price. To reduce price, the industry has therefore selected its silicon raw material from various second-grade classifications of semiconductor silicon, being less expensive than prime-grade polysilicon. We may assume that this feedstock has cost the PV industry, on average, one-third of what prime-grade polysilicon would have cost. The present silicon feedstock for crystalline cells consists of the following factors.

1. *Rejects from crystal growth*: Crystal growth, particularly by the CZ method, generates significant amounts of unusable silicon as follows:
   - The head (or top) as well as the bottom (or tail) of the single crystal (also called *ingot* or *boule*). These sections are rejected because of size, defects in the crystalline structure and higher impurity levels.
   - Ingots from aborted runs, for example, because of electrical power failure during crystal pulling.
   - Ingots or ingot sections that fail to meet the specifications of crystal structure, electrical characteristics or carbon (C) and oxygen (O) content.
   - Crucible leavings or pot scrap.

As late as ten years ago, almost half of the polysilicon purchased for crystal growth was rejected for the above reasons. Crystal growth yields have improved and processing techniques have been developed to recycle the higher purity reject material into test or so-called *dummy* wafers. These improvements have reduced the quantity of feedstock available to the PV industry. Rejects from crystal growth, except for the pot scrap, *n*-type, and heavily doped *p*-type material, have been the ideal silicon feedstock for crystalline solar cells. Acceptable quality was available at reasonable prices. We estimate this source at 5 to 6% of all polysilicon shipped, that is, in 2000 approximately 1000 MT. Pot scrap is the remainder of the silicon melt in the quartz crucible after the CZ crystal growth is completed. After solidification, the crucible cracks and pieces of it adhere to the solidified silicon residue. Driven by the need to find new cost-effective sources, the PV industry has found ways to clean mechanically (sand blasting) and chemically (treatment by hydrofluoric acid) selected crucible residues. This has resulted in added quantities to the PV silicon feedstock. We estimated this source at 500 to 700 MT in 2000.

2. *Rejects from polysilicon*: Four to five percent of polysilicon produced is also rejected for quality reasons. These are
   - chunks and rods from aborted runs (failure under operation);
   - broken or imperfect seed rods;
   - "carbon ends," parts of the rod close to the electrical graphite contacts;
   - fines and small chips generated during processing of rods into chunk form;
   - "popcorn" or excessive dendritic growth with unacceptable surface texture that may occur under certain operative conditions;
   - small granules from the fluidised bed process;
   - rod sections that have been sawn or fabricated, so have unacceptable purity.

At 5% of polysilicon produced this amounts to another 1000 MT in 2000.