load following.

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[6] TURN Workpapers, WP- CAISO 2024 (Diablo) Study-9-14 v1.xlsx, cell L8794.
[7] U.S. Environmental Protection Agency, Office of Air and Radiation, *GHG Abatement Measures*, Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units, Docket ID No. EPA-HQ-OAR-2013-0602, June 2014, page 2-22.
[8] Id., page 2-21.
[9] EPA, Clean Power Plan, EPA 5-13_Base_Case SupplyResource Utilization.xlsx
[10] WECC Staff, *EPA Clean Power Plan, Phase I - Preliminary Technical Report,* September 19, 2014, page 14.

For the forgoing reasons, it is more likely that the TURN results are a consequence of noise in the production cost modeling rather than forecasted coal plant cycling.

B. The Analysis of the PG&E Production Cost Modeling is Irrelevant for SDG&E

TURN erroneously makes a number of conclusions based on PG&E-specific production cost modeling. PG&E has a completely different mix of resources than SDG&E, including baseload nuclear, a significant amount of hydroelectric generation, and exchange energy with the Northwest. TURN makes no attempt to justify why a PG&E-specific analysis is applicable to SDG&E, which has no hydro generation, no nuclear, and no exchange agreements. In addition, there are significant transmission constraints between the two regions.

Of particular concern is the forced outage issue described above and how the hydroelectric generation is dispatched. Because the underlying model is confidential, I can only speculate; but it seems like with higher load, hydro may be dispatched differently between the two production cost model runs and could be an additional reason for the high calculated off-peak emissions. If in the low load run, hydro was dispatched off-peak, but in the higher load run is dispatched on-peak, the off-peak results would have the replacement of hydro with fossil as well as higher emissions with added generation to meet the added load. The result would look like high emissions coal was on the margin when, in fact, it was not.

Another unknown is whether the California's AB 32 Cap-and-Trade program is modeled. If the modeling did not consider the GHG cost of imported coal, the modeling dispatch would be wrong and the results irrelevant to the question of off-peak GHG content.

For all of the foregoing reasons, the TURN analysis of the data should be disregarded.

C. The Analysis of the CAISO 2024 Study Does Not Show the Pattern Indicated by TURN

TURN states at page 24, lines 20-25, that the proposed SDG&E winter and summer off-peak TOU periods would have higher incremental GHG emissions than on-peak periods based on review of Table 2. And again at page 30, lines 6-7, TURN states that the figure F-1 (which is the same data as Table 2 in graphical form) "shows[s] that CO2 emission rates would be higher in each of the utilities proposed off-peak periods than in their proposed on-peak periods." However, that statement is simply untrue for SDG&E. Table 2, calculated by TURN from the CAISO 2024 Study data, shows the exact opposite – GHG emissions are higher in SDG&E proposed on-peak periods than in proposed off-peak periods for both the summer and winter periods.

TURN's Table 2 Results for SDG&E Proposed TOU periods

	Summer			Winter		
	Peak	Partial-Peak	Off-peak	Peak	Partial-Peak	Off-peak
SDG&E	1,024	930	911	1,003	890	882 lbs./MWh

However, these results are suspect as well for the same reasons as mentioned above – the noise in the results due to variations in forced outage periods and changes in the dispatch of hydro generation can greatly affect the results on an hourly basis.

IV. COAL IS NOT ON THE MARGIN IN OFF-PEAK PERIODS FOR SDG&E

Production cost modeling is a simplification of the complex reality that is the California electricity market. TURN rightly points out that regulations to limit coal use have been adopted in California. The Emission Performance Standard of Senate Bill 1368 prohibits SDG&E from entering into new long-term contracts with coal generators,[11] and the Air Resources Board's cap-and-trade program places a carbon fee on imported power.[12] TURN rightly mentioned these, but omits mention of the cap-and-trade provisions on "resource shuffling," the selling of coal power to California disguised as other power. This practice is expressly prohibited by the ARB regulation, but is difficult to model in a WECC-wide production cost simulation. Since it is complicated to

[11] TURN testimony, p. 15.
[12] Id., p. 16.

model, and because the focus of the CAISO Studies was not analysis of greenhouse gases, the CAISO Studies do not model the ARB resource shuffling restriction precisely. Instead they provide an approximation to the Cap-and-trade regulation on unspecified imported power through an undifferentiated import fee. If indeed coal was on the margin and the TURN result was not the end product of noise, the production simulations' simplification of the cap-and-trade program would be essentially make the TURN result rely on resource shuffling, an illegal activity.

Second, the modeling does not consider EPA's new Clean Power Plan under 111 (d) of the Clean Air Act, a proposed federal regulation that is currently out for comment. The proposed regulation would shift coal generation to natural gas as a key method of reducing GHG in the electric sector in the United States. Under building block two of EPA's Clean Power Plan, each state in the WECC with coal generation would have significant obligations to shift generation from coal-fired generation to natural gas-fired combined-cycle generation. For example, the recent WECC Study of the proposed EPA Clean Power Plan regulation suggests that an incremental 2,700 MW of coal will need to retire by 2024 for Arizona to meet the EPA goals.[13] With that level of incremental reduction in coal generation in the state neighboring San Diego, it is unlikely Arizona would be exporting coal power to San Diego even if California had no resource shuffling provisions in its cap-and-trade regulation.

