

Due Diligence and Valuation Report

Arrowhead Code: 41-01-27
 Coverage initiated: March 28, 2017
 This document: December 21, 2023
 Fair share value bracket: CAD 4.4 to CAD 5.2
 Share price (December 21, 2023): CAD 3.60ⁱ

Analyst Team

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Market Data

52-Week Range: CAD 2.48 – CAD 3.99ⁱⁱ
 Average Daily Volume (3M): 185,750ⁱⁱⁱ
 Market Cap (December 21, 2023): CAD 319.3 million (mn)^{iv}

Financial Forecast (FY ending - December)

USD	FY23E	FY24E	FY25E	FY26E
NI High – 000s	18,329	21,416	26,338	31,376
EPS – High	0.21	0.24	0.30	0.35
NI Low – 000s	14,370	16,838	22,000	26,220
EPS – Low	0.16	0.19	0.25	0.30

Company Overview: 5N Plus Inc. (“5N Plus”, “the company”) is a leading global producer of engineered materials and specialty chemical products, fully integrated with closed-loop recycling facilities. It is headquartered in Quebec, Canada, and operates through manufacturing facilities and sales offices in several locations in Europe, North and South America, and Asia. The company is listed on the Toronto Stock Exchange (TSX) under the stock symbol “VNP.”

Q3 2023 Results: VNP reported a revenue of USD 62.9 mn in Q3 2023, a decline of c. 5.1% on a Year-on-Year (YoY) basis. The Specialty Semiconductors segment generated a revenue of USD 41.8 mn, an increase of 30.6% YoY, driven by strong demand. However, the Performance Materials witnessed a drop in its revenue to USD 21.2 mn, a fall of c. 38.4% YoY, owing to the company’s exit from the low-margin extractive and catalytic products market in H2 2022. The adjusted gross profit stood at USD 15.7 mn, a fall of c.3.1% YoY, with the adjusted gross profit margin increasing slightly to 24.9% as compared with 24.3% in Q3 2022. The adjusted EBITDA for the period rose to USD 9.6 mn, up 5.5% YoY, while the adjusted EBITDA margin went up to 15.3% from 13.7% in Q3 2022. The company reported a net profit of c. USD 1.5 mn for Q3 2023, compared with a net loss of USD 7 mn YoY. The company’s net debt stood at USD 78.6 mn at the end of Q3 2023, compared with a net debt of USD 78.3 mn at the end of FY 2022.



Company: 5N Plus Incorporation
 Ticker: TSX: VNP
 Headquarters: Quebec, Canada
 Chairman: Luc Bertrand
 CEO: Gervais Jacques
 CFO: Richard Perron
 Website: www.5nplus.com

Key Highlights: **(1)** 5N maintains its guidance to achieve an adjusted EBITDA of USD 35 – 40 mn in FY 2023 and USD 45 – 50 mn in FY 2024; **(2)** 5N will continue to benefit from strong demand in high-growth industry sectors, such as space solar power and terrestrial renewable energy under Specialty Semiconductors, which is evident from its strong order backlog and active pipeline of future business opportunities; **(3)** The company foresees growth potential from critical sectors such as health and pharmaceuticals under its Performance Materials segment; **(4)** VNP, through its wholly owned subsidiary, AZUR SPACE Solar Power, has supplied triple junction solar cells to RayGen’s proprietary solar technology. These cells allow RayGen to provide energy on a large scale, consistently and on short notice, with minimal environmental impact; **(5)** VNP has uniquely positioned itself to play a significant part in the new Photon Counting Detectors technology for CT scan, and continues to explore other potential market opportunities for its specialty semiconductor products especially in defense and security sectors; **(6)** Through its subsidiary AZUR, 5N Plus announced a 10-year partnership with Sierra Space, with USD 10.0 mn and USD 20.0 mn of incremental revenue contribution in FY 2023 and FY 2024 respectively; **(7)** The ongoing capacity expansion program is progressing well and as per plan. 5N is in the advanced stages of securing additional complex feeds and secondary streams for the recovery of critical minerals for its Montreal plant; **(8)** 5N’s solar cell technology, developed by AZUR, has been deployed in the latest lunar exploration mission conducted by ISRO, known as Chandrayaan-3.

Risks: Strategy risk, international exposure risk, environmental and regulatory risks, competition, and commodity price risk.

Valuation and Assumptions: Based on due diligence and valuation estimates, Arrowhead believes that 5N Plus fair share value lies in the CAD 4.4 to CAD 5.2 bracket, using a Discounted Cash Flow (DCF) model.

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Investment Thesis

Arrowhead is updating its coverage on 5N Plus (VNP) with a fair value of CAD 4.4 per share in the low bracket scenario and CAD 5.2 per share in the high bracket scenario, using a DCF methodology.

Headquartered in Montréal, Québec, 5N Plus is a TSX listed company who is a leading global producer of specialty semiconductors and performance materials. The company deploys a broad range of proprietary and proven technologies to manufacture products which are used in several advanced pharmaceuticals, electronic and industrial applications.

A critical semiconductor value chain poised for growth

5N Plus is a vertically integrated specialty semiconductor company. The company is already a strategic partner and critical materials supplier to many of its key customers in this sector. With recent acquisition of AZUR, who is the leader in manufacturing of multi-junction solar cells for space and terrestrial photovoltaic applications, will provide the company with a highly competitive specialty semiconductor value chain and meaningfully expands the company's product portfolio in large and expanding target markets. The acquisition will deepen the value chain from procurement and closed-loop management of critical materials to finished epitaxy engineered substrates (estimated TAM of USD 200 mn by 2025). The acquisition will allow the company to expand to gain market share in Europe with AZUR Space being the leading manufacturer of space solar cells. Recently, the company, through its wholly-owned subsidiary AZUR, signed a 10-year extension of its exclusive teaming arrangement with Sierra Space, for the production of a new solar cell, referred to as the MWT. The incremental revenue contribution from Sierra Space to AZUR is expected to reach c. USD 10.0 mn in FY 2023 and over USD 20.0 mn in FY 2024.

A comprehensive portfolio of performance materials

A substantial proportion of revenue in FY 2021 was supported by strong demand in the performance materials segment, which brings together the activities in the health and pharmaceutical, and industrial applications. The company is the leading global supplier of bismuth-based active pharmaceutical products, the company has been benefited from strong demand for active pharmaceutical ingredients and health compounds. The strategic way of expansion into this market and satisfy customer demand has been driven due to the process technology investments made by the company. This led to improvement of efficiency and flexibility of the operations as well as the quality and consistency of the products. Recently, the company also entered into a strategic agreement with Microbion, to supply bismuth-based active APIs for its new class of antibiotic and antibiofilm drug products. As per the terms of the agreement, 5N Plus acquired an equity stake in Microbion, a clinical stage pharmaceutical company. The total addressable market for the antibiotic and antibiofilm drug products being developed is c. USD 1-3 bn in the US, with APIs constituting up to 5% of the value.

A clear focus on growth to drive enormous opportunity

The company over the past several years, has worked diligently to reposition its business towards higher value-added activities and towards large and expanding markets where the AZUR acquisition is a case in point. In 2022, the company completed its integration of AZUR and is looking to continue its growth momentum by investing in developing and marketing Wide Band Gap Materials, including Gallium Nitride (GaN), which represents a multi-billion-dollar market in High Power Electronics and Communications (RF) applications. Additionally, it will focus on reassessing its legacy businesses to consider their long-term compatibility with the strategy. 5N Plus is looking continuously to drive organic growth in the fields of leadership while also seizing external opportunities to accelerate growth in the target markets.

Partnerships & divestments will be paying dividends in the long term

The company recently announced a partnership with Rio Tinto for the Supply of Tellurium. This strategic commercial agreement with global mining group Rio Tinto to refine the tellurium in two of its facility i.e., Montreal and St. George, to serve clients in renewable energy, security, and medical imaging markets. A new supply source of tellurium will help the company to manufacture solar panels and other high-tech equipment in addition to primary copper production. This will allow the company to accelerate semiconductor development and manufacturing activities in North America and to further leverage company's globally

recognized expertise in the transformation of mining and metallurgical by-products into high purity value-added critical minerals.

Moreover, the company discontinued its production at its manufacturing facility in Tilly, Belgium and proceed with the site's closure. The decision was majorly triggered due to lack of earnings or margin improvements on the lead-based products it manufactures coupled with significant additional capital required to maintain daily operations, thereby making it no longer economically viable or compatible with the company's long-term strategy. The decision was taken despite several optimization measures and investments made over the years to improve the site's competitiveness. As a result, the company expects that the divesture may provide incremental adjusted EBITDA contribution to consolidated results and support more favorable net working capital levels.

Strong emphasis on profitability

Amidst the COVID-19 pandemic, the company worked towards its new strategic direction. The new strategy has a strong emphasis on simplifying business operations, doing away with lower-margin legacy businesses and increasing the target addressable market (TAM). In line with it, the company seeks to augment the company's existing TAM, build on its leading position in the existing markets and deliver returns beyond the company's cost of capital. Additionally, it is looking to focus on optimizing its asset base with an emphasis on economies of scale and the development of supportive ecosystems.

Certain risks could impede VNP's growth plans through

International trade regulations may impede growth in the short term

The company does business in several countries from various locations, due to which it may face risks associated with changes in international trade regulations and policies. Some of these risks include barriers to or restrictions on free trade, changes in taxes, tariffs, and other regulatory costs. Although the company operates primarily in countries with proximity to its clients and suppliers and with stable economic and political climates, it is not a certainty that its business will not be adversely affected by the risks inherent to the changing international political landscape and its impact on global trade.

Business interruption could lead to short-term impact

The company has contractual obligations to deliver products in a timely manner. These contracts are generally long-term in nature. Any disruption in activities leading to a business interruption might impede growth in the short term.

Increasing competition may result in revenue and margin headwinds

5N Plus is a leading producer of specialty metal and chemical products and has a limited number of competitors. A few of its competitors are as fully integrated as the company is and offer a similar range of products. As a result, the company has to provide differentiated products. However, new competitors may emerge in the future. Greater competition could have an adverse effect on revenues and operating margins.

Investment thesis conclusion

We think 5N Plus (VNP) has a huge opportunity for growth through both organic and inorganic means. The company expects to enable critical industries through essential products based on advanced material technology. It expects to propel the growth of these markets by developing and manufacturing advanced materials to enable product performance. The company's strategy of focusing on the right end markets with high-value-added products and partnerships across segments, investments and commercial initiatives is proving beneficial for the company in the context of high inflation and complex global market dynamics. However, certain impediments in terms of international trade restrictions, business interruption, and increased competition could pose a threat to the company's growth.

Business Overview

Listed on the TSX, 5N Plus is a leading global producer of specialty semiconductors and performance materials with strategically located facilities around the world. Headquartered in Montreal, Canada, the company has multiple facilities located in North America, Europe and Asia. 5N Plus operates research and development (R&D), manufacturing and commercial centers in strategically located facilities around the world, including Europe, North America and Asia.

