Critical Review of the Dewberry Report

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December 12, 2018

The Dewberry Engineers Inc. memo to Ms. Wanda Parrish, AICP, Director, County of Spotsylvania, dated November 2018, report cites several of my studies but some of its conclusions contradict the cited studies. Below I highlight these contradictions.

I. On setback distances

The Dewberry report recommends 350 ft setbacks from the properties of Fawn Lake and they state that such is "matching the results in reference (3)". Ref 3 is a paper I wrote "Analysis of the Potential for a Heat Island Effect in Solar Farms"[i] but I did not mention anything about necessary setbacks. Perhaps Dewberry misinterpreted the field data I listed indicating that the heat build-up from the plant would have been effectively dissipated within a distance of 100 m (328 ft) from the perimeter of a large solar farm, as temperature at such distance has approached the ambient within 0.45 C (1 ^{O}F). However, these data corresponded to maximum mean temperature differences that may occur for only a few hours. Also the Sarnia solar farm, from where I obtained the data, did not have any trees in its perimeter, whereas the proposed Spotsylvania solar farm would have a buffer zone with trees and bushes that would enhance heat dissipation and will result to a faster temperature decline around the perimeter of the plant. Overall I do not believe that there is a justification for a 350 ft setback distance from residential properties. Another misinterpretation of my paper in the Dewberry report is the quotation that "temperatures return to ambient at 60 ft (18.7 m) above the panels". Again, this corresponds to a maximum; actually my simulations showed that the thermal energy emitted from the panels completely dissipates to the environment at heights of 5 m to 18 m. In addition, the Dewberry report did not site my major conclusion that 'analysis of 18 months of detailed data showed that in most days, the solar array was completely cooled at night and is unlikely that a heat island effect could occur". In summary, I have not offered any suggestions for setbacks; for such I am referring to Solar Ordinance Guides that specify setbacks of up to 100 ft. For example, the comprehensive Georgia Solar Ordinance Guide "Best practices for setbacks from large and intermediate systems"[ii] specifies:

• 15-50 feet setbacks from property lines or roads for solar energy systems in commercial, industrial, and agricultural districts;

• 15-100 feet setbacks from property lines or roads for solar energy systems in residential districts; • Specify larger setbacks from residences, ranging between 50-100 feet; (p. 45).

It is noted that the Georgia Solar Model is a most recent (2018) Guide of Solar Zoning Ordinance and it references Solar Ordinances in the States of California, Delaware, Massachusetts, Minnesota, North Carolina, Florida, New Jersey, New York, Texas, Utah and Virginia (pp. 3-4). None of these Ordinances requires setbacks larger than 100 ft from property lines in residential districts.

II. On the potential for a heat island effect

The Dewberry report cites six research papers on the heat island effect; five of them showed that solar farms do not cause a heat island effect whereas one showed an effect. I discuss the later in the last section of this report.

As discussed in my initial report for sPower, based on my studies and the review of other studies, I believe that a "heat island effect" would not happen in the considered north Virginia solar installation. Heat build-up quickly dissipate with height and distance from a solar park, and would not be felt at the surrounding community.

In essence the Dewberry report agrees with my assessment as shown from statements quoted below:

"Panels have low thermal mass as compared to soils, meaning that they do not retain heat very well. They will lose heat quickly, so a prolonged sense of heat will not be carried out into the evening and night time. This will not create a consistent increase in temperature of the area which would suggest a micro-climate."

"Dewberry previously conducted a study on the impact of a solar farm on local heating on a project in Washington, NJ. The following was observed: Temperatures were several degrees higher directly above the panels within the solar farm. Temperature decreased to ambient at the perimeter of the solar farm."

III. On decommissioning at the end-of-life

I feel that a decommissioning and recycling plan is imperative for the sustainability of large PV growth, as recycling of the materials from PV modules and the balance of system (BOS) not only protects the environment but would also result to recovery of valuable materials (e.g., Ag, Te, In, Al, glass). However, I think that requiring a fine level of detail (e.g., type of equipment, storing locations, etc.) is both unreasonable and illogical as so many conditions and options would have changed in 30-35 years when decommissioning would be needed. Any decommissioning plan requirement should have a built-in flexibility. For example, the Georgia Model Solar Zoning Ordinance Guide (2018)[ii], offers the following insights regarding decommissioning**.** "When a decommissioning plan is required, it should not be extensive. A few pages answering the required considerations may be sufficient. The Georgia Model Solar Ordinance requires a decommissioning plan that identifies who is responsible for decommissioning, when decommissioning must happen, the structures to be removed, how materials will be recycled or reused, how the land will be restored, and the timeline for decommissioning." (pp. 62-63)

The same Ordinance Guide states that "A county or city should avoid requiring decommissioning bonds. But, if a county or city feels strongly otherwise, the bond should only be required for the largest solar energy systems and the county or city should consider not requiring the bond be posted until at least 5 or 10 years after the start of the system" (p.44).

IV. On CdTe PV modules

The Dewberry reports states: "Cadmium telluride drawbacks: 1. Lower efficiency levels: Cadmium telluride solar panels currently achieve an efficiency of 10.6%, which is significantly lower than the typical efficiencies of silicon solar cells. 2. Tellurium supply".

It seems that Dewberry used 10 yrs old numbers for panel efficiency. The efficiency of current generation CdTe is 17.5 %, much higher than the stated 10.6%. Also although Te is not abundant, copper production generates enough Te to reach two million MW (2 TW) cumulative deployment by mid-century[iii],[iv].

V. Comments on documents cited by Dewberry.

a) Dr. Clinton Andrews Memos dated 9/9/2012 and 9/25/2012 (Ref. 6 in Dewberry report). I completely agree with Dr. Andrews assessment. He noted that grasses thrive underneath solar panels during hot summer months and that solar panels have a very small thermal mass and, therefore, they do not retain heat for long, as urban structures do. He took temperature measurement during a sunny summer afternoon in the middle and at the edges of a solar farm in New Jersey and performed standard heat transfer and engineering calculations. Based on his observations, measurements and calculations, he concluded that "a solar farm is unlikely to cause significant local heating that may adversely affect neighboring households or farms".

b) Barron- Gafford et al. (2016) (Ref. 2 in Dewberry report) temperature measurements within the University of Arizona (UA) Science and Technology Park Solar Zone (latitude of 32^{o} N) that contrasted all other studies; I reached out to them about a year ago asking for background information, but I did not receive any response. At this point I can only hypothesize that the differences between their findings and those of all other investigators enact from the very dry and low wind conditions in their bare ground location that is surrounded by buildings, not plants. I note that the climate in Tucson, AZ is very different than that of Spotsylvania, Virginia and that the Solar Zone in the UA lacks vegetation, is exposed to high ambient temperatures and dry air, all conditions that do not allow effective cooling.

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[i] Fthenakis V. and Yu Y., Analysis of the Potential for a Heat Island Effect in Solar Farms", 39 IEEEPV Specialists Conference, 3362-33226, 2013.
[ii] The Georgia Model Solar Zoning Ordinance Guide, Version 1.0, July 2018http://www.energy.gatech.edu/sites/default/files/documents/2018-07-30_mso_guide_final.pdf
[iii] Fthenakis V.M., Sustainability of photovoltaics: The case for thin-film solar cells, Renewable and Sustainable Energy Reviews, 13, 2746-2750, 2009.
[iv] Fthenakis V.M., Sustainability metrics for extending thin-film photovoltaics to terawatt levels. MRS Bulletin, 37(4), 425-430, 2012