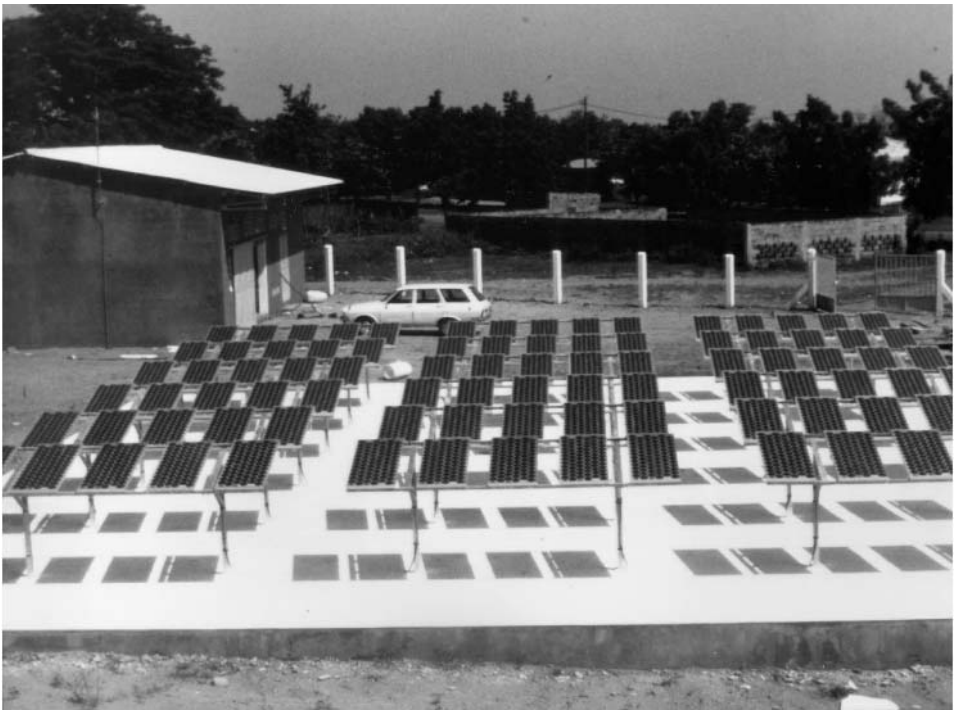

Figure 11.16 Albedo-collecting modules in a 10 kWp installation in the Senegalese village of Noto

Fraunhofer group is a one-axis tracing approach that achieves high concentration through the use of secondary optical elements [41]. The concept is shown in Figure 11.17.

11.3.9 History of Performance Improvements

The performance on concentrator cells and modules has steadily improved over time, as would be expected. Figure 11.18 presents the independently verified efficiency records from 1977 to 2001. Early silicon concentrator cells were basically 1-sun cells redesigned for high current by providing a fine, high metal coverage grid. The efficiency of this approach rapidly achieved 20% by 1982 [12]. The Swanson group at Stanford University introduced the back point-contact cell in 1984 with an efficiency of 22% [42]. The point-contact cell has maintained the efficiency record for silicon concentrator cells to the present. GaAs-based cells have always had superior performance to silicon. Varian introduced a 26% GaAs cell in 1980, and increased this to 29% in 1988. Unfortunately, it was eclipsed in 1988 by the first multijunction cell to set a record – a 31% mechanically stacked GaAs cell on a silicon bottom cell [43]. This result was eclipsed by a mechanically stacked GaAs on GaSb, which set a record that lasted until 2001. In 2000, Spectrolab announced a 32% monolithically stacked GaInP on GaAs cell [44]. They followed this up with a 34% result in 2001 (Spectrolab press release), finally outdoing the 1988 mechanically stacked record with a fully monolithic triple-junction cell.