Apart from being a trusted supplier, the company strives to be a trusted business partner by:

- Deploying proprietary and proven technologies to meet the customer-specific demand
- Securing long-term sourcing contracts with producers, thereby increasing customer dependency
- Offering value-added services such as cradle-to-cradle recycling and R&D partnerships

The Company's products find application in several key industries, including renewable energy, security, space, pharmaceutical, medical imaging and industrial and additive manufacturing.

Assets and Projects

5N Plus is a leading global producer of engineered materials and specialty chemicals with integrated recycling and refining assets to manage the sustainability of its business model. The company is headquartered in Montreal, Québec, Canada and operates R&D, manufacturing, and commercial centers in several locations in Europe, the Americas and Asia. 5N Plus deploys a range of proprietary and proven technologies to produce products which are used as enabling precursors by its customers in several advanced electronics, optoelectronics, pharmaceutical, health, renewable energy, and industrial applications. Many of the materials produced by 5N Plus are critical for the functionality and performance of the products and systems produced by its customers, many of whom are leaders within their industry.

The company is an integrated supplier having both primary and secondary refining capabilities. Its forte in primary refining allows it to treat very low-grade metal concentrates and extract and refine the required metals so as to be fed to their secondary refining operations to attain the highest level of purity. Once purified, metals can be sold to customers in the form of pure metals, alloys, or chemicals. As the company excels in extensive refining functions, leading them to go from one end of the purity spectrum to the other and manufacture chemicals and alloys, and this drives them to consider themselves a supplier with integrated refining capabilities. Furthermore, their primary refining proficiencies enable them to treat complex feeds and very low-grade concentrates containing minor amounts of the metals of interest, playing a vital role in the recycling of the specialty metals that they produce.

Purification and manufacturing activities are carried out using a variety of metallurgical and chemical processes. Their raw materials or "feedstock" are in the form of concentrates or recyclable materials containing the metals of interest. Given the nature of their activities and the metals that we purify, they operate under and comply with stringent environmental, health and safety conditions. Several operations of the company are either certified (ISO 9001, ISO 14001, ISO 50001, and OHSAS 18001) or have approval from the FDA or have GMP requirements, reinforcing the commitment to best practices in terms of operations, quality, health, and safety.

Businesses Model

From the extraction of critical metals to the manufacturing of ultra-pure materials, the operational scope and technical expertise of 5N Plus is deep. The business model enables the company to transform refined and commercial-grade metals into value-added materials used in a broad range of applications essential to life.

For the past several years, the company has been offering its products and services through:

- Upstream businesses
- Downstream businesses

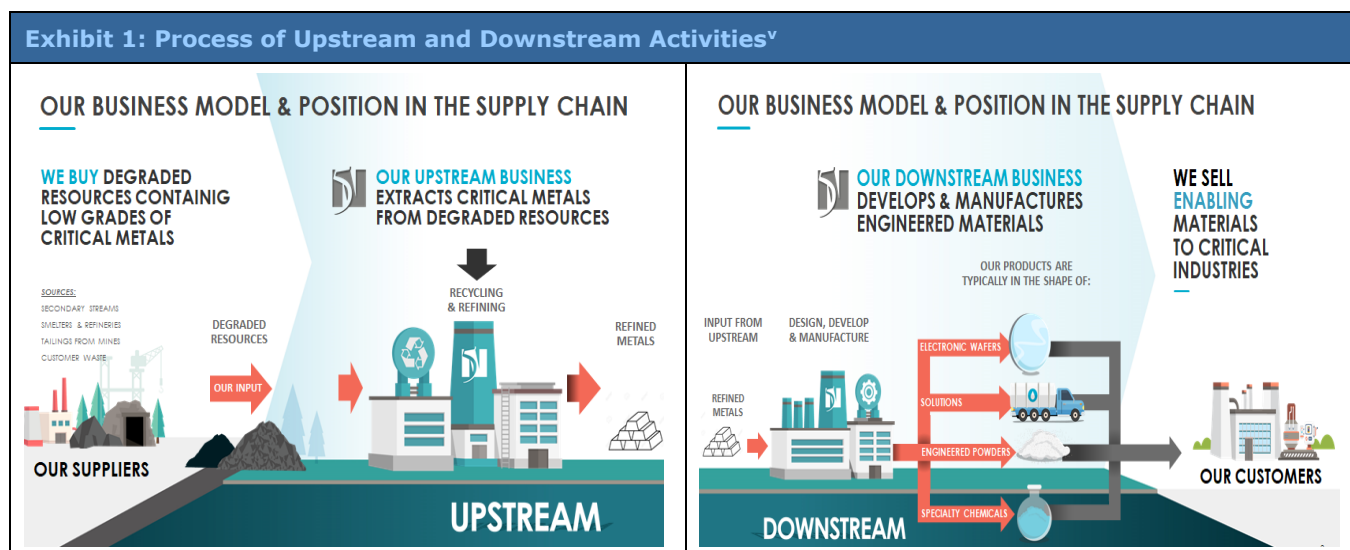
The upstream activities of the company are referred to as the acquisition of specialty metals used in its products and services. However, this can be the purchase of required metals from the market or the

acquisition of complex feeds, by-products, industrial waste, etc. Once these streams are procured, the next step is to process technology along with recycling & refining assets which are used to extract necessary metals utilized in the downstream businesses. The company does not have any plans to migrate to mining-related activities and it will continue to work closely with current and future suppliers to develop their upstream goals.

In the Downstream portion of the business, the company utilizes upstream valorized metal as a consumable to produce various materials for a whole host of industries. The aim is to grow value-added activities and move further downstream.

In this bimodal approach, upstream business benefits from higher metal prices and downstream business benefits from lower metal prices; together these enable growth of earnings while reducing earnings volatility. With this model, the company should be able to generate market competitive returns independent of metal prices.

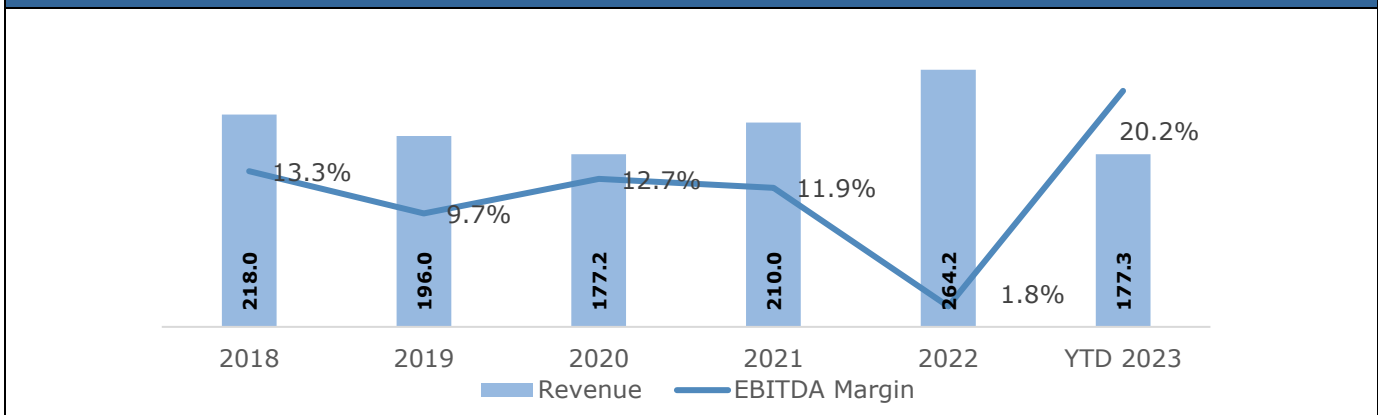
The company embraces technologically complex sectors which enable pricing power – it believes complexity can serve as an entry barrier. 5N Plus aims at the utilization of process technologies to enable higher effectiveness in the procurement of various metals from complex residues at reasonable terms. The company expects contribution from its recycling & refinery activities to remain muted given the low metal notations. Additionally, 5N Plus calls for further migration downstream and the use of product technology as an enabler and a differentiator to take care of more value-added market requirements, which usually promise better margins. Over time, 5N Plus expects the metal to account for a smaller percentage of the cost of goods sold (COGS).



5N Plus has continued to make progress towards its strategic initiatives and has positioned its business segments with emphasis on higher value-added downstream markets and further expansion into upstream activities. The company has been consistently transforming its production by moving towards engineered products and high purity metals, thus, moving towards value addition and therefore, margin expansions.

In Q3 2023, the company generated revenue of USD 62.9 mn, a decrease from USD 66.4 mn in Q3 2022. The adjusted EBITDA for the period stood at USD 9.6 mn, marking a 5.5% YoY increase from the USD 9.1 mn reported in Q3 2022. VNP's YTD revenue stood at USD 177.3 mn, compared with USD 203.2 mn for the corresponding period in 2022. YTD Adjusted EBITDA increased to USD 29.3 mn, compared with USD 23.3 mn YoY, with adjusted EBITDA margin increasing to 16.5%, compared with 11.5% YoY.

Exhibit 2: Trend of Revenue (USD mn) and EBITDA Margin (%)^{vi}



The company operates through two reportable segments, namely:

- Specialty Semiconductors
- Performance Materials

Specialty Semiconductors

The Specialty Semiconductors segment manufactures and sells products used in several applications such as renewable energy, space satellites and imaging. The products of this segment are sold either as semiconductor compounds, semiconductor wafers, ultra-high-purity metals, epitaxial semiconductor substrates and solar cells. This segment operates in North America and Europe and is similar to the former Electronic Materials segment. With the recent acquisition of AZUR, all the products and operations have been integrated in this segment.

Products manufactured in this segment are associated with the following metals:

- Cadmium
- Gallium
- Germanium
- Indium
- Tellurium

These are sold either in elemental or alloyed form as well as in the form of chemicals and compounds. The end user markets include photovoltaics (terrestrial and spatial solar energy), medical imaging, infrared imaging, optoelectronics and advanced electronics. In Q3 2023, the revenue from Specialty Semiconductors amounted to USD 41.8 mn, representing a 30.6% YoY increase from the USD 32.0 mn recorded in Q3 2022.

Supply of raw materials

Key raw materials include specialty metal concentrates which are procured from many non-ferrous metal suppliers with whom the company has had long-term commercial relationships.

Cadmium and indium are by-products of zinc refining and are purchased from zinc producers in various forms. Gallium is typically purchased in metal form from various producers. Germanium, a by-product of zinc or coal, is typically procured in the form of concentrates or in metallic form. Tellurium is a by-product of copper, zinc or gold refining. It is procured from several sources worldwide. Upstream capabilities enable the company to valorize metal from complex concentrates in addition to outright purchase of metal from metal markets.

Competition

The company has a limited number of competitors, a few of which are fully integrated or have a similar range of products and capabilities. As a result of which, they are not in a position to provide the same comprehensive set of services and products as provided by 5N plus. The main competitors include Umicore in Belgium, IQE plc in the United Kingdom and Vital Chemicals Co., Ltd. in China. As for AZUR, apart from some limited local capabilities in Russia, China and Japan, the main competitors are Spectrolab and SolAero Technologies Inc., which are located in the US.

