INTRODUCTORY FRAMEWORK FOR A DISCUSSION OF OBJECTIVES FOR HOURLY RECs

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I. SELECTED TERMINOLOGY

GREENHOUSE GAS (GHG) ATTRIBUTES OF RENEWABLE ENERGY (RE) GENERATION

Direct GHG emissions of renewable generation: The amount of emissions, emissions profile, or emissions factor/rate associated with the electricity generation. Zero for wind, solar, and hydropower. Positive for biomass and some geothermal. Used in attributional accounting. A "primary" attribute of renewable energy generation.

Avoided GHG emissions of renewable generation: The net change in emissions on the grid from what would have occurred without the renewable generation. Used in consequential GHG accounting. The difference between the direct emissions of the generation likely displaced by renewable energy generation (usually generation from marginal or non-baseload resources) and the direct emissions of the renewable energy generation (usually zero). Often estimated using the non-baseload output emissions rate for the grid region or subregion. A "secondary" (or "derived") attribute of renewable energy generation.

ACCOUNTING

Attributional accounting: Measuring the fuel type or direct emissions that can be attributed to the production of electricity generated or consumed over a specified timeframe.

Consequential GHG accounting: Measuring the emissions impact or consequences of producing or consuming electricity on the grid over a specified timeframe.

Hourly accounting: Attributional or consequential accounting on an hourly basis.

Source-based RE and GHG accounting (also called "production-based" accounting): Measuring what is generated at the source; the point of measurement or reporting entity is the generator. E.g. accounting for in-state (or in-region) emissions for a cap-and-trade program.

Load-based RE and GHG accounting (also called "consumption-based" or "demand-based" accounting): Measuring what is consumed, delivered, sold to, or serving a specific load, or determining "retail claims" for a particular place. Requires allocation, attribution, or tracking of generation (and/or

individual attributes) to load. The point of measurement can be the utility, load-serving entity (LSE), importer, or consumer. E.g. accounting for RE serving retail load in power source disclosure, clean energy standard (CES), or renewable portfolio standard (RPS) programs.

DATA

Static generation data: The primary attributes of the generator that do not change based on operation (e.g. fuel type, location, date of first operation, etc.).

Dynamic generation data: The primary and secondary attributes associated with generation that vary based on operation (e.g. quantity, date and/or time of generation, marginal grid emissions rate).

Hourly RE generation data: Information about the primary and secondary attributes (including impacts) of renewable generation that varies by hour of the day.

ACTIVITIES AND APPLICATIONS

Hourly RE procurement (also called, "24x7" procurement): Purchasing or sourcing renewable or carbon-free energy for operations on an hourly basis, 24 hours per day and seven days per week. Matching one's electric load with renewable or carbon-free electricity generation in every hour, using either voluntarily contracted renewable generation in the region or hour-by-hour renewable generation in the regional grid mix.

Load-shifting: Changing the time of electricity consumption; for example, to times of the day when there is more renewable generation operating. Requires an understanding of generation by resource type on an hourly basis. Not equivalent to hourly procurement.

Energy Efficiency (EE): Reducing the amount of electricity consumption.

METRICS

Hourly avoided GHG emissions associated with RE procurement: The result of consequential accounting for the avoided GHG emissions associated with purchased renewable generation that occurs at different hours of the day. Calculated to evaluate the hourly carbon impact of procured renewable generation. The hourly marginal impact of procurement.

Hourly avoided GHG emissions associated with EE or load-shifting: The result of consequential accounting for avoided GHG emissions associated with electricity consumption at different hours of the day. Calculated to evaluate the hourly carbon impact of electricity consumption. The hourly marginal impact of consumption.

Hourly RE usage and scope 2 GHG emissions: The amount or percentage of RE consumed and the GHG emissions associated with purchased/consumed electricity ("scope 2 emissions") in a given hour. Scope 2 GHG emissions can be calculated according to either a "market-based" or "location-based"

method.[1] The result of attributional accounting for fuel type or direct emissions of purchased electricity (also called "load-based" accounting). Calculated to characterize hourly consumption or delivery.

Hourly RE generation and associated GHG emissions on the local grid: The amount or percentage of RE produced and the GHG emissions associated with electricity generated or produced in a certain geographic or grid area in a given hour. The result of attributional accounting for fuel type or direct emissions of electricity generated in a certain geographic or grid area (also called "source-based" accounting). Calculated to characterize hourly generation on the local grid, e.g. to inform EE and load-shifting, or to evaluate the impact of consumption on curtailment and peaks.

More information and explanation of terms can be found in:
Jones, T. and Bucon, N. (Oct 17, 2017). *Corporate and Voluntary Renewable Energy in State Greenhouse Gas Policy: An Air Regulator's Guide*. Center for Resource Solutions. Sec. 2-4.5 (pg. 4-17). Available at: https://resource-solutions.org/wp-content/uploads/2017/10/Corporate-and-Voluntary-RE-in-State-GHG-Policy.pdf.

DISCUSSION

Communication is needed on the differences between the following concepts:

1. Data vs. accounting vs. procurement;
2. Avoided emissions vs. direct emissions/usage; and
3. Load-shifting activities vs. procurement activities.

We should clearly distinguish the impacts of:

- Hourly renewable generation data;
- Hourly accounting of RE usage and emissions; and
- Hourly procurement of RE.

