

**Summary Report**  
**Environmental, Health, and Safety (EHS) Aspects of**  
**First Solar Cadmium Telluride (CdTe) Photovoltaic (PV) Systems**  
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Carried out under the authority of the French  
Ministry of Ecology, Energy, Sustainable Development, and the Sea

This review was carried out under the authority of the French Minister of Ecology, Energy, Sustainable Development, and the Sea, following the request of First Solar and EDF Energies Nouvelles with the aim of conducting an independent and complete evaluation of the environmental, health, and safety (EHS) aspects of First Solar's cadmium telluride (CdTe) photovoltaic (PV) systems. The review was designed to assess these aspects using life cycle analysis, taking into account manufacturing, product use, and end-of-life recycling and disposal of the systems. Five experts were selected from France's Centre National de la Recherche Scientifique (CNRS), the University of Utrecht, France's Institut National de l'Environnement Industriel et des Risques (INERIS), France's Commissariat à l'Énergie Atomique (CEA), and the European Commission Joint Research Centre. None of the experts has a direct interest in First Solar. The panelists are specialists in life cycle analysis, EHS practices and regulation, CdTe materials research, and photovoltaics. The review was led by Dr. Daniel Lincot of CNRS.

The expert panel based its assessment on the available third-party literature on CdTe and CdTe PV and internal First Solar documents. In addition, the experts conducted a visit of First Solar's manufacturing and recycling facilities in Germany and met with key plant staff and company management. This allowed in-depth analysis of key technical EHS aspects of the manufacturing, waste management, and recycling processes in place at First Solar.

This review follows up on a similar 2005 peer review, which was organized by the European Commission's Joint Research Centre (JRC) and moderated by the German Federal Ministry of Environment (BMU). The expert panel reviewed the findings of that review as well as updates and changes since that review took place.

The following are the panel's conclusions based on its full in-depth report:

- During standard operation of CdTe PV systems, there are no cadmium emissions – to air, to water, or to soil. In the exceptional case of accidental fires or broken panels, scientific

studies show that cadmium emissions remain negligible. Accordingly, large-scale deployment of CdTe PV can be considered safe to human health and the environment.

- The carbon footprint of First Solar's CdTe PV systems is the lowest among currently available PV technologies, and compares well with nuclear and wind technologies. CdTe PV can contribute decisively to the objective of a rapid reduction of CO<sub>2</sub> emissions in order to combat climate change.
- The energy payback time of First Solar's CdTe PV systems is less than one year, which is the shortest among all currently available PV technologies.
- Atmospheric life cycle emissions of cadmium from CdTe PV are very low; liquid waste emissions are well below regulations for wastewater effluents and progress continues to be made to reduce this level.
- First Solar's low cadmium emissions, small carbon footprint, and short energy payback time are primarily related to First Solar's state-of-the-art technology and commitment to continuously improving the competitiveness and environmental excellence of its CdTe PV technology.
- First Solar's pre-funded program for end-of-life panel collection and recycling, which uses best available technology, resolves concerns about cadmium recovery from spent panels.

With respect to First Solar's EHS aspects, the expert panel found that:

- No major concerns were identified during this review regarding EHS aspects of First Solar's manufacturing and recycling activities. Over the course of several years, First Solar has developed EHS policies and management systems, and has demonstrated continuous improvement in these areas at its facilities globally. First Solar ensures compliance with its EHS policies and regulatory requirements not only through internal practices, but also through periodic audits by third parties.
- First Solar has successfully obtained ISO 14001 certification of its environmental management systems for its plants in Germany and the United States, and is on track to obtain certification for its Malaysian facility by the end of 2009.
- First Solar has a true commitment to EHS risk prevention, taking a long-term perspective.
- First Solar takes a proactive risk assessment-based approach to EHS issues and promotes continuous improvements to further reduce risks.
- First Solar has implemented several important EHS management programs, including specific cadmium management programs.

- Data from First Solar’s Frankfurt (Oder) manufacturing facility on workplace and health monitoring, as well as on emissions to the environment, presented during the review show that First Solar’s emissions are low compared to legal, recommended, and internal limit values. In fact, they are in many cases more than one order of magnitude lower than the limit value.
- First Solar samples with high frequency the exposure of its employees to cadmium compounds (by both workplace air quality monitoring and medical monitoring). Over its entire ten-year monitoring history, the company and its third-party auditors have detected no evidence of cadmium exposure among its employees.

In conclusion, CdTe PV, as developed by First Solar, is the leading PV technology in terms of carbon footprint and energy payback time, and at the same time has the lowest manufacturing cost per watt of all PV technologies. During normal operation – as well as in the case of fire or broken panels – risks are negligible, and so the large-scale deployment of CdTe PV can be considered safe to human health and the environment. First Solar’s CdTe PV represents an important breakthrough in renewable energy technologies towards large-scale applications, contributes decisively to the much-needed acceleration of PV deployment, and has an excellent environmental profile. With respect to manufacturing operations, First Solar has policies, practices, and management systems in place to protect the health and safety of its workers. It also has policies, practices, and management systems in place to protect the environment where its manufacturing and recycling operations are located and continuously seeks further improvements.