Performance Materials

The Performance Materials segment manufactures and sells products that have pharmaceutical and healthcare, industrial and catalytic and extractive applications. These products are sold as active pharmaceutical ingredients, animal feed additives, specialized chemicals, commercial-grade metals, alloys, and engineered powders. The company has regrouped all commercial-grade metal and engineered powder under the Performance Materials segment. This segment operates in North America, Europe, and Asia and is similar to the former Eco-Friendly Materials segment. The Performance Materials segment is strongly associated with bismuth. Bismuth is one of the very few heavy metals which have no detrimental effect on either human health or the environment. As a result, bismuth is being increasingly used in a number of applications as a replacement for more harmful metals and chemicals. In Q3 2023, the revenue from the segment amounted to USD 21.2 mn, representing a 38.2% YoY decline from the USD 34.3 mn recorded in Q3 2022.

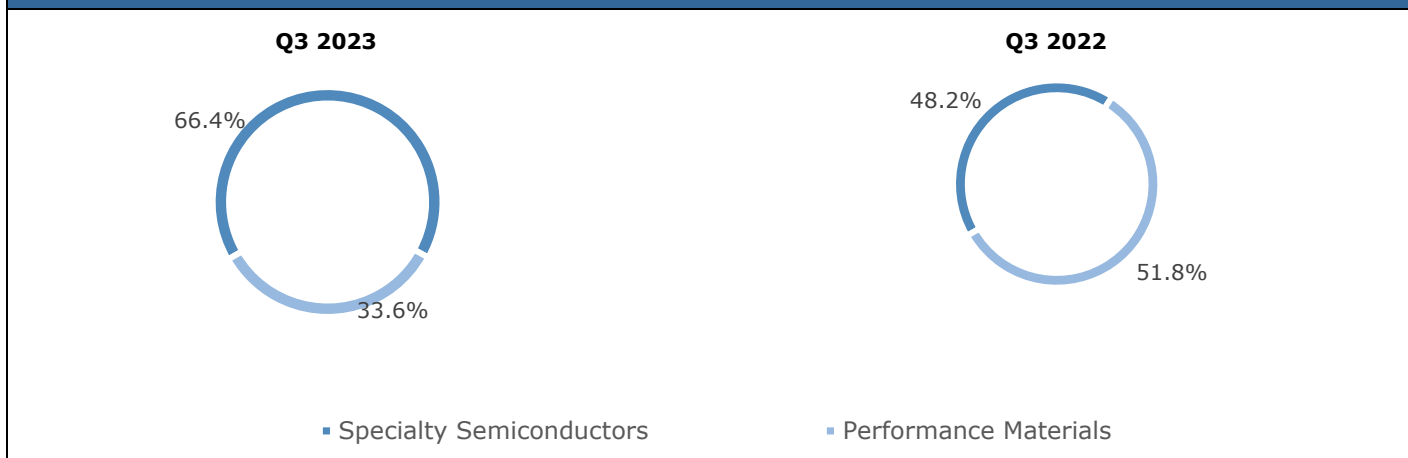
Supply of raw materials

Key raw materials used in the Performance Materials segment primarily include bismuth and feedstocks. Bismuth is often associated with lead, tin and tungsten and recovered as a by-product. The company is a sizeable refiner of bismuth and deals with most producers of primary bismuth worldwide. Another metal, Tin, is purchased in metal form from various producers.

Competition

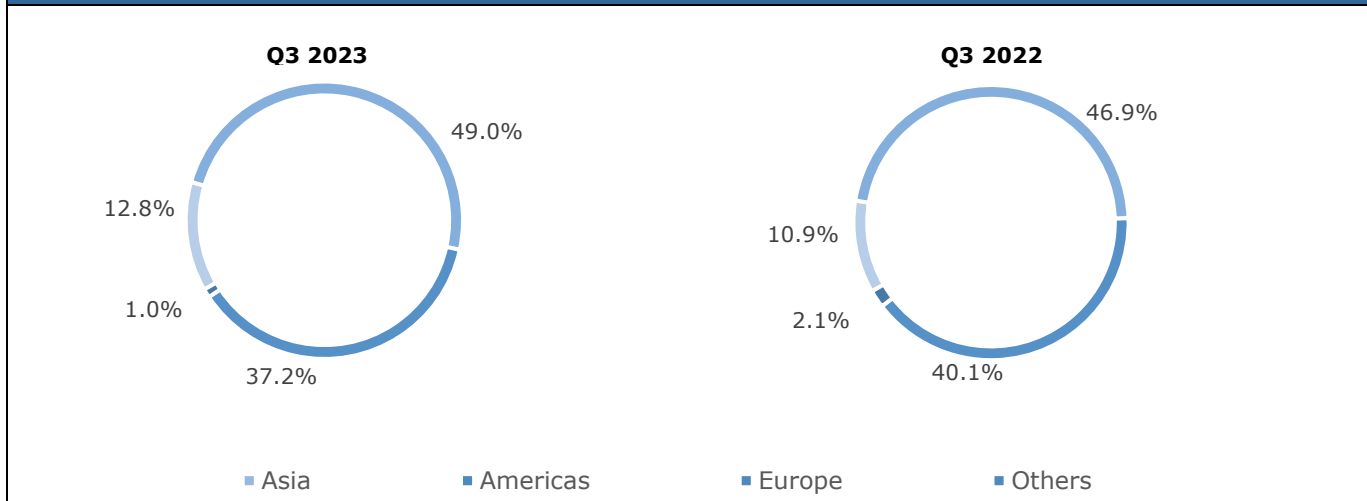
The company has a notable presence and a breadth of services and products which is unique in the bismuth market. The company expects the competitive landscape to change as the bismuth market continues to develop and attract more interest. The company believes the ability to leverage both the sourcing of the raw material and value proposition in end products will enable it to continue to compete effectively and minimize volatility in the earnings. However, the company expects that certain Asian competitors could gain limited market share in the low-value-added segments of the market (commodity products) where pricing is the key decision driver for the end-users.

Exhibit 3: Revenue Contribution by Segments^{vii}



The Specialty Semiconductors and Performance Materials divisions operate in the US, China, Japan, Germany, France, UK, and a few other countries, with none of the countries contributing more than 50% to the total revenues.

Exhibit 4: Revenue Mix by Geography^{viii}



Products Offerings and Market Scenario^{ix}

Specialty Semiconductors Segment

Cadmium is primarily used in renewable energy applications and in industrial materials. It is extensively used in association with tellurium and sold by 5N Plus in the form of cadmium telluride (CdTe) for solar modules and in security, sensing and imaging applications.

Gallium is extensively used in electronic applications. Gallium arsenide (GaAs) is the semiconductor for wireless devices and high-frequency electronics, whereas gallium nitride (GaN) is often preferred for light-emitting diodes (LED) and display applications. It is now an emerging material of choice for high-power electronics and radio frequency applications, referred to as wide-band gap materials. In addition, 5N plus uses gallium internally in the manufacturing of epitaxial layer products. The company sells gallium as a high-purity metal.

Germanium has unique properties for aerospace applications. It is being used as a substrate for high-performance solar cells. The company produces germanium semiconductor materials and engineered substrates and solar cells for solar arrays utilized in the space industry.

Indium is used primarily in display applications in the form of indium tin oxide (ITO), a technical material used to manufacture flat panel displays. The company sells indium in the form of pure metal. It also sells engineered substrates and semiconductor materials containing indium as a critical component in infrared sensing and imaging applications.

Tellurium is used in renewable energy, security, sensing and imaging applications. The company has an active presence in all the market segments, selling CdTe to solar cell manufacturers, engineered materials for imaging and sensing applications, metal to thermoelectric device producers, and tellurium metal and alloys for metallurgical applications.

Exhibit 5: Specialty Semiconductor Segment Product offerings^x

Particulars	Cadmium and Cadmium chemicals	Gallium	Germanium	Indium and indium alloys	Tellurium, tellurium chemicals and tellurium alloys

Description	Cadmium is a shiny, bright white metal with bluish reflections discovered in 1817. Present in most zinc ores, Cadmium is obtained as a by-product of zinc refining. A significant percentage of world cadmium production comes from recycled materials.	Gallium is a silvery metal with a shiny surface, discovered first in 1875. It is recovered as a by-product during alumina production. Gallium is one of the few metals that melt just above room temperature.	Germanium is a lustrous, hard-brittle, grayish-white metalloid in the carbon group, chemically similar to silicon & tin. Pure germanium is a semiconductor with an appearance similar to elemental silicon. Like silicon, germanium naturally reacts and forms complexes with oxygen in nature.	A rare metal extracted from zinc ores, indium is a silvery, lustrous gray metal discovered in 1863 by the German chemists Hieronimus Theodor Richter and Ferdinand Reich.	Tellurium was discovered in 1782 by Austrian chemist Franz Joseph Muller von Reichenstein. Despite its metallic appearance, it is a semi-metal or metalloid, extracted primarily from residues produced by copper and lead refining.
Products	<ul style="list-style-type: none"> • Cadmium Telluride • Cadmium Zinc Telluride 	<ul style="list-style-type: none"> • Gallium Metal • Gallium Antimonide • Gallium Nitrate • Gallium Oxide • Gallium Trichloride 	<ul style="list-style-type: none"> • Germanium wafers 	<ul style="list-style-type: none"> • Indium Metal • Indium Antimonide • Indium Nitrate • Indium Oxide • Indium Sulphate • Indium Trichloride 	<ul style="list-style-type: none"> • Tellurium Metal • Tellurium Dioxide • Cadmium Telluride • Cadmium Zinc Telluride • Zinc Telluride
Applications	<ul style="list-style-type: none"> • Renewable Energy • Security • Sensing and imaging • Industrial materials 	<ul style="list-style-type: none"> • LED lights • Flat panel displays • Integrated Circuits • Optoelectronic devices • Renewable energy • Technical materials 	<ul style="list-style-type: none"> • Aerospace • Infrared optics • Optical fibers • Catalysts 	<ul style="list-style-type: none"> • Flat panel displays • Renewable energy • Solders • Catalysts • Ceramics 	<ul style="list-style-type: none"> • Renewable energy • Security, sensing and imaging • Optical storage • Metallurgical additives
Annual Worldwide production (MT)	<ul style="list-style-type: none"> • Approx. 25,000 	<ul style="list-style-type: none"> • 400 	<ul style="list-style-type: none"> • 140 	<ul style="list-style-type: none"> • 900 	<ul style="list-style-type: none"> • 1,000
Availability	<ul style="list-style-type: none"> • Low-Melting-Point Alloys • Semiconductor compounds 	<ul style="list-style-type: none"> • Chemicals 	<ul style="list-style-type: none"> • 100 mm • 150 mm <p>(In Diameters)</p>	<ul style="list-style-type: none"> • Chemicals • Low-Melting-Point Alloys • Semiconductor compounds 	<ul style="list-style-type: none"> • Chemicals • Semiconductor compounds
Purity	4N – 7N	4N – 7N	Customized	3N – 7N	2N5 - 7N
Form	<ul style="list-style-type: none"> • Ingot • Shot • Stick 	<ul style="list-style-type: none"> • Ingot • Pellet • Solid • Nugget • Shot 	<ul style="list-style-type: none"> • Wafers 	<ul style="list-style-type: none"> • Foil • Granule • Ingot • Pellet • Powder 	<ul style="list-style-type: none"> • Granule • Ingot • Lump • Pellet • Powder

				<ul style="list-style-type: none"> • Shot • Wire 	<ul style="list-style-type: none"> • Shot • Stick
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Performance Materials Segment

Bismuth is used as a replacement for lead in a number of industrial applications, particularly coatings and pigments, and is also used in electronics, optics and glass. Bismuth is also used in the pharmaceutical industry and is an active ingredient in a number of drugs for treating stomach ulcers and other discomforts associated with the gastrointestinal tract. The company sells bismuth in various forms, including chemicals and pure metals.

