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Electrons have no identity: Setting right misrepresentations in Google and Apple's clean energy purchasing

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ABSTRACT

Aside dedicated generation, transmission and distribution networks, the hype around corporations and other entities purchasing so called *clean energy* may be considered a deliberate accounting misrepresentation. To illustrate this case in this short perspective, we begin by explaining the technical difficulties of remaining "renewables pure". We then give case studies of two organisations – Apple Inc. and Google LLC – who are, arguably, at fault of making such claims. The method is a simple, non-systematic comparison between what is technically possible, and what is claimed to be possible. Given that incongruous renewables claims have the potential to further impoverish vulnerable households who must bear the financial costs of renewables integration, we conclude that a successful decarbonisation pathway must not have selective winners or losers.

1. Introduction

It is a common and growing misconception within the decarbonisation agenda that electrons can be differentiated by their source or "gender"; that you can distinguish electricity from fossil-based sources like coal, oil and natural gas and from renewables such as wind and solar after it has been produced and enters the grid. It is a further misconception that affiliating with one means you do not associate with the other. This fallacy, as perpetuated by Eckhouse [1] amongst others, is hinged on the erroneous assumption that power purchase agreements (PPAs) for green ("clean") energy between corporations and utilities absolve the corporations from the comparatively "sinful" burdens associated with fossil based generation through some form of so called "green indulgences". What is more worrisome though, is the fact that corporations using the banner of renewables as a claim for a pioneering role in the transition towards a low-carbon energy society are often not held to account. In this perspective, we begin by explaining the technical difficulties of remaining "renewables pure". We then give case studies of two organisations – Apple Inc. and Google LLC – who, arguably, are at fault of making such claims.

We zero in on Apple's claim to be 100% renewable-run, especially for its data centres in the United States, arguing that Apple's latest declaration runs afoul of engineering principles. This becomes a case study to illuminate potential hypocrisy around low-carbon energy transitions globally. We also show that Google too may stand guilty of such claims, and highlight the apparent reluctance of big corporations like Apple and Google to take responsibility for internalizing carbon emission reduction. We finally evidence that publicity outlook and financial incentives are underlying causes for this growing "renewables or bust" myth. Our aim throughout is not to name and shame, but to reflect upon the veracity of our 100% renewables systems when fossil fuels still retain a significant stake in global energy systems. The method is a simple, non-systematic comparison between what is technically possible, and what is claimed to be possible. We close with a consideration of those who must bear the financial costs of renewables integration and conclude that a successful decarbonisation pathway must not have selective winners or losers.

2. A background on the electricity network and its standardization

Our indifference to the complexity of the electricity network has allowed us to ignore the realities of how electricity is produced and delivered, with implications for our ability to make informed policy contributions towards decarbonisation [2]. Here we explain why.

Generally speaking, the electricity grid consists of a generation network, transmission network and the distribution/utilisation network. The generation network consists of generators converting energy in various forms into electricity. For instance, generators at a dam convert the potential energy of water at a height through kinetic energy

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into electricity. Similarly, thermal power stations utilise fuels such as coal, gas and oils to heat up water into steam that is then used in driving turbines to produce electricity from the generators. The output electricity from the generators varies between say 2 kV to about 30 kV and is usually stepped up using alternating current (AC) transformers to transmission level voltages[1] (typically between 115 kV and 765 kV). The transmission network allows for the evacuation of electricity from the generation site to load centres (usually incurring losses that increase with distance). At the load centres, substation transformers are then used to step down the high voltages that are then transmitted to distribution transformers of residences and industries at appropriate distribution voltages and frequency. In the same vein, the integration of renewables and other sources of electricity like solar, wind and biomass with the conventional electricity grid is done at points of common coupling (PCC) and at appropriate voltages, and is regulated using standards such as IEEE [3] (for 60 Hz sources); a uniform standard for the interconnection and interoperability of distributed energy resources (DERs) with the electric power system (EPS).

Considering the complex nature of the EPS, IEEE [3] and its suite of sub-standards ensure that at the PCC, the DERs meet with strict criteria with regards to voltage regulation during ride through, voltage and reactive power control, flicker, frequency droop, islanding regulations and interoperability. This is to ensure that the synchronization of the DERs with the EPS does not negatively impact the electricity grid. Furthermore, and importantly, the synchronization at the PCC facilitates the flow of electric current through the electricity network without differentiating between the source (DERs or the EPS). An analogy to this would be the incorporation of various water sources – recycled waste water, flowing stream, reservoirs, rainfall etc. – into a water treatment facility which is then fed into the water supply network of a city. In this scenario, it is nonsensical to have houses claiming to source their water strictly from recycled wastewater, rainfall or reservoirs. This brings us to the danger of some companies' renewables claims.