Lastly, the TURN analysis is statewide and not utility-specific. The analysis assumes the marginal resource is the same for each utility in each hour regardless of the utility's portfolio of resources and regardless of transmission constraints. TURN blithely assumes an analysis specific to PG&E is applicable to SDG&E and a statewide CAISO analysis does not need to be disaggregated

[13] WECC Staff, *EPA Clean Power Plan, Phase I - Preliminary Technical Report*, September 19, 2014, figure 5, p. 15.

by utility. These analyses are not applicable to SDG&E given the different utility portfolios in the State and the complexities of the electric system.

SDG&E does not have any coal in its portfolio, and is not scheduling any coal into California. Further, given the impact of energy efficiency, distributed generation, and slow economic growth, demand growth is limited. In addition, the 33 percent RPS and need for local resources has created more than adequate supply to meet all off-peak demand. SDG&E's imports are limited to a single CHP utility prescheduled contract, a firming-and-shaping contract associated with out-of-state wind generation, and very limited short-term market purchases. Between renewable generation, must-take cogeneration, and must-run local facilities, SDG&E is not dependent on imports at all in off-peak periods and is unlikely to import any additional power in off-peak periods. For SDG&E, the "all gas model" is an appropriate short-term assumption for shifting load from on-peak to off-peak, while the appropriate long-term assumption should consider the CAISO's 2024 Study to determine how many off-peak hours will have renewables on the margin in the post-2020 period. This amount can be easily determined based on the number of hours where renewable energy curtailment takes place in the CAISO Study.

V. TOU PERIODS HAVE OTHER PURPOSES BESIDE GHG REDUCTION

TURN repeatedly states its assumption that TOU periods should be designed primarily for GHG reductions including at page 9, lines 12-16; page 17, lines 9-13; page 23, lines 9-13; page 25, lines 3-8; page 27, lines 6-12, page 29, lines 13-16; and page 30, lines 7-10. TURN, however, does acknowledge that there are other factors including wholesale electricity prices and lowering the need for new generating capacity that should factor into the design of TOU periods.[14]

TURN spurious data should not detract the Commission from considering TOU periods as proposed by SDG&E that provide accurate price signals. As shown in my Rate Design Window

[14] Turn, page 23, line 13 and page 27, lines 9-12.

testimony, the SDG&E-proposed TOU periods capture the bulk of the hours in which there is a probability of the need for new capacity in the future with more renewable generation. The shift in the peak both statewide and locally to later in the day means residential customers will be contributing more to the new peak and need to be provided with an accurate price signal to efficiently use the existing electric infrastructure.

And as shown in my Rate Design Window testimony, the SDG&E-proposed TOU periods capture the bulk of the high wholesale electricity prices expected in 2017 and beyond, but also capture most of hours of high SDG&E DLAP prices in 2013. The SDG&E proposed TOU periods provide price signals as to the time period when electric prices are expected to be high.

In SDG&E's consideration of new proposed TOU periods for all customers, both energy prices and statewide and local capacity needs were considered. Second, customer considerations influenced decisions on the number of TOU periods, making the TOU periods contiguous, and providing as much consistency as possible between summer and winter TOU period hours. Third, long-term considerations played a role in establishing its TOU proposal in recognition of the Commission's guidance that the TOU periods should last at least five years and the fact that the current default TOU period structure has been in place for 30 years. The fact that GHG emissions for SDG&E are also correlated with its proposed TOU periods is gravy.

VI. CONCLUSION

TURN's conclusions from production cost modeling results are likely due to noise in the data and not due to out-of-state coal cycling to provide power in off-peak periods. Further, the 2024 CAISO study results presented do not support TURN's conclusions for SDG&E. TURN's conclusions should be ignored.

This concludes my prepared rebuttal testimony.

VII. STATEMENT OF QUALIFICATIONS

My name is David T. Barker. My business address is 8330 Century Park Court, CP32F, San Diego, California 92123. I have been employed as an economist in the Resource Planning group of San Diego Gas & Electric Company since 2007. Prior to that, I was employed as an economist in the Regulatory Affairs Department of Sempra Energy Utilities from 2002 to 2007. Before 2002, I was employed at Southern California Gas Company in various staff positions including Economist (1991-1995 and 1998-2002), Market Consultant (1988-1989 and 1995-1998), Electric Energy Analyst (1990-1991), and Demand Forecasting Supervisor (1989-1990).

I received a B.S. in Mathematics from New York State University, a Masters of Economics degree from North Carolina State University, and a joint Ph.D. in Economics and Statistics from North Carolina State University. I taught undergraduate economics and statistics courses for four years on a full-time basis in Oregon, and then worked in the private sector for five years as an economist at Merrill Lynch prior to joining Southern California Gas Company.

I have previously testified before the Commission on greenhouse gas issues.