Low-melting-point alloys are also part of the product portfolio of the Performance Materials segment. These are often used in the optics industry where dimensional stability and low temperature are important.

Metallic nitrates, such as Cobalt, Nickel, Copper and Iron are used extensively in industrial applications and particularly the petrochemical industry for the production of clean fuels and lubricants.

Tin is used for solder, plating applications and specialized alloys. The Performance Materials segment uses tin for the production of low-melting-point micro-powder alloys used in the fabrication of solder pastes used in the micro-electronics industry.

Exhibit 6: Performance Materials Segment Products offerings ^{xi}					
Particulars	Bismuth and bismuth chemicals	Trace element premixes	Alloys	Metallic nitrates	Tin alloys
Applications	<ul style="list-style-type: none"> • Pharmaceutical industry • Electronics • Cosmetics • Magnets • Non-toxic substitute for lead • Lubricating greases • Pigments • Metallurgical additives 	<ul style="list-style-type: none"> • Animal feeds 	<ul style="list-style-type: none"> • Soldering • Industrial work holding • Optical lens production • Electrical safety 	<ul style="list-style-type: none"> • Petrochemical Industry • Industrial chemicals • Mining 	<ul style="list-style-type: none"> • Micro-electronics • Semiconductor packaging
Annual Worldwide production	<ul style="list-style-type: none"> • 12,000 MT 	<ul style="list-style-type: none"> • 40,000 MT 	<ul style="list-style-type: none"> • 1,500 - 2,000 MT 	<ul style="list-style-type: none"> • 50,000 MT 	<ul style="list-style-type: none"> • > 150,000 MT for solder applications

Outlook^{xii}

Following the exit from the low-margin business, the company posted impressive quarterly results in terms of profitability and has a strong outlook underpinned by unprecedented demand in target end markets (including terrestrial renewable energy and space solar power under Specialty Semiconductors and in the health and pharmaceutical sector under Performance Material segment), an improved product mix and the effectiveness of its commercial excellence program. As a leading supplier of ultra - high-purity specialty semiconductor materials outside of China and as a leader in critical metal recovery, the Company remains uniquely positioned

to continue to benefit from strong demand in critical and high - growth industry sectors, such as space solar power and terrestrial renewable energy. The ongoing capacity expansion programs are progressing well and as planned and include an increase in output capacity at AZUR by 30% by 2024 and an increase in production capacity for renewable energy applications by 35% in 2023 and 100% in 2024, combined with key customer capacity expansion plans. The Company is in the advanced stages of securing additional complex feeds and secondary streams for the recovery of critical minerals for its recycling and refining capacity at its Montreal plant.

The strong outlook helped the company to maintain its previously disclosed Adjusted EBITDA guidance range of USD 35 - 40 mn for FY 2023 and a projected Adjusted EBITDA range of USD 45 - 50 mn for FY 2024.

Recent Developments

In September 2022, 5N Plus announced a historic multi-year supply agreement with renewable energy leader First Solar for the supply of semiconductor materials associated with the manufacturing of thin-film photovoltaic (PV) modules. The largest award until now is expected to increase 5N Plus volumes by 35% in 2023 and by more than 100% in 2024, in line with First Solar's growth plans. This will allow the company to make the necessary planned investments in its Montreal facility to significantly increase its domestic supply of materials to the North American market by late 2023, incrementally, to its current international offering. Investments in 5N Plus manufacturing assets to increase production capacity will be in addition to those already being made to consolidate the company's recycling and refining activities in Montreal. The Company is also looking to expand the development and manufacturing of critical materials, including advanced semiconductor compounds and engineered powders used in solar, medical and security technologies. As the company executes its strategy focused on value-added business opportunities, this agreement further cements its standing as a leading global supplier of engineered semiconductor compounds to the thin-film renewable energy industry.

The company, in October 2022, announced the signing of a 10-year extension of its exclusive teaming arrangement with Sierra Space, through its wholly owned subsidiary AZUR SPACE Solar Power GmbH ("AZUR"). It will facilitate the production of a new solar cell, referred to as the MWT, for use in the production of Sierra Space's unique Space Solar Surface Mount Technology solar array systems. The solar cell technology, developed in partnership by both companies, will enable automated production and assembly and is expected to revolutionize solar array cost of assembly, resiliency, and power density. The MWT solar cells enable arrays with higher power density, reducing the size of the arrays for equivalent power of a conventional design, and are more cost-effective when completing the laydown to satellite solar power arrays. The automation enables Sierra Space to deliver solar power arrays with less than one-half the conventional array lead times. The incremental revenue contributions from Sierra Space to AZUR are expected to reach c. USD 10 mn in FY 2023 and over USD 20 mn in FY 2024.

In April 2023, VNP announced that it has implemented several measures to increase the capacity of AZUR Space by 30% over the course of 2023 and 2024 to meet its existing contract pipeline. As part of these measures, the company has put in place a productivity improvement program, which includes an additional shift to the assembly line schedule and has ordered new equipment to increase the front-end production. It also plans to implement co-investment initiatives to purchase equipment, improve productivity, automate processes, and increase capacity.

5N Plus' wholly owned subsidiary, AZUR SPACE Solar Power GmbH (AZUR), supplied triple junction solar cells to RayGen's flagship power plant in Carwarp, Victoria (Australia). The power plant was inaugurated on August 31, 2023, delivering 4 MW solar and 2.8 MW / 50 MWh storage capacity, making it the world's largest and lowest-cost next-generation long-duration energy storage project. AZUR's high-efficiency solar cells formed a key component of RayGen's proprietary solar technology and enabled it to provide energy on a large scale, both consistently and on short notice, with minimal environmental impact.

Brief Overview of 5N Plus’s new strategic plan

In order to move onto the next phase of development for the company, the company management recognized a need to move away from its commodity-based businesses and towards higher margin businesses with the following objectives:

1. Larger TAM

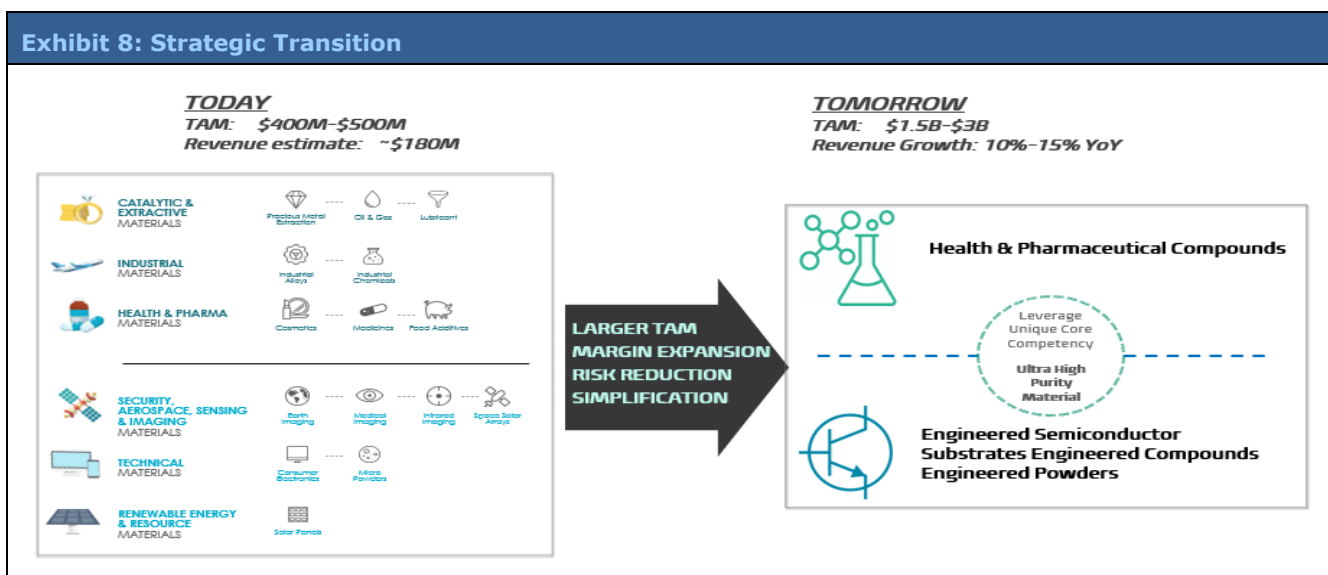
5N Plus has already consolidated c. 50% market share in its existing addressable markets.

Exhibit 7: Downstream Opportunities			
Sector	Market Growth Prospect	Current Capital Requirements	5N's Position
Pharma, Health, and Nutrition	High	High	Market Leader
Electronics and Electro-Optics	Average	Low	Top 3
Industrial Chemicals	Average	Low	Top 3
Coating and Pigments	Average	Low	Top 3
Alternative Energy	High	Low	Market Leader
Aerospace, Security and Defence	High	Low	Top 3

Now the company looks to expedite its growth by targeting and expanding into markets with a significantly larger TAM. The company will look to leverage M&A opportunities in addition to organic initiatives to drive its future growth.

2. Simplification, Risk Reduction and Margin Expansion

The company is looking to simplify its business operations and reduce the number of business verticals to realign its resources in its strongest markets. In order to achieve that, the company is moving away from commodity-based products in favor of higher-value-added activities which present opportunities for margin expansion and reduction of volatilities.



Recent growth initiatives under the new strategy

The company, while keeping in mind the two above-mentioned objectives, has looked to monetize its existing growth initiatives, recognizing opportunities in the engineered semiconductor products and engineered powder products markets in FY 2020 and Q1 2021.

The company entered the detector market for medical imaging. The rationale for entering the market was based on the increased demand for medical scanners based on new technology to reduce radiation and the company’s position as a key supplier of semiconductor materials and detector technology. In the second half of 2020, the company saw a strong demand of semiconductor materials for a new generation of medical devices based on as photon-counting detectors, which the company believes is drawing strong interest from original equipment manufacturers (OEMs) in the medical imaging business. It additionally signed a long-term agreement with Samsung for the supply of engineered substrates after a successful collaboration. The Company has uniquely positioned to play a significant role in the new Photon Counting Detectors technology for CT scan, which is set to revolutionize medical imaging in the medium-term.

