Description

- Tenements
- JORC Report

Background to HPQ

The term High Purity Quartz, also known as HPQ, is reserved for quartz material that satisfies exacting quality requirements for use in several critical applications in the solar photovoltaic, semiconductor, optical fibre, specialist glassware and optics industries. HPQ feedstock (HPQF) deposits can be defined as naturally occurring quartz in economically viable quantities that are amenable to beneficiation and purification to meet those quality requirements. The main quality determinants include a very low level of impurities, an application-dependent particle size distribution, and melting behaviour that are acceptable for downstream manufacturers. However, and most importantly, commercially the term HPQ is reserved for processed quartz material that satisfies those exacting standards. None of the products mentioned above can be manufactured without a reliable supply of consistent quality HPQ and HPQF. The rapidly growing solar PV market is predicted to require significant new sources of supply over at least the remainder of this decade.

HPQ Global Supply Chain

The HPQ Global Supply Chain comprises the following components:

- Miners who supply the HPQ feedstock (HPQF), commonly after some basic crushing, screening and washing. Greentech intends to participate in this part of the

supply chain for at least the next two years. It will also investigate the feasibility of building a processing plant to enable it to participate in the next step and become a processor.

- Processors who purchase feedstock from miners and apply multistage purification processes to deliver HPQ at greater than 99.99% SiO_2 concentration to fabricators.
- Fabricators who produce a range of end-products, mainly for the semi-conductor, PV solar panel and specialist glassware industries. Most of the processed HPQ by volume and by value is fabricated into silica crucibles used to grow extremely pure silicon metal crystals and ingots for cutting into the silicon wafers that are the critical components of semi-conductors and photovoltaic cells.

Approximately 70% of the global HPQ supply market is controlled by two companies, Sibelco and QuartzCo, who mine feedstock from their own mines at either end of a single alaskite pegmatite at Spruce Pine, North Carolina in the United States. Both these companies have their own processing facilities and produce a range of very high-purity quartz sand and powder grades to fabricators, but do not undertake fabrication themselves. The balance of the HPQ industry comprises processors and processor-fabricators in Asia, Europe, Russia and Canada. The largest of these is Pacific Quartz in China, which purchases all its feedstock from small miners and produces processed HPQ products as well as undertaking some fabrication of end-products. Pacific Quartz has tested some Greentech HPQF, and the companies had a preliminary offtake agreement which has lapsed (Refer to Section 4.3 for more information).

Greentech has discovered, assayed and had preliminary processing undertaken that indicates that it has the potential to deliver significant quantities of HPQ feedstock into the global HPQ processing market. As the geopolitical landscape

changes, additional potential suppliers to this market sector become more critical. Greentech intends to commence operations by mining and undertaking basic physical processing (e.g., crushing, comminution, sorting and/or leaching) of HPQ feedstock (HPQF).

HPQ Specifications and Prices

There is no globally accepted High Purity Quartz (HPQ) specification. However, Sibelco markets its range of products under the brand name IOTA. IOTA categories are defined based on grade, application, purity, and individual elemental contaminations, and several HPQ classifications for benchmarking purposes are used internationally. A common categorization method is to use SiO_2 content as a measure of HPQ quality as follows (Exawatt and ANZAPLAN, 2021).

- Low-grade HPQ is generally considered to be material of purity greater than 99.995% (or 50 ppm of impurities);
- Medium-grade material starting at 99.997% (30 ppm) impurities; and
- High-grade HPQ starting at 99.999% (10 ppm) after full processing.

IOTA has set a high purity benchmark for the rest of the HPQ market. It contains 20 ppm per million or less as a standard, equating to >99.998% of SiO2. The IOTA brand is the industry standard for high-quality fused quartz products. Its highest-quality grade used in significant volumes, IOTA6, is a chlorinated product that commands the highest prices of all HPQ types and is required for semiconductor crucibles, quartz glassware and optical fiber cladding. Sibelco’s higher-grade HPQ products such as IOTA8 are only produced in limited quantities.

The table below has been compiled by Greentech from third-

party sources, Exawatt and ANZAPLAN, 2021.

HPQ SAND	HPQ sand is high purity quartz silica with at least 99.99% (<100 ppm impurities). This sand is used in high purity epoxy fillers, ceramics, specialty glass and moulding compounds. Pricing is US$1,000 to US$2,000 per tonne.
GRADE I	Grade I HPQ includes high purity quartz having SiO_2 concentration >99.99% but <99.995% (50 to 100 ppm impurities. HPQ considered in the scope of Grade I is equivalent to the IOTA basic standard. Some of the common applications of Grade I HPQ include halogen and mercury lamps, optical glass, and custom production applications such as fused quartz tubing and ingots. Pricing is ~ US$4,000 to US$6,000 per tonne.
GRADE II	Grade II HPQ includes high purity quartz having SiO_2 concentration >99.995% but <99.998%. HPQ considered in the scope of Grade II is equivalent to IOTA 4 and 5 standards. Some of the common applications of Grade II HPQ are monocrystalline crucibles for solar applications, high-quality fused glass, tubing, and quartz-ware. Pricing is ~ US$6,000 to US$9,000 per tonne.
GRADE III	Grade III HPQ includes high purity quartz having SiO_2 concentration ≥99.998%. HPQ considered in the scope of Grade III is equivalent to the IOTA 8 standard. Some of the common applications of Grade III HPQ are semiconductor grade crucibles and high-end solar and semiconductor applications. Pricing is ~ US$8,000 to US$12,000 per tonne.

Please note that the above table is a guide only and illustrative of what prices the buyers of the Company's HPQF product may achieve once HPQF has been significantly processed. The Company cannot produce these products at present because it does not have the relevant beneficiation and purification assets.

The naturally occurring feedstock (HPQF) must be quartz of a sufficient grade and an amenable impurity profile to enable cost-effective upgrading to an IOTA or similar standard of specifications. Deposits of quartz that meet these specifications are very rare. The processing required to produce a particular HPQ grade depends on the amount and type of impurities present. It may include crushing, screening, flotation, acid washes, magnetic separation, and/or other physical, chemical, and thermal techniques.