As can be seen in Figure 2, there are no liquids to leak from a broken panel. The glass and plastic layers are inert. The silicon PV cells are nearly 100% silicon, which is harmless and is the second most common element in the earth's crust. The only component of a PV panel that has any potential of toxic impact is the lead in the solder, which is the same tin-lead solder (~36% lead) that is standard in the electronic industry. This solder is used to connect the solar cells together, by connecting the thin strips of silver that collect electricity from each cell to the next solar cell and to the busbars at the end of the circuit.[5] The tiny amount of silver in a panel does not create a toxicity hazard, but it does add potential recycling value.

Even though there is only a tiny amount of lead in each panel, the total amount of lead in all the PV modules in a utility-scale project adds up to a considerable amount of lead. However, these PV panels are spread out over a large area and when the amount of lead in the PV panels is compared to the amount of lead naturally occurring in the soil under the PV array, it is obvious that even if all the lead somehow leached out of every module (which as explained below is impossible), the increase in total lead in the soil would be less than the naturally occurring difference between different soils. Across the US soils naturally have between about 10 and 50 mg of lead per kg of soil, with the average being somewhere in the 20s. Across 93 USGA survey locations across Georgia, the values ranged from 2 to 115 with an average of 15 and a median of 11.[6] For a location that naturally has 15 mg of lead per kg of soil, all the lead in all the PV modules in the facility would have the same amount of lead as just the top 4 inches of soil at the site.[7]

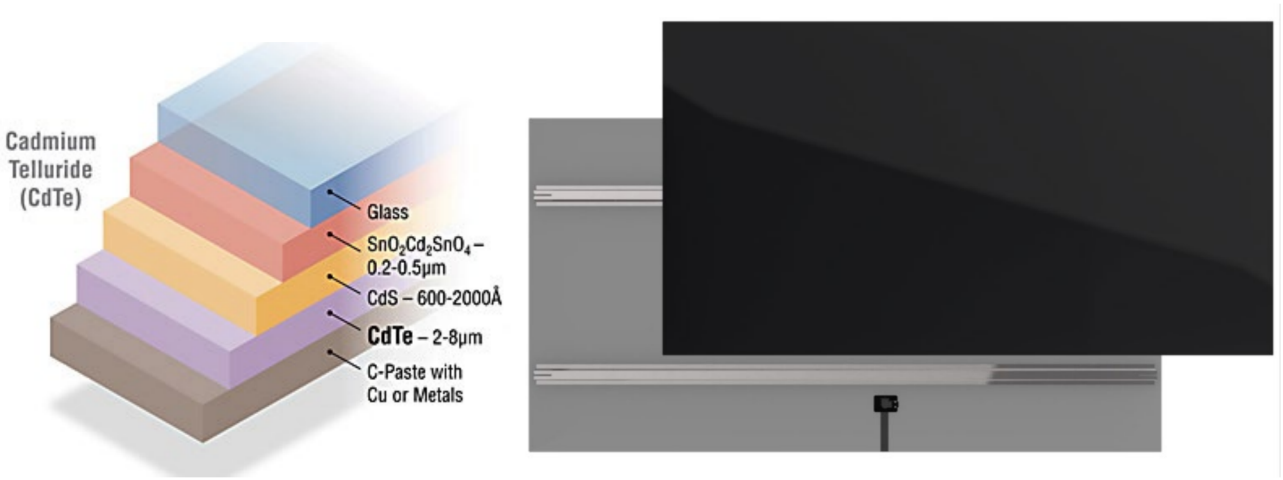

Figure 3. Contents of Cadmium Telluride Panels (Source: NREL); Front and Rear Photo of First Solar Series 7 CdTe Panels (Source: First Solar)

The leading alternative PV technology to silicon-based PV is Cadmium telluride (CdTe), which is by far the most common thin film PV technology. While Morven Solar will you silicon modules and will not use any CdTe modules, this assessment report is still providing a basic introduction to CdTe modules because it is not uncommon for stakeholders to have confusion about the differences in the two technologies. CdTe is referred to as thin film because the active layers are less than 1/10th the thickness of a human hair. Figure 3 above contains two images, on the left is a not-to-scale diagram of the layers for a CdTe PV module (thickness dimension provided in image), and the right image is a photo of two First Solar CdTe modules showing the back of one module and the front of another. The PV cells consist of an incredibly thin layer of cadmium telluride with an even thinner coating of cadmium sulfide (roughly 1/60th the thickness of the CdTe film). Above these active layers is a transparent conducting metal oxide, commonly tin oxide (SnO_2), and below the active layers is a layer of metal to conduct away the electricity. This thin stack is sandwiched between two sheets of heat-strengthened glass that provides electrical

[5] A detailed bill of materials for crystalline silicon PV modules is provided in Table 2 of the International Energy Agency (IEA) PVPS's report entitled: Life Cycle Inventories and Life Cycle Assessments of Photovoltaic Systems, December 2020 https://iea-pvps.org/wp-content/uploads/2020/12/IEA-PVPS-LCI-report-2020.pdf

[6] Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L., 2013, Geochemical and Mineralogical Data for Soils of the Conterminous United States: U.S. Geological Survey Data Series 801, 19 p., http://pubs.usgs.gov/ds/801/

[7] PV: 12 g of lead (per panel) per 65 ft^2 (panel footprint of 21.5 ft^2 / ground coverage ratio of 0.40) = 0.223 g of lead/ft^2
Soil: 15 mg of lead per kg of soil * 45 kg of soil per ft^3 * 4 inches (0.333 ft) soil depth * 65 ft^2 = 14.61 g of lead / 65 ft^2 = 0.225 g of lead/ft^2