The company signed a strategic agreement with Microbion in January 2021, to supply compounds for a new class of drug products. The agreement reiterates the company’s focus on improving its product mix and moving toward high-margin businesses and away from commodity-based products.

In November 2021, the company completed the acquisition of AZUR Space, a leader in manufacturing multi-junction solar cells. The acquisition has bolstered company’s opportunities and TAM in the engineered semiconductor substrates market through AZUR Space’s Epitaxy technology and will allow the company to access the potentially large markets revolving around Wide Band-Gap Materials (expected TAM around USD 200 mn by 2025, USD 300 mn by 2030). Furthermore, the company look to invest behind developing new Wide Band-Gap Materials, such as Gallium Nitride (GaN), which represents a multi-billion-dollar market in high-power electronics and communications applications alone. In June 2021, the company invested USD 8.5 mn in the Montreal campus to expand the development of specialty semiconductor compounds and engineered powders. Investment will ensure competitive access to critical products, lower the unit cost of production, lower the carbon footprint, reduce consumption of chemical reagents and generation of solid by-products. The investment emphasizes the company’s focus on improving its position within ESG-related themes.

Exhibit 9: Key Future Markets



Key Achievements under previous strategic plan

The following are the key achievements of the company under its previous strategic plan:

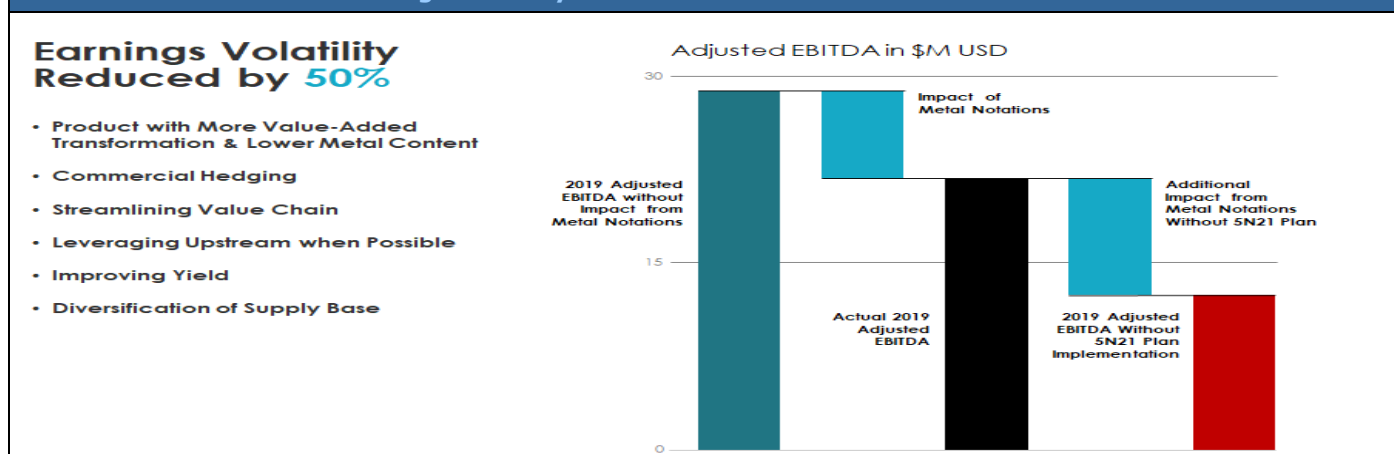
The revenue from downstream activities was more reliant on specific industries before the start of the plan. Over the course of the plan, the company has managed to balance its revenue sources (end users), eliminating reliance on specific end user industries and the risks pertaining to it.

Exhibit 10: Downstream Revenue Development



The company managed to reduce earnings volatility by 50% in FY 2019 with a focus on higher value-added content and lower metal content, commercial hedging, streamlining of value chain and diversification of supply base. In numerical terms, the company was able to limit the impact of low metal notations to USD 7 mn on adjusted EBITDA (without the strategy, it could have been between USD 15 20 mn).

Exhibit 11: Reduction in Earnings Volatility



Key Markets

Specialty Semiconductors segment

Thin-Film Photovoltaic modules: The global thin-film photovoltaic modules market was valued at USD 9.0 bn in 2019 and expected to grow at a CAGR of 3.7% to reach USD 11.2 bn by 2025. Thin-film solar modules are very thin (measured in nanometers), more flexible and lightweight. Additionally, they are more economical and lead to fewer emissions as compared to multi-crystalline silicon (which dominate the photovoltaic modules market). Growing focus on the renewable energy sector, especially solar, with countries all over the world setting targets to increase its share and reduce greenhouse gases, is expected to drive the

market. 5N Plus is a key supplier of semiconductor materials related to the manufacture of thin-film photovoltaic modules by First Solar.^{xiii} Recently, the company has renewed and increased its supply agreement with First Solar Company's where the company expects that the supply volumes will increase by 35% in FY 2023 and over 100% in FY 2024, compared to FY 2022 levels.

Medical imaging: The detector market for medical imaging is a multi-billion-dollar market which is expected to grow at CAGR of 7.3% to USD 6.6 bn by 2025. The market for semiconductors in medical imaging had a volume of 46 mn units in 2015, with growing demands for power savings, lower production cost, higher resolution, and the need to support integrated security and communications expected to lead the next phase of growth. 5N Plus entered the market and is the leading supplier of semiconductor technology for a new generation of medical imaging devices based on Photon Counting Detector (PCD) technology.^{xivxv}

Wide-Band-Gap Materials (WBG): Wide-Band-Gap Semiconductor Materials have gained importance as a key material for applications in high-performance optoelectronics and electronic devices as they allow for smaller, faster, more reliable power electronic components and with higher efficiency as compared to silicon-based components. They allow devices to operate at higher temperatures, higher voltages and higher frequencies making power electronic modules more powerful and more efficient. WBG are expected to lead to elimination of 90% of power cuts during power transmission, enable high-power performance, provide better overall system reliability, enable smaller and lighter systems with reduced lifetime energy use and facilitate compact and less costly product designs.

The market for WBG is seeing increased adoption in applications such as telecom equipment, computers, military devices, electric vehicles, and photovoltaic inverters and the power semiconductors industry. These factors were expected to drive the market to USD 3 bn at a CAGR of 22% from 2019 to 2027. 5N Plus expanded its capabilities and gained access to the market through the acquisition of AZUR Space. 5N Plus plans to enter the market in 2024 (TAM of USD 250 mn by 2025 and USD 500 mn by 2030) with products for the power electronics, electric vehicles, data centers, solar and electric power, 5G and 6G infrastructure, cellphones (as silicon replacement), satellite communication and defense end-user markets.^{xvixvii}

Additive Manufacturing: The company entered the additive manufacturing industry as a supplier of engineered powders, the materials that are used in the printing processes. Additive manufacturing (AM) is the manufacturing of parts and products in a layer-by-layer fashion. Metal powders are metals that are reduced to fine particles and are the preliminary base materials for most 3D printing processes that produce metallic parts.

To ensure consistency in printing output, metal powders need to have consistent characteristics. The particle size – which determines the smallest possible layer height that can be achieved, particle shape and the powder's level of purity are key characteristics which help maintain quality. The market for engineered powders in additive manufacturing was worth USD 500 mn in 2020 and expected to grow at a CAGR of 25% over the next 5 years.^{xviiiix}

Performance Materials segment

API: API is an active ingredient of the drug which produces the intended effect. For example, an active ingredient in a painkiller is one intended to relieve pain. Bismuth, as one of the least toxic metals, has various medicinal uses (most notably used to treat diarrhea, Helicobacter pylori or H. pylori, and stomach ulcers) as APIs. 5N Plus is the market-leading producer of Bismuth-based APIs and in January 2021, acquired an equity stake in Microbion, a clinical-stage pharmaceutical company. 5N Plus will assume the responsibility of producing Bismuth-based APIs for Microbion's class of drug compounds including the lead API. The APIs account for 5% of the total drug price for Microbion's drugs, providing 5N Plus access to market with a TAM of USD 25 mn in 2020, expected to grow to anywhere between USD 100 mn – USD 300 mn based on the success of the pipeline drugs' studies.^{xxxxixxii}

Animal Feed: Minerals form an important part of animal feed as they contribute to growth, development, and overall well-being to prevent diseases in livestock. In some areas, soil is deficient in essential minerals, due to the development of agriculture and production methods, which lead to mineral deficiencies in animals. In such cases, essential trace elements and minerals that are not produced in the body need to be added in the feed externally for better standards and quality of animal-derived products. 5N Plus entered the animal feed minerals market in 2018, capitalizing on its leading position in the production of ultra-high-purity metals and API to adhere to the requirements of the feed industry. The company initially entered the animal feed market containing trace elements (sub segment generating more than USD 100 mn annually). Factors such as

increasing demand for animal protein sources, increased adoption of scientific methods to increase meat production and growing need for high-quality meat by the meat processing industry are expected to drive the growth in the lucrative animal feed containing minerals. The market for animal feed minerals is expected to grow to USD 6.9 bn by 2026 at a CAGR of 6.4%.^{xxiiiixivxxvxxvi}

Low-Melting-Point Bismuth: Fusible Alloys are used in thermoelectric materials and CPU coolers and usually contain indium or bismuth but can contain lead, tin, and cadmium. They are additionally used as lead substitutes in solders. Indium fusible alloys are used as mercury substitutes and solders. Tin fusible alloys are used in coatings and plating, as alloying additives, in battery electrodes, and as solders. Lead fusible alloys have applications in balancing weights, radiation shielding, battery electrodes, and solders. Bismuth-based fusible alloys have the ability to expand 3.3% when their state is changed from liquid to solid, alloys with over 55% of bismuth expand on solidification.^{xxvixxxviii} 5N Plus is the leading producer and seller of low-melting-point alloys made up of cadmium, bismuth, indium, tin, and lead.^{xxix}

Pigments: Pigments are compounds added to materials to provide color. The market for metallic pigments is gaining prominence owing to changing consumer preferences, which puts more emphasis on colors and visual effects. The market is expected to grow to more than USD 2.3 bn by 2024 with demand for eco-friendly paints and coating from other end-user industries (including automotive, automotive OEM, cosmetics, packaging). 5N Plus is a supplier of bismuth-based pigments and can be used as an alternative to chrome and cadmium pigments, cadmium yellow or chrome yellow for traffic signs, indoor decoration, and other applications.^{xxxixxxixxxii}

Financial Overview

Q3 2023

Revenue decline owing to exit from low-margin business

In Q3 2023, the company's revenue declined to USD 62.9 mn, compared with USD 66.4 mn in Q3 2022. The drop can be largely attributed to the company's decision to discontinue the manufacturing of low-margin extractive and catalytic products, a strategic move implemented in the latter half of 2022, and the related divestiture of its Tilly, Belgium, operations in Q4 2022.

