

To: Adam Freihoefer, Wisconsin Department of Natural Resources

From: Andrew Behm and Edward Maxwell, Ruekert and Mielke

Date: April 24, 2018

Re: Foxconn's responses to DNR questions regarding water efficiency, cooling, and consumptive use

Attorney John Sheehan of Michael Best provided the attached information on behalf of Foxconn. This information responds to your email questions from April 2, 2018, regarding Foxconn's planned water conservation and efficiency measures and consumptive use for cooling.

April 19, 2018

Responses to DNR data request for City of Racine water diversion application

**1. Please provide additional information on the water conservation and efficiency methods planned for the Foxconn facility.**

General background on planned facilities

The Foxconn manufacturing facility as currently planned for Mount Pleasant includes facilities for large scale LCD panel manufacturing and final assembly into display devices. The LCD manufacturing process comprises three main manufacturing lines: (1) thin film transistor (TFT) deposition on a glass substrate, (2) color filter (CF) deposition on a separate glass substrate, and (3) cell assembly where the CF and TFT substrates are sandwiched with liquid crystal between them. The cells are then cut into final panel sizes and assembled into housings like TV's and other display products.

In each of the main deposition lines (TFT and CF) there are several repetitive process steps required to deposit the functional compounds on the glass including deposition, photolithography, and etching. Between each step the substrate is thoroughly cleaned and rinsed with highly purified water (DIW or deionized water) to prevent defects in the final display. These processes are carried out in large custom-built equipment inside of expansive cleanrooms with automated systems to transfer the substrates from step to step.

Water usage and conservation and efficiency methods

The primary uses of water in these facilities are for: (1) direct use in the manufacturing processes, and (2) indirect use in the manufacturing process as cooling medium for process equipment. Much smaller amounts of water are also used for indirect use in general building spaces for climate control (air conditioning) and human use for potable water and sanitary waste systems. As explained below, the company intends to implement environmentally sound and economically feasible water conservation measures.

(1) Process water, direct use in the manufacturing process. Based on the projected production rate for the LCD fabrication plant ("fab"), the company has calculated that the total amount of purified water normally required to clean and rinse the products is approximately 21 million gallons per day (mgd). This represents the baseline process water consumption.

Based on its knowledge of the cleaning processes in the fabs, the company is able to segregate the wet process drains into specific treatment systems that target the chemical contaminants from the various wet processes. Treated wastewater is returned to the DIW supply system to be used in the process again. As it does in its factories in Taiwan and Japan, the company is planning to reclaim and retreat approximately 85% of wastewater from the processes, reducing the net city water. Foxconn intends to repeatedly recycle its process water. Recycling this water would significantly reduce the demand for this facility, lowering its expected volume of water needed from 20.6 mgd on an average day to the current estimate of 5.8

mgd. Re-use of 85% of the process water is virtually unprecedented in the microelectronics industry in the United States, but is more common practice in parts of the world where water usage is more constrained.

(2) Process cooling water, indirect use in manufacturing as a cooling medium. The second most significant use of water in the fabs is cooling of manufacturing equipment, largely to reject heat loads from power consumption. Historically, large industries provided cooling water loads by circulation of water from a local lake or river through the plant, rejecting heat from process equipment into the water through heat exchangers. The water was returned directly to the natural source at elevated temperature. This approach is often referred to as direct contact cooling because the process equipment contacts the natural water supply directly. Direct contact became problematic from both economic and environment perspectives.

In order to manage the cooling water quality and to control the critical process temperatures, the company will employ an industry standard non-contact cooling system for the process equipment. In this system, cooling water is circulated around in a closed loop, with heat exchangers rejecting heat to a secondary loop. The secondary loop then circulates through cooling towers where the heat is ultimately rejected to the atmosphere via heat of vaporization of the water as the water evaporates from the tower. By “closed looping” the cooling water system and rejecting the equipment heat via evaporative cooling towers, the plant is able to reduce the water draw on the order of one-tenth of that required for open looping. This cooling scheme is generally energy efficient and is required to maintain the cooling system reliability for critical manufacturing processes. This is now the industry standard.

**2. Please provide additional information on the consumptive use projections included in the application. Information should be specific to the estimates for Foxconn’s cooling needs and should include why the cooling method is appropriate at this volume of water consumed, any alternative cooling methods considered, and how efficiency at the cooling facility is in keeping with or exceeds industry practices.**

Consumptive use is defined in the Great Lakes Compact as “that portion of the Water Withdrawn or withheld from the Basin that is lost or otherwise not returned to the Basin due to evaporation, incorporation into Products, or other processes.” (Compact, Section 1.2 Definitions).

For the proposed Foxconn facility, the vast majority of the consumptive use is a result of the cooling tower evaporation and no water is imbedded in the final products shipped offsite. As described above in the discussion of process water, the company’s commitment to efficient water use is on a scale not generally seen in the United States and means that it will only need approximately 5.8 mgd for its process water where a typical plant of this type would need 20.6 mgd. Thus, the water that is evaporated in the cooling cycle is a percentage out of 5.8 mgd rather than 20.6 mgd. Specifically here, in the diversion application, the consumptive use is thus about 36% of the total water demand of 5.8 mgd. Were it not for the 85% reclaim rate of process water, the consumptive use would be on the order of 10% of a total water demand of 20.6 mgd. Thus, while some concerns have been raised about the high percentage of the consumptive use of

the water, the reason the percentage is higher than normal is that the water efficiency – the total water draw needed – is so much lower than normal due to the state of the art conservation methods and, consequently, the percentage of consumptive use is higher.

Addressing the part of the question about the appropriateness of the cooling method and whether alternative methods were considered, the company points out that its cooling method is considered standard industry practice and other methods were not considered in any depth. The efficiency of the closed loop cooling process, in the company's judgment, meets or exceeds industry practices.