Rebuttal of Comments from Public During February 26 Meeting

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Author's Qualifications

I am a chemical and environmental scientist and engineer with B.S. and M.S. degrees in chemistry and chemical engineering and a Ph.D. in fluid dynamics and atmospheric science. Currently, I am an adjunct Professor and founding Director of the Center for Life Cycle Analysis at the Department of Earth and Environmental Engineering of Columbia University, and Senior Scientist Emeritus at the Brookhaven National Laboratory (BNL) where I served for 36 years. I specialize on solar energy environmental health and safety (EH&S) assessment, and energy-environmental life cycle analysis with focus on photovoltaics (PV). I have co-authored two books, edited three more, and wrote more than 400 publications in these areas; my publications have been cited about 9,800 times and my Google Scholar h-index is 49. During my career, I guided the PV industry in maintaining safe and environmentally-friendly facilities. I was the Head of the Department of Energy (DOE) Photovoltaics Environmental Health and Safety Assistance (EHS) Center at BNL. The DOE-sponsored research encompasses all commercial PV technologies and special focus was given during 2003-2013 to Cadmium Telluride (CdTe) PV technologies because of concerns regarding potential exposures to cadmium. My research on CdTe PV has been reviewed positively by environmental expert committees in more than a dozen countries (Germany, France, Spain, Italy, Thailand, India, Japan, Middle East, China, Chile, Brazil South Africa), and has guided PV deployment world-wide.

It is unfortunate that fear has taken precedence to reason among vocal participants of the meeting I attended on Tuesday, February 26, 2019. During that meeting, some members of the public quoted distortions of my work, I think that I have an obligation to correct the record.

Comments and Rebuttal

Comment: Dr. Fthenakis' paper showed heat island impact associated with an 80 MW solar farm in Ontario, Canada.

Answer: The commentator, Mr. David Hammond, has been distorting my findings since the Planning Commission meetings. Actually, my studies show that there is no Heat Island Effect. Specifically, my studies showed that there is a temperature increase within the solar farm during

the day, but it quickly dissipates with height and distance from the perimeter of the facility. The solar farm completely cools down at night.

From a total of six studies cited during these proceedings, and reviewed by Dewberry for the potential of heat island effect only one, by Barron Gafford[1] reports a heat island. The Barron-Gafford team looked within a solar plant in the campus of U. Arizona, but subsequently, he reported[2] that a temperature difference with the surroundings was greatly reduced at just 98 ft (30 m) away from the edge of the solar farm and that at 131 ft (40 m) there was no difference between recorded temperatures and those of the surroundings.

In Spotsylvania, the proposed by sPower has a 100-ft corridor of evergreens and trees, unlike the Orlando solar farm from my study, which did not have trees or evergreens in its perimeter,

This will result in lower temperatures outside the facility than the temperatures I reported in my study. The green corridor will lessen potential temperature increases in the surroundings for two reasons: a) the buffer of trees and bushes will increase the vertical dissipation of heat so that less heat will be transported horizontally; b) the bushes and trees induce evapotranspiration that has profound effect on cooling the space. As a result, no so-called "temporary temperature increases" would be felt by the neighborhoods adjacent to the Spotsylvania solar project.

Comment: Dr. Fthenakis stated that installations of PV in the deserts would give the most environmental benefits; thus we should only install PV in deserts.

Response: I certainly stated the first but not the second piece of this argument. Based on the one factor: the level of solar irradiation, our deserts are best locations. But when other factors are considered, such as based on the proximity to the grid and demand loads, the Spotsylvania proposed location is a great location for PV.

Another member of the public said that NREL documents show very little potential for PV in Virginia, **is also false**. There are several scenarios of PV penetration that have been studied by NREL, in the DOE SunShot vision study, and the high penetration scenario shows a lot of PV in Virginia and other regions near loads where solar irradiation is around the US average (1800 kWh/m2/yr) on latitude tilt surface.

Comment: CdTe PV have Cd that could leach out and is dangerous for health and so on…

Response: This is an issue that we have studied holistically and comprehensively. People at the public hearing expressed fears for what they thought were "unknown" risks. However, the Environmental and Health and Safety (EHS) effects of CdTe PV have been studied extensively by my team and others during the last 20 years and **there are no unknowns** in this regard. The Department of Energy (DOE) commissioned such studies to my Center at Brookhaven National Laboratory in the last 90s. We have examined all commercial PV technologies (c-Si, a-Si, GaAs,

[1] Baron-Gafford et al. (2016)
[2] Little Bear Draft EIR (2018)

CIGS, CdTe) and we have produced the bulk of the peer-reviewed literature that comprehensively examined potential EHS impacts of PV technologies and recommended risk mitigation strategies.

CdTe is very different than raw Cadmium (Cd); it is orders of magnitude less soluble, less toxic, and thermodynamically and chemically a lot more stable than elemental Cd and soluble compounds of Cd. Furthermore, in CdTe PV modules, a very thin, 2.5 micrometer, layer of CdTe is encapsulated between two sheets of glass and nothing can come out during normal operation. Any potential for accidental releases, due to fires, and breakage have also been extensively studied and is proved without doubt, that such extreme conditions cannot present any health or environmental hazards. There are more than 20,000 MW of CdTe PV plants with more than 200 million panels operating world-wide and there has not been a single case of soil or water contamination; even in during tornados and hurricanes that have dislodged and damaged PV panels. Actually, CdTe PV modules, score higher than any other PV technology in terms of environmental sustainability metrics, like maximum Energy Return on Energy Investment, minimum life-cycle greenhouse and toxic emissions, and proven end-of-life recycling.

Furthermore, our studies show that recycling of CdTe PV modules, can be profitable due to the recovery value of Te, in addition to that of glass, Cu, and Al.

Our studies on CdTe PV have been reviewed and our findings have been accepted as authoritative by all Ministries of Energy and Ministries of the Environment that examined the technology. Therefore, I can state with certainty that the long-term operation of the Spotsylvania solar facility will not adversely impact local groundwater, soil or air quality, nor will the project adversely impact local public health. Conversely, I believe the operation of the Spotsylvania solar project will beneficially impact the environment and public health, as it will displace fossil fuel power generation and associated greenhouse and toxic gas emissions. I hope that the public in Spotsylvania can be better informed about the benefits of PV and I would be glad to talk to the public whenever you think this may be possible.