Adjusted Gross margin stood at 24.9%

The adjusted gross profit stood at USD 15.7 mn, a decline of c. 3.1% over Q3 2022. However, the YTD adjusted gross margin was positively impacted due to a favorable product mix, strategic initiatives undertaken in the previous year in the form of a commercial excellence program and a strategic exit from low-margin business. This resulted in a slight increase in adjusted gross margin to 24.9% in Q3 2023 from c. 24.3% in Q3 2022.

Increase in EBITDA underpinned by impairment of non-current assets

The company's EBITDA stood at USD 9.6 mn, compared with USD 1.8 mn in Q3 2022. This increase was due to an impairment of non-current assets of USD 7.1 mn recorded in Q3 2022. The consolidated EBITDA margin stood at 15.3% as compared with 2.7% in Q3 2022.

The adjusted EBITDA reported during the quarter stood at USD 9.6 mn, compared with USD 9.1 mn in Q3 2022, an increase of 5.5% YoY. The consolidated adjusted EBITDA margin stood at 15.3% as compared with 13.7% in Q3 2022.

Higher EBITDA and lower depreciation expense led to an Operating Margin expansion

During the quarter, depreciation and amortization expenses stood at USD 4.0 mn compared with USD 4.0 mn in Q3 2022, majorly due to the company's divestiture of its Tilly, Belgium, operations in Q4 2022. As a result, operating profit stood at USD 5.4 mn, compared with operating loss of USD 2.4 mn in Q3 2022. The consolidated operating profit margin stood at 8.6% in Q3 2023.

Controlled cost structures helped the company post a strong bottom line

In Q3 2023, selling, general and administrative (SG&A) expenses stood at USD 6.2 mn, compared with USD 6.5 mn in Q3 2022. In Q2 2022, the company recorded litigation and restructuring income of USD 8.8 mn (net of cost), with no such income reported in Q3 2023. Financial expenses amounted to USD 2.2 mn during the quarter. During the quarter, the company posted a net profit of USD 1.5 mn, compared to a net loss of USD 6.9 mn in Q3 2022.

Minor fluctuations in cash flows – Decrease in CFO and less cash used in Investing activities

During the quarter, cash used in operating activities stood at USD 2.1 mn, compared to cash generated from operating activities of USD 10.1 mn in Q3 2022. Cash used in investing activities amounted to USD 2.7 mn, compared with USD 3.3 mn in Q3 2022, mainly due to the net decrease in additions to property, plant and equipment reduced by disposal of assets held for sale in Q3 2022. In Q3 2023, the company used cash of USD 5.2 mn from its financing activities, compared with USD 3.3 mn in Q3 2022. Minor fluctuations in cash flows resulted in an increase in net debt to USD 78.6 mn at the end of Q3 2023 from USD 78.3 mn at the end of FY 2022.

Segment Information

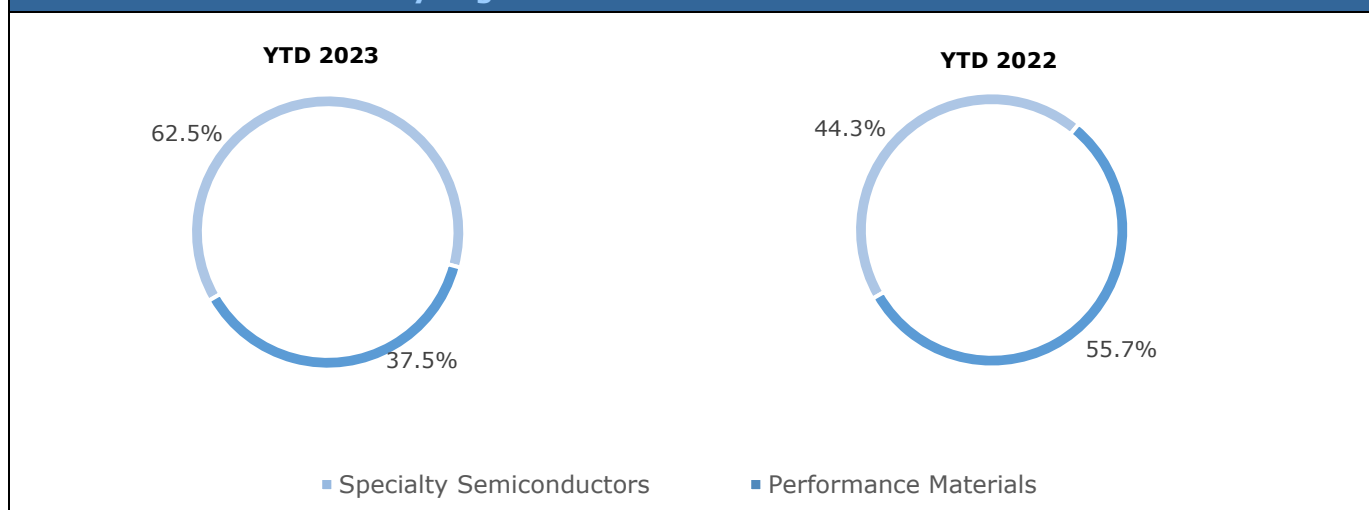
Specialty Semiconductors

The revenue for Specialty Semiconductors stood at USD 41.8 mn, compared with USD 32.0 mn in Q3 2022, an increase of 30.6% YoY, driven by higher demand in strategic sectors. The adjusted gross profit for the quarter was negatively impacted by the revenue mix under space shifting AZUR’s incremental contribution from Q3 to Q4. Adjusted EBITDA for the quarter decreased to USD 4.7 mn in Q3 2023 due to shifted contribution under AZUR from Q3 to Q4 2023.

Performance Materials

Performance Materials’ revenue was at USD 21.2 mn in Q3 2023, compared with USD 34.3 mn in Q3 2022, owing to the company’s strategic decision of exiting the low-margin extractive and catalytic products in the latter half of 2022 and the sale of its Tilly, Belgium, business in Q4 2022. The adjusted gross margin for the quarter came in at 39.4%, compared with 20.6% in Q3 2022. Adjusted EBITDA for the period stood at USD 6.6 mn, 30% higher on a YoY basis, with the adjusted EBITDA margin at 31% compared with 15% in Q3 2022.

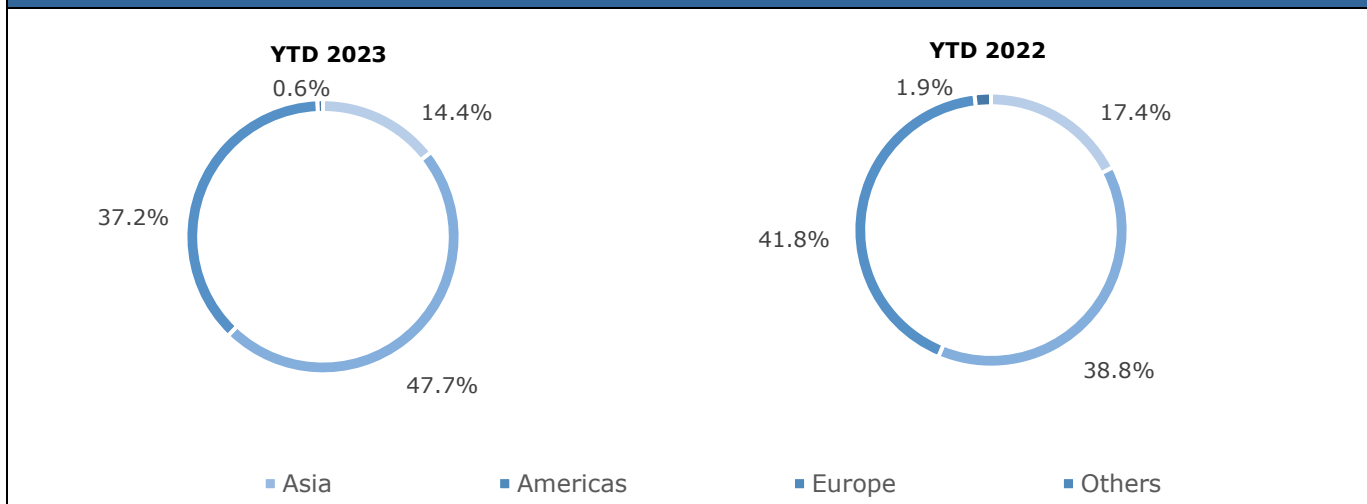
Exhibit 13: Revenue Mix by Segment^{xxxiii}



Geographical Information

The revenue from the Americas stood at USD 30.8 mn in Q3 2023, as compared with USD 31.1 mn in Q3 2022. The company’s US operations contributed USD 28.8 mn in revenue during the quarter, while the other regions contributed USD 2.0 mn. The revenue from Europe stood at USD 23.4 mn, compared with USD 26.6 mn in Q3 2022, with Germany being the highest contributor with revenue of USD 14.7 mn. The revenue from Asia stood at USD 8.1 mn, as compared with USD 7.4mn in Q3 2022.

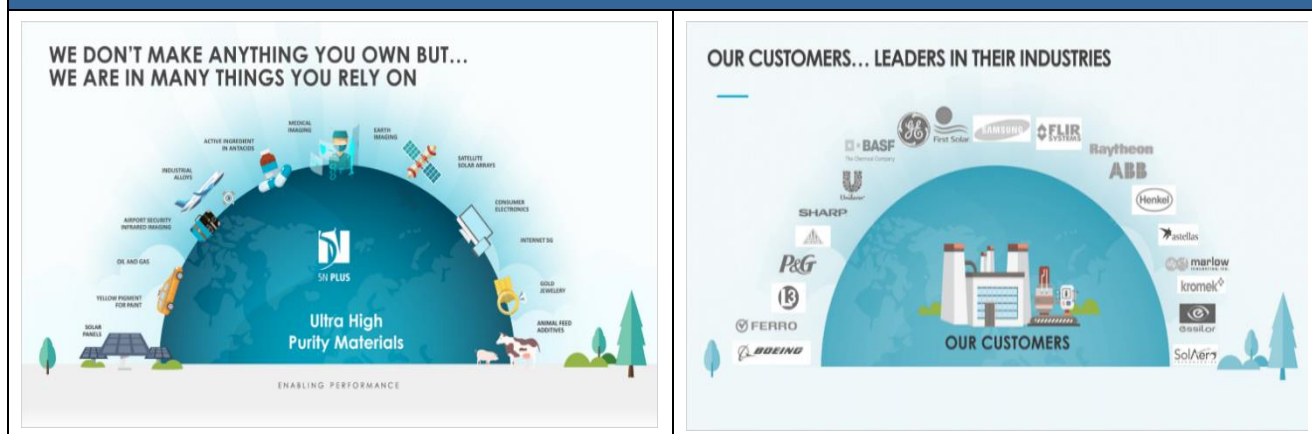
Exhibit 14: Revenue Mix by Geography



Company Premiums

- a) **Consolidation of position and entry into new markets:** The company has entered various partnerships in recent years, as per its new strategy, to consolidate its leading position in existing markets and increase its TAM by entering large markets. The company built on its position in the engineered powders business by entering the Additive Manufacturing market (TAM of USD 500 mn) and partnered with Metalpine to capture market share. It additionally signed an agreement with Microbion to grow its Pharma business, supplied semiconductor material for technological breakthroughs in medical imaging devices and has completed its acquisition of AZUR Space to grow its Space business in the process and enter the market for Wide Band-Gap Materials (TAM of USD 200 mn by 2025).
- b) **Leading supplier of engineered materials having multiple applications:** 5N Plus is a leading manufacturer of engineered materials and specialty chemicals made from critical metals such as bismuth, tellurium, gallium, and indium. Bismuth, having multiple uses in the pharmaceutical and electronics industry, is being widely substituted for lead, and germanium and tellurium are highly demanded in the satellite and solar power generation industries. 5N Plus has acquired certifications to supply bismuth products to the US Food and Drug Administration (FDA) and Good Manufacturing Practices (GMP) standards. It also has a significant position in the supply of germanium, tellurium, gallium, and indium.

