To make the process cost effective, the economics of both the production of the volatile silicon compound and its decomposition or reduction to elemental silicon had to be reviewed. Compared to the historical processes, the research projects did not discover radically new silicon compounds. Silicon halides $SiX_{4-n}H_n$ could apparently not be avoided. However, innovative methods were discovered to produce these silicon compounds. Metallurgical grade silicon remained in most cases the starting point, but silicon fluoride, obtained as co-products from phosphates leaching (fertilisers) and direct chlorination of natural silica to produce tetrachlorosilane, were envisaged as serious challenges. The research abandoned completely the concept of heated filament or seed rod that was clearly perceived as too expensive. Texas Instruments had demonstrated the benefit of the fluidised bed technology, that is,

- larger throughput
- lower energy consumption
- continuous operation
- lower capital expenditure.

Although the quality was not acceptable for making microelectronics devices, this was not a drawback for the development of the solar cell market.

In addition to the fluidised bed, free space reactor implying spontaneous seedless formation of solid silicon particles through homogeneous decomposition of silane has also been envisaged among others by Union Carbide [38].

None of these projects have resulted yet in establishing a new polysilicon route devoted to solar cells and decoupled from the electronic feedstock. The research has to a large extent developed and strengthened the classical polysilicon business by developing new products and processes to produce semiconductor grade silicon (Union Carbide, Ethyl Corporation). However, it is believed that for quality reasons, a significant portion of the Ethyl Corporation process production is still to find outlet in the solar market, making this product to some extent a prime solar grade polysilicon.

The other polysilicon producers have declared that by relaxing the production procedures and quality control they could, when excess capacity is available, produce specifically a solar grade polysilicon at reduced cost. It seems reasonable to expect a price reduction of approximately 35%. The same producers have underlined that specific investments to produce solar grade silicon by this route should not be expected because of too low profitability [80, 81].

At the time of writing, three projects aimed at developing a solar polysilicon route were in the process of being developed:

1. The German chemical company Bayer AG has for several years re-explored the decomposition of silane in fluidised bed reactor. The method combines the cost-effective synthesis of silane as in the Union Carbide process and the fluidised bed reactor as in the Ethyl Corporation process. The company has published the results of its basic assumption and made positive announcements [82–84]. Meantime, Bayer AG has withdrawn from the solar wafer business, which was the main driver for this feedstock development. To date it is therefore uncertain what the future of this project will be.