the solution is also given by equation (4.53) and therefore, the limiting efficiency of a set of cells that is series-connected is also 86.8%.

4.5.2 Thermophotovoltaic Converters

Thermophotovoltaic (TPV) converters are devices in which a solar cell converts the radiation emitted by a heated body into electricity. This emitter may be heated, for example, by the ignition of a fuel. However, in our context, we are more interested in solar TPV converters in which the sun is the source of energy that heats an absorber at temperature T_r, which then emits radiation towards the PV converter. Figure 4.7 draws the ideal converter for this situation.

An interesting feature of the TPV converter is that the radiation emitted by the solar cells is sent back to the absorber assisting in keeping it hot. To make the cell area different from the radiator area (so far cells in this chapter have all been considered to be of area unity), the absorber in Figure 4.7 radiates into a reflecting cavity containing the cell. The reflective surfaces in the cavity and the mirrors in the concentrator are assumed to be free of light absorption.

In the ideal case [39], the radiator emits two bundles of rays, one of étendue H_{rc} (emitted by the right side of the absorber in the Figure 4.7a), which is sent to the cell after reflections in the cavity walls, with energy E_r' without losses, and another (unavoidable) one H_{rs}, with energy E_r, which is sent back to the sun (by the left face of the absorber) after suffering reflections in the left-side concentrator. Ideally, the radiator illuminates no other absorbing element or dark part of the sky: all the light emitted by the radiator's left side is sent back to the sun by the concentrator. Rays emitted by the radiator into the cavity may return to the radiator again without touching the cell, but since no energy is transferred, such rays are not taken into account.

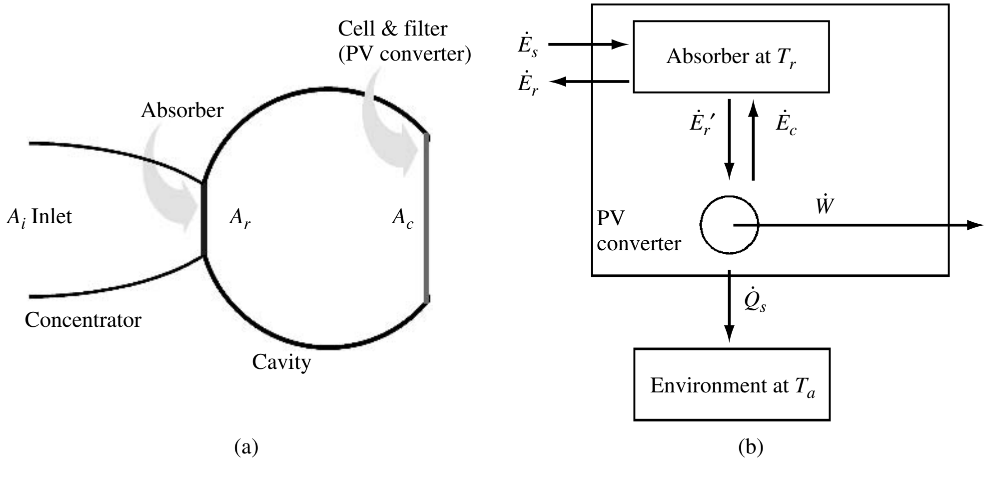

Figure 4.7 (a) Schematic of an ideal TPV converter with the elements inserted in loss-free reflecting cavities and (b) illustration of the thermodynamic fluxes involved. In the monochromatic case, $\dot{E}_s \equiv \dot{E}(T_s, 0, 0, \infty, H_{rs})$, $\dot{E}_r \equiv \dot{E}(T_r, 0, 0, \infty, H_{rs})$, $\dot{E}_r' \equiv \dot{e}(\varepsilon, T_r, 0, H_{rc})\Delta\varepsilon$, $\dot{E}_c \equiv \dot{e}(\varepsilon, T_a, qV, H_{rc})\Delta\varepsilon$