Exhibit 12: Applications across Industries^{xxxiv}



- c) Specialized in manufacture of high-quality micro-powders:** The company has made significant investments in developing high-performance atomizing technology over the past few years. This has helped the company to efficiently manufacture fine metallic powders, known as micro powders. The demand for these powders has grown significantly in the electronics industry where the main application is in the production of solder pastes and conductive adhesives in mobile device and automotive applications. The micro powders technology of 5N Plus has distinct properties for preparing powders with consistent shape, uniform size distribution, and controlled purity, ideally suited to meet the challenges of these demanding markets.
- d) International market leader in the production of Low Melting Point Alloys (LMPAs):** LMPAs are fusible alloys that are made of bismuth, lead, tin, cadmium, and indium. LMPA-type alloys have a melting point below 450°F (233°C). Major applications of these alloys are seen in optics, radiation screening, fusible core technologies, and in architecture and construction. 5N Plus has expertise in the production of such alloys. The company also sells customized LMPAs which meet customer specifications and needs.
- e) Promoting sustainable development through recycling initiatives:** 5N Plus has formulated sustainable development policies to reduce the adverse impact on the environment. One of the initiatives to reduce environmental impact is the adoption of recycling its by-products. 5N Plus' extensive expertise in industry processes has enabled it to help smelting operations across the world to utilize the full potential of its mining sites and its by-products. 5N Plus has developed unique technologies which recover and treat the by-products and scrap generated in the metallurgical process. The company promotes the recycling of industrial waste generated by its manufacturing processes and has set targets that will ensure minimal environmental impact. The company has set up recycling plants in continents namely, Eisenhüttenstadt (Germany), and Montreal (Canada).
- f) Experienced management team:** The company's management personnel have relevant experience and a wealth of knowledge and expertise, which helps them achieve strategic objectives such as improving bottom-line performance and extracting appropriate value from existing assets. On average, each senior management member has industry experience of about 20 years.

Company Risks

5N Plus is subject to a number of risk factors that may limit the company's ability to execute its strategy and achieve its long-term growth objectives. The management analyses these risks and implements strategies in order to minimize their impact on the company's performance.

- a) International operations:** Commodity prices may fluctuate owing to several reasons that are beyond the control of the company thereby affecting the results of its operations and cash flows. Although the company operates primarily in countries with stable economic and political climates, there can be no assurance that its business will not be adversely affected by the risks inherent in international operations.

- b) International trade regulations:** The company does business in several countries from various locations due to which it faces risks associated with changes in international trade regulations and policies. Some of these risks include barriers to or restrictions on free trade, changes in taxes, tariffs, and other regulatory costs. Although the company operates primarily in countries with proximity to its clients and suppliers, and with stable economic and political climates, it is not sure that its business will not be adversely affected by the risks inherent to the changing international political landscape and its impact on global trade.
- c) Competition risk:** 5N Plus is a leading producer of specialty metal and chemical products and has a limited number of competitors. A few of its competitors are as fully integrated as the company is and offer a similar range of products. As a result, the company has to provide differentiated products. However, it cannot be assumed that this situation will continue in the future and competition could arise from new low-cost metal refiners or from certain customers who could decide to integrate backward. Greater competition could have an adverse effect on the revenues and operating margins if the competitors gain market share and the company is unable to compensate for the volume lost to its competition.
- d) Sources of supply:** The company is unsure whether it will be able to secure the critical raw material feedstock on which it depends for its operations. Currently, the company procures its raw materials from a number of suppliers with whom it has had long-term commercial relationships. The loss of any one of these suppliers or a reduction in the level of deliveries to the company may reduce the production capacity and impact deliveries to its customers. As a result, the sales and net margins may be negatively impacted, resulting in additional liabilities with respect to some of the supply contracts. The company faced a supply shortage of complex feed in FY 2019 when metal's notations declined triggering suppliers to cease or withhold supply of materials. This resulted in the contraction of margins in the upstream activities of the company, while the company increased the sourcing of commercial-grade metal at historically low notations. The shortage in supply faced in FY 2019 continued in 9M 2020 as expected by the company, having a detrimental effect on the upstream activities of the company and its margins.
- e) Business interruptions:** Business interruptions might result in losses for the company. In many instances, especially those related to long-term contracts, the company has contractual obligations to deliver products in a timely manner. Any disruption in activities leading to a business interruption could harm the customers' confidence level and lead to the cancellation of contracts and legal recourse against the company. In FY 2019, 5N Plus faced production challenges which adversely affected overall sales. Increased demand resulted in equipment downtime as the company faced mass-scaling production challenges.

Major Shareholders^{xxxv}

The company had 88,704,724 shares of common stock issued and outstanding on December 21, 2023.

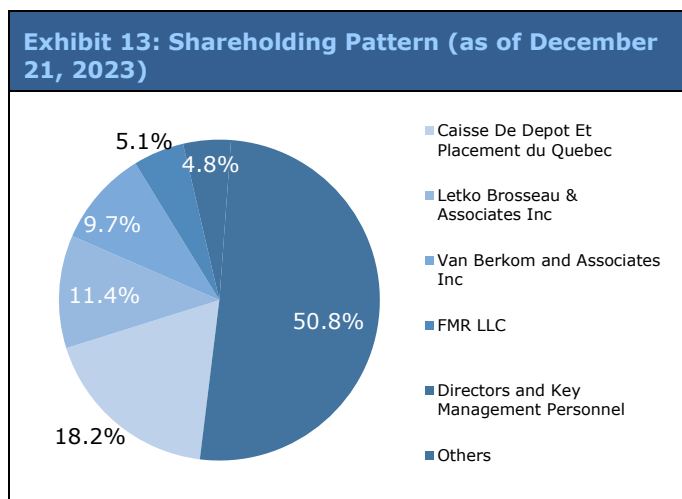


Exhibit 14: Top Shareholding Pattern

Shareholders	Shares outstanding
Caisse De Depot Et Placement du Quebec	16,157,050
Letko Brosseau & Associates Inc	10,088,680
Van Berkomp and Associates Inc	8,602,598
FMR LLC	4,550,000
Directors and Key Management Personnel	4,257,850
Others	45,048,546
Total	88,704,724

Listing and Contact Information

5N Plus is listed on the TSX in Canada under the symbol VNP and started trading on December 20, 2007.

Contact

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News^{xxxvi}

- **RayGen's solar storage photovoltaic project powered by AZUR Space's triple junction solar cells:** On September 5, 2023, VNP announced that AZUR SPACE Solar Power GmbH ("AZUR"), its wholly owned subsidiary, supplied triple junction solar cells utilized in RayGen's, an Australian solar and storage company, flagship power plant in Carwarp, Victoria (Australia). The power plant was inaugurated on August 31, 2023, delivering 4 MW solar and 2.8 MW / 50 MWh storage capacity, making it the world's largest and lowest-cost next-generation long-duration energy storage project. AZUR's high-efficiency solar cells formed a key component of RayGen's proprietary solar technology and enabled it to provide energy on a large scale, both consistently and on short notice, with minimal environmental impact.
- **Chandrayaan-3 Powered by 5N Plus Solar Cells:** On August 11, 2023, the company announced that the solar cell technology developed by its subsidiary, AZUR SPACE Solar Power GmbH ("AZUR"), was to be employed in the latest lunar exploration mission conducted by the Indian Space Research Organization (ISRO), known as Chandrayaan-3. In this mission, AZUR supplied the 3G30 solar cells for the propulsion module (758W), the lander (738W) and the rover (50W).

- **Announced Election of Directors:** On May 04, 2023, the company announced that the nominees that were listed in its Management Information Circular (released on April 04, 2023) were now elected as directors of the company. Mr. Luc Bertrand was re-appointed as Chairman of the Board of Directors of the Company by the directors.
- **Announced plan to increase the capacity of AZUR Space:** On April 26, 2023, 5N Plus announced that it was implementing measures to increase AZUR Space's capacity by 30% in 2023 and 2024 to cater to the existing contracts. It has planned to purchase new equipment, automate processes and bring into effect a productivity improvement program to add to its front-end capacity and improve the efficiency of the assembly line schedule.
- **Announced contribution to European Space Agency's program:** On April 14, 2023, 5N Plus announced that the solar cell technology of its subsidiary, AZUR Space, was utilized by the European Space Agency's 'Mission to Jupiter' program. Additionally, NASA's Europa Clipper mission to Jupiter was also utilizing AZUR Space's solar cell technology.
- **Announced appointment of Blair Dickerson:** On February 23, 2022, 5N Plus announced the appointment of Ms. Blair Dickerson to its Board of Directors, with more than two decades of experience in natural resources, communications, public affairs and public policy work.
- **Announced exclusive arrangement with Sierra Space:** On October 17, 2022, 5N plus announced that the company, through its wholly-owned subsidiary AZUR, had signed a 10-year extension of its exclusive teaming arrangement with Sierra Space. As part of the arrangement, AZUR will produce a new solar cell, referred to as the MWT, exclusively for Sierra Space for use in the production of Sierra Space's unique and patented Space Solar Surface Mount Technology solar array systems. The strategic agreement between AZUR and Sierra Space is expected to yield c. USD 10 mn and USD 20 mn of incremental revenue in FY 2023 and FY 2024, respectively.
- **Announced historic multi-year supply agreement with renewable energy leader First Solar:** On September 29, 2022, 5N plus announced that the company had successfully renewed and increased its multi-year agreement with First Solar Inc. for the supply of semiconductor materials associated with the manufacturing of thin-film photovoltaic (PV) modules. The company expects its annual volume to increase by 35% in 2023 and by more than 100% in 2024 from current levels. As a result, the company is to make necessary planned investments in its Montreal facility to significantly increase the domestic supply of materials to the North American market by late 2023, incrementally to its current international offering.
- **Announced appointment of Roland Dubois as Chief Commercial Officer:** On July 28, 2022, 5N plus announced the appointment of Mr. Roland Dubois as Chief Commercial Officer. He would be responsible for leading the company's commercial excellence program and go-to-market strategy with a segmented approach to commercial partnering.
- **Renewal of USD 124.0 mn Syndicated Credit Facility:** On June 16, 2022, 5N Plus announced the renewal of its USD 124.0 mn senior secured multi-currency revolving syndicated credit facility with an option to increase by another USD 30.0 mn. The tenure of the new credit facility is four years.
- **Discontinuance of manufacturing facility in Tilly:** On May 18, 2022, 5N Plus announced that the company intended to discontinue its production at its manufacturing facility in Tilly, Belgium and proceed with the site's closure. The decision was majorly triggered due to a lack of earnings or margin improvements on the lead-based products it manufactures coupled with significant additional capital required to maintain daily operations, thereby making it no longer economically viable or compatible with the company's long-term strategy. The decision was made despite several optimization measures and investments made over the years to improve the site's competitiveness.
- **Announced partnership with Rio Tinto for Supply of Tellurium:** On May 11, 2022, 5N Plus announced that the company had reached a commercial agreement with global mining group Rio Tinto to

refine tellurium. The company would refine and transform the tellurium in two of its facilities, i.e., Montreal and St. George, for renewable energy, security and medical imaging applications.