3. Apple's renewables claims

In its Environmental and Responsibility Reports [4–7], Apple has consistently claimed to have its data centres in the United States run entirely (100%) on renewables, with renewables contributing over 90% of the total energy demand of its data centres and corporate offices worldwide. For example, according to Apple [4], their data centre in Maiden, North Carolina is powered by up to 39% photovoltaic (PV), 37% from fuel cells and 24% from North Carolina GreenPower. They acknowledge too that despite these claims, the data centre remains connected to the Duke Energy Carolinas electricity network, which has renewable energy contributing less than 1% [4].

According to Apple [6], their renewable energy sourcing principles include displacement (in which Apple feeds in clean energy that is equivalent to what its facilities take from the grid), additionality (whereby Apple participates in developing additional clean energy sources to feed into the grid), and accountability (for which Apple applies rigorous vetting processes and third-parties to track its energy supply). To some, this would appear a thoughtful and positive approach. Yet Apple falls foul of artificially streamlining the process of electricity generation, transmission and distribution.

Apple's displacement principle oversimplifies the complex responsibilities involved in electricity system planning and operation. By reducing their PPAs to simple addition and subtraction, Apple appears to (perhaps deliberately) overlook the complex issues of reactive power compensation, real time demand/supply balancing, voltage regulation and line losses compensation. Indeed, it is common sense that when a grid link is present, electricity generated in one spot cannot be directed to one specific user, meaning there is no way to prove that wind farm X is supplying facility Y. In reality then, considering the effect of weather variation on the power production of its PV and wind power plants, Apple inherently relies on the conventional and "dirty" grid to handle the issues of intermittency associated with PV and wind production and to support its operations. In so doing, they incorrectly remove the need for additional investments in support infrastructure and storage facilities were their data centres to be run exclusive of the conventional grid.

4. Google's guilt

Such an argument can be made with reference to other companies too (to the extent that the example we use here is one of myriad potential cases). In 2016, Google stated that they also expected to start sourcing 100% of the electricity needs of their data centres from renewable energy sources [20]. Eric Schmidt (executive chairman of Alphabet) highlighted Google's investments of over $2 billion in clean energy projects since 2007, including investments in Google's carbon neutrality drive while also advocating for a strong and effective outcome at the 21st United Nations Conference of the Parties (COP21) climate change conference in Paris [8]. Yet it is ironic that despite Google's hype with regards to its strides in fostering low-carbon energy transitions, they admit that it is not feasible for its data centres to operate off the conventional electricity grid [9]. In fact, quoting verbatim from a company report, they state – "*The plain truth is that the electric grid, with its mix of renewable and fossil generation, is an extremely useful and important tool for a data centre operator, and with current technologies, renewable energy alone is not sufficiently reliable to power a data centre*" ([9: 2]). Here, a mismatch between aspirational and attainable goals arises.

5. Apple and Google's actions and the spill-over effects

We do not set out to antagonise Apple and Google; if anything, we sincerely commend their investment efforts in supporting the development of renewable energy projects which, when we consider how large these organisations are, certainly go some way towards reaching the targets enshrined by the Paris Agreement. We do, however, condemn bold attempts at simplifying the transition process to low-carbon energy sources. In such cases, claims of being "100% renewable", or at least striving for that goal, have the potential to falsely influence the perception of the larger society with regards to the feasibility of rapid low-carbon energy transitions. We further argue that in light of grid limitations and the continued presence of fossil fuel technologies, such claims remain insincere and must not be encouraged. Indeed, the dangers of such statements are widespread. By either intentionally or inadvertently engaging in accounting misrepresentation, these corporations create the impression that associated problems of stochasticity, intermittency and storage which continue to plague the full exploitation of renewables are insignificant.

We ground this argument (which we acknowledge to be contentious) in established and peer reviewed evidence as presented in Clack et al. [10], where it was surmised that the reliable operation of the electricity grid involves myriad challenges beyond just matching total generation to total load. Clack et al. [10] offer that the electricity grid's reliable operation is complicated by its alternating current (AC) nature; with real and reactive power flows and the need to closely maintain a constant frequency. In addition, allowances must be provided to accommodate for generator failure or unavailability - a process usually achieved through systems operations and planning to maintain grid stability.

Through PPAs and by externalising the associated problems of renewables, corporations may avoid the penalty of carbon taxes by claiming renewable energy credits (RECs). Moreover, these

[1] A reason for the high transmission voltages is to reduce power losses on the transmission line.

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