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Executive Summary

The Clean Energy Factor (CEF) developed by Sabreez describes electric power systems with abundant wind and solar in consumer-friendly terms; the Wind Number and Solar Boost. Having defined these terms, there are a range of use cases that benefit from describing electric power generation in this manner. Although this document addresses energy storage, the CEF should be used to engage energy consumers into sustainable energy use through consumer-facing messaging that promotes the adoption of enabling technologies and ultimately integrated with retail real-time pricing programs as a rebate program. The CEF correlates with wholesale costs (Appendix A), which are lower when the CEF is high, and higher when the CEF is low. The CEF shows consumers that clean energy costs less.

Sabreez has prepared this evaluation of our CEF for review by stakeholders in California's energy system. As part of California Public Utilities Commission (CPUC) Proceeding 12-11-005, CPUC staff has recommended the adoption of a greenhouse gas (GHG) signal to integrate into control systems for distributed storage systems. The CEF describes California's electric power generation in terms of wind and solar relative to thermal resources. The CEF is the GHG signal, but reported as the resource rather than as emissions. Our equation is shown below:

Sabreez's Clean Energy Factor (CEF)

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Wind Number + Solar Boost = Clean Energy Factor (CEF)

$$\left(\frac{\text{Wind Power Resources}}{\text{Thermal Resources}} * 100\right) + \left(\frac{\text{Solar Power Resources}}{\text{Thermal Resources}} * C\right) = \text{Clean Energy Factor (CEF)}$$

Where:
Clean Energy Factor (CEF) is a Measure of Clean Energy Resources Relative to Power from Fossil Fuel Burning Plants
Wind Power Resources= Regional Wind Power Resources
Thermal Resources= Regional Natural Gas + Coal Power Resources
Solar Power Resources= Regional Solar Power Resources
C= Constant Based on Current Regional Solar Development Relative to Wind Development

The CEF was created to encourage consumers to shift energy use to times of the day when energy is cleaner; thus reducing peak demand. The CEF is based on data provided by the California Independent System Operator (CAISO), which manages electric power transmission. As California electrifies the energy sector, hourly prices are being adopted to pass-through higher rates to consumers during times of peak demand. However, California has also seen growing curtailment of solar power while the net peak demand is actually

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shrinking and getting moved later into the day for much of the year. As oversupply of renewables builds in real time, decreasing electric power production from thermal power plants reported through our equation creates an asymptotic signal. This natural energy production cycle is effectively described by the CEF in an actionable and programmable format. By contrast, marginal emissions data is not conducive to addressing daily oversupply, focusing instead on incremental increases in carbon emissions from progressively less-efficient power plants. The CEF also reports the incremental change during the daily ramp better than marginal emissions data.

California's energy system is a function of the weather, and people are much more engaged with the weather than they are with energy. Now that both energy generation and energy demand are closely linked to the weather, California needs a system of consumer-facing energy reporting in a weather-like format. The Wind Number and Solar Boost provide the basic building blocks for that energy information system. Reporting the CEF, which is the sum of the Wind Number and Solar Boost essentially creates a tachometer for clean energy.

In recent years, energy generation data has improved to the point that it is increasingly accurate and reliable. To complement price, there is growing consensus that we should convey when energy is cleaner, since wholesale prices are lower when it's sunny and windy, and/or demand is low. The default option chosen by regulators has been to report changes in marginal emissions from the electric power system, but the CEF does a better job of informing energy consumers when energy is cleaner for the following reasons;

1. The CEF can be forecast more accurately than emissions reporting because the emissions forecasting is a derivative of energy generation data.

2. The CEF does a better job of switching DERs on because a number of power plants have similar marginal emissions, leading to blind spots in the ramping progression.

3. When curtailment is imminent, an asymptotic signal from the CEF signals DERs to switch on.

4. In the event of an interruption of energy source data, the CEF can be estimated through other data sources and made available to licensees with 100% reliability.

This report presents our actual energy forecasting presented on social media in California over the most recent 6 month period in Appendix B. The inverse correlation between the CEF and systemwide carbon emissions is evident from the hourly data. The CEF plots as the mirror image of carbon emissions, with a higher amplitude during clean energy peaks, showing consumers when energy is cleaner rather than when it is more polluted. These daily clean energy events can be exploited by marketing and advertising professionals to create engaging content to motivate a lasting behavior change. As consumers realize that clean energy costs less, they'll enjoy using cleaner energy. This could potentially engage a much larger segment of the population into energy efficient behavior than previous programs, and provide sufficient interest from connected device managers and manufacturers that no public funding of the information system is required.