Creating access to hourly generation data does not require hourly accounting or hourly procurement. Hourly generation data can support existing accounting frameworks and long-term procurement

[1] Both market-based and location-based scope 2 emissions represent attributional accounting of direct GHG emissions of purchased electricity, and load-based accounting. Neither represent consequential accounting because both measure the direct emissions that can be attributed to the production of electricity, rather than the avoided grid emissions. Both are load-based because they are intended to measure the direct emissions attributed to the production of electricity that is *consumed*, rather than generated in a particular place. However, the location-based method merges the third and fourth metrics listed here—it uses the GHG emissions on the local grid (produced emissions) as the GHG emissions associated with consumed electricity (consumed emissions). In other words, it does not distinguish between source-based and load-based accounting because it does not recognize contractual purchasing and transactions of renewable and other specified power. It also does not recognize RECs. It contends that the shared grid prevents delivery of differentiated power, and therefore all electricity customers should be assigned the grid average emissions based on their location. In contrast, the market-based method reflects the reality that electricity is differentiated and specified power can be bought and sold using contractual instruments in many parts of the world. And there is a (often legally enforceable) difference between the third and fourth metrics—direct emissions consumed vs. direction emissions produced. Therefore, for this document and in the context of discussions of hourly RECs, we can consider that the third metric listed (scope 2 emissions) would be market-based.

strategies. Hourly accounting and procurement of renewable energy do not necessarily produce hourly grid benefits of renewable energy. The benefits of hourly accounting might not be the benefits of hourly procurement.

Hourly renewable energy certificates (RECs)/energy attribute certificates (EACs) are an accounting and procurement tool that contain the hourly static and dynamic data associated with generation. These instruments could be used to calculate:

- Hourly RE usage and scope 2 GHG emissions, and
- Hourly avoided GHG emissions associated with RE procurement (where data is available).

High-level Questions:

- What are the benefits of hourly accounting for each of the above metrics compared with annual accounting?
- How do hourly RECs facilitate hourly accounting for each of the above?
- What are the benefits of hourly procurement?

II. BACKGROUND ABOUT USAGE AND CLAIMS

All customers rely on the grid (and emitting resources), whether they do annual or hourly accounting.

Hourly matching of generation to load does not mean physical delivery of electricity from renewable sources (or the GHG attributes) in those hours or change the sources of physical electricity on the grid. Hourly (or 24x7) procurement does not fundamentally change a company's relationship with the grid. Companies purchasing renewable energy on a 24x7 basis still rely on the grid and, until the entire grid is carbon-free, that will include carbon-based power. The same is true for companies that purchase renewable energy to match load on an annual basis. Accounting for RE usage and scope 2 emissions is the same for voluntarily contracted renewable energy whether it is done on an hourly or annual basis—matching generation to consumption.

Load-shifting is not equivalent to hourly procurement.

Shifting consumption to times of the day when there is more renewable generation operating may change the marginal impact of electricity consumption, and it may have overall emissions reduction benefits if the load-shifting can lead to greater renewable integration and penetration, which would require a shift of consumption across the entire region. Furthermore, grid operations and regional transmission organization (RTO) markets and processes have broad impacts on what is dispatched and how the grid, and other loads, respond to changes in load on the system, making it a complex task to accurately report the impact of a single customer's load shift on overall grid operations. Load-shifting also requires an understanding of the generation by resource type on an hourly basis. But it is not the

same as hourly procurement or procurement of renewable energy to match hourly load. Load-shifting based on hourly grid data is a separate activity that does not affect corporate RE usage claims and it can be pursued with long-term and annual corporate renewable energy procurement.

Arguments in a recent Stanford article address the accounting of carbon impact, not renewable energy use and emissions.

The article in question[2] says that avoided emissions accounting (for the carbon impact of RE generation) is more accurate at an hourly level. That does not mean that hourly procurement will produce those benefits or that hourly accounting for usage claims is more accurate. This article calculates the difference between the location-based direct emissions of purchased electricity (based on the grid average emissions rate) and the avoided emissions associated with purchased RE (based on the marginal emissions rate), which it calls both "the consumer's net environmental impact" and the "emissions attributable to the consumer." Those are different, and it is neither. This is not the way that emissions attributable to the consumer (i.e. scope 2 emissions) are calculated. Scope 2 emissions do not describe the impact of the RE generation on the grid or the impact of the RE purchase. This calculation does not represent "the consumer's net environmental impact" (the impact of the purchase) either. The consumer is causing neither the emissions in the grid average nor the avoided emissions from the RE. Buying RE (a REC) is not equivalent to buying a quantity of emissions reductions. It also conflates attributional accounting with consequential accounting—subtracting avoided emissions (impact) from direct emissions (footprint, embedded emissions) of purchased electricity. Only the avoided emissions represent impact and again they are the impact of the generation, not of the purchase or the consumer. Hourly accounting of avoided emissions may be more accurate, but that doesn't mean that hourly accounting of usage and direct emissions is or that hourly procurement will yield an hourly accounting of avoided emissions.

III. DISCUSSION QUESTIONS

Questions about benefits and impacts of hourly accounting for RE usage and scope 2:

- Is there any increased risk of double counting associated with hourly accounting for usage and scope 2 emissions due to the lack of hourly delivery data?

Questions about the impacts of hourly procurement and hourly RECs:

- Does hourly procurement help scale up renewable energy development overall?
- Does hourly procurement help maximize avoided emissions?

[2] de Chalendar, J.A. and Benson, S.M. (June 19, 2019). *Why 100% Renewable Energy Is Not Enough*. Joule 3, 1389–1393, 2019 Elsevier Inc. https://www.cell.com/action/showPdf?pii=S2542-4351%2819%2930214-4

- Does hourly procurement help address grid integration and reliability challenges associated with higher penetration levels of renewable energy?
- Are hourly RECs helpful to achieve the benefits of load-shifting? If so, how?
- Will hourly RECs provide a closer link with power markets, and what would that mean for RE development and decarbonization?