- **Announced new interim CEO:** On November 26, 2021, VNP announced that Mr. Arjang Roshan had stepped down as the President and the CEO. Mr. Gervais Jacques had been appointed as the interim President and CEO, with a permanent appointment expected to be made during the annual meeting of shareholders in 2022.
- **Completed the acquisition of AZUR Space:** On November 08, 2021, 5N Plus announced that it had completed the acquisition of AZUR Space after receiving approvals from various relevant agencies.
- **Organizational change:** On June 30, 2021, 5N Plus announced the planned departure of Nicholas Audet, Executive Vice President of Electronic Materials, who would be leaving the organization effective from Q3 2021. Additionally, following the acquisition of AZUR Space, Jürgen Heizmann, the managing director of AZUR, is to join 5N Plus' Executive Committee.
- **Invested USD 8.5 mn in Montreal campus for II-VI Specialty Semiconductor Materials:** On June 02, 2021, 5N Plus announced that it had invested USD 8.5 mn in its Montreal campus to expand the development and manufacturing of II-VI Specialty Semiconductor Materials. The investment is supported by Ministère de l'Économie et de l'Innovation (Ministry of Economy and Innovation) and the Ministère de l'Énergie et des Ressources Naturelles (Ministry of Energy and Natural Resources).
- **Signed agreement to acquire AZUR Space:** On March 30, 2021, 5N Plus announced that the company will acquire AZUR Space, a leader in manufacturing solar cells, for an expected purchase price of USD 7379 mn. The company plans to make payments through 6.5 mn shares and USD 53 mn in cash.
- **Extended credit facility:** On March 24, 2021, 5N Plus announced that the company had extended its credit facility for an amount of USD 79.0 mn. The credit facility can be extended to USD 124.0 mn, contingent on the closing of the acquisition of AZUR Space. The company has the right to further extend the credit facility to USD 154.0 mn.
- **Signed strategic agreement with Microbion:** On January 12, 2021, 5N Plus signed a strategic agreement with Microbion to supply bismuth-based APIs for Microbion's antibiotic and antibiofilm drug products which are under development. As part of the agreement, 5N Plus acquired an equity stake in the company.
- **Expanded its API portfolio:** On January 12, 2021, 5N Plus announced that it had expanded its API portfolio to include compounds for a new class of antibiotic and antibiofilm drug products. The expansion follows on from the company's investments made in the last year in its pharmaceutical facility and is expected to allow it to build on its position as the world's leading producer of Bismuth-based APIs.
- **Signed multi-year contracts in the renewable energy sector:** On November 12, 2020, 5N Plus signed multi-year contracts for the supply of semiconductor materials to First Solar Inc for the manufacturing of thin-film photovoltaic (PV) modules.
- **Completed investment of USD 10.0 mn in process technologies:** On October 28, 2020, 5N Plus announced that it had completed a series of investments amounting to USD 10.0 mn in process technologies that it had begun in July 2019. The investments focused on select sites in Europe and China and will benefit the Eco-Friendly Materials segment primarily.

Management and Governance^{xxxvii}

Personnel	Designation	Current and Total Experience
Luc Bertrand	Chairman of the Board	Mr. Luc Bertrand has been the Vice-Chairman of National Bank of Canada since February 2011 and is responsible for developing and maintaining relations with corporate, institutional, and government clients in Canada. He serves on the Board of the International Finance Centre of Montréal, is also Chairman of the Board of the Montreal Canadiens/CH Group Inc. He also serves on the Board of TMX Group.
Gervais Jacques	President and Chief Executive Officer	Mr. Jacques served earlier as the managing director of Rio Tinto Aluminum, where he was responsible for the commercial and marketing activities, which included R&D collaborations and managing customer relationships in the automotive and consumer goods market. He has also served as Chairman of the International Aluminum institute, of the Canadian Aluminum Association and of Halco Mining and as the director of the owner committee of Aluminerie de Bécancour and of Elysis. He has a degree in chemical engineering from Université Laval and has completed a leadership and strategy program at London Business School.
Richard Perron	Chief Financial Officer	Mr. Richard Perron is a Certified Public Accountant (CPA) having 25 years of international experience in the manufacturing and technology sectors. He has served as the Chief Financial Officer and Strategy Manager of Long Carbon Americas, at ArcelorMittal, and also as the Director of Finance and Control and Chief Information Officer at Danfoss Turbocor Compressors of Danfoss Group. Mr. Perron holds a B.Com. degree (Accounting), an M.Sc. in Administration, Management and Accounting, and an M.B.A. from the University of Sherbrooke.
Paul Tancell	Executive Vice President, Performance Materials	Mr. Paul Tancell has over 20 years of experience across several international regions and industries, including automotive, chemical, and minor and precious metals. He has held senior roles in companies such as Umicore, Ford Motor Company, and Johnson Matthey. He has an excellent track record of developing high-performing organizations and delivering competitive results across industries, environments, and geographies. Mr. Tancell holds a B.Sc. in Environmental Chemistry and a Ph.D. in Chemistry from the University of Plymouth, UK.
Roland Dubois	Executive Vice President, Specialty Semiconductors and Chief Commercial Officer	Mr. Roland Dubois has over 30 years of experience in B2B sales, marketing, commercial and strategy, with a strong track record of successfully implementing go-to market strategies on multiple continents in the metals, engineering plastics and electricity industries. Prior to joining 5N Plus, Mr. Dubois was Vice President, Group Head of Sustainability, based out of Zurich, Switzerland in ABB. Prior to that, he spent 16 years with Rio Tinto where he held various commercial, marketing and strategic development leadership roles. Mr. Dubois is a graduate of Grenoble École de Management, in addition to having completed an Executive MBA from HEC Paris.

Valuation

On December 21, 2023, the fair market value for 5N Plus shares stood between CAD 385.2 mn and CAD 459.9 mn, and the fair market value for one of 5N Plus publicly traded shares stood between CAD 4.4 and CAD 5.2.

DCF Valuation

WACC^{xxxviii}

Risk-free rate	3.1%
Beta	1.4
Market Return	10.0%
Cost of equity	12.4%
Discount rate	12.4%
Terminal Growth Rate	1.0%

FCFF (High) Time Period --> (USD '000)

Year Ending- December	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Net Cash from Operating Activities	33,313	62,012	36,697	45,146	57,069	65,223	47,843	89,922
Capital Expenditure	(15,229)	(15,712)	(15,502)	(16,446)	(17,391)	(18,319)	(19,213)	(20,319)
Free Cash Flow (FCF)	18,084	46,300	21,195	28,700	39,678	46,905	28,631	69,603
Discount factor	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4
Present Value of FCF	16,036	36,521	14,872	17,914	22,031	23,167	12,580	27,205

FCFF (Low) Time Period --> (USD '000)

Year Ending- December	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Net Cash from Operating Activities	29,896	58,139	33,289	40,985	51,900	59,087	42,055	81,202
Capital Expenditure	(15,229)	(15,712)	(15,502)	(16,446)	(17,391)	(18,319)	(19,213)	(20,319)
Free Cash Flow (FCF)	14,667	42,427	17,787	24,539	34,509	40,768	22,842	60,883
Discount factor	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4
Present Value of FCF	13,005	33,466	12,481	15,317	19,161	20,136	10,036	23,796

In the model, the valuation is continued to the year 2030 from which point the terminal value is established.

Arrowhead Fair Value Bracket	Low	High
Terminal Value (TV) (USD '000)	5,38,694	6,15,851
Present Value of TV (USD '000)	2,10,550	2,40,707
Present Value of FCFF (USD '000)	1,47,399	1,70,325
Present Value of TV+FCFF (USD '000)	3,57,949	4,11,033
Less: Net Debt (USD '000)	68,331	68,331
Total Present Value of Equity (USD '000)	2,89,618	3,45,821
Shares O/s (000's)	88,330	88,330
Fair Share Value Bracket (USD)	3.1	3.9
USD/CAD ^{xxxix}	1.33	1.33
Fair Share Value Bracket (CAD)	4.4	5.2
Current Market Price (CAD)	3.6	3.6
Upside/(Downside)	21.1%	44.6%
Current Market Cap. (CAD '000)	3,17,989	3,17,989
Target Market Cap. Bracket (CAD '000)	3,85,192	4,59,942

Sensitivity Analysis

Sensitivity Table - Low		WACC (%)				
		8.4%	10.4%	12.4%	14.4%	16.4%
GROWTH RATE (%)	0.8%	7.9	5.7	4.3	3.3	2.6
	0.9%	8.0	5.8	4.3	3.3	2.6
	1.0%	8.1	5.8	4.4	3.4	2.6
	1.1%	8.2	5.9	4.4	3.4	2.7
	1.2%	8.3	5.9	4.4	3.4	2.7

Sensitivity Table - High		WACC (%)				
		8.4%	10.4%	12.4%	14.4%	16.4%
GROWTH RATE (%)	0.8%	9.3	6.8	5.1	4.0	3.2
	0.9%	9.4	6.8	5.2	4.0	3.2
	1.0%	9.5	6.9	5.2	4.1	3.2
	1.1%	9.6	6.9	5.2	4.1	3.3
	1.2%	9.7	7.0	5.3	4.1	3.3

Valuation Methodology: The Arrowhead fair valuation for 5N Plus is based on the DCF method. The time period chosen for the valuation is 84 months (2023E-2030E).

Time Horizon: The Arrowhead fair valuation for 5N Plus Inc. is based on the DCF method. We have assumed a longer time horizon. The later years are heavily discounted and have a marginal effect on valuation, which are included primarily to present a full project cycle situation.

Underlying Business Plan: 5N Plus engages in the manufacturing and sales of specialty metals and chemicals. The company produces a range of products used as an input in industries such as solar photovoltaics, LEDs, and ecofriendly materials.

Terminal Value: Terminal value is estimated to depend on a terminal growth rate of 1.0%, representing maturity, technology change, and prospective competitiveness in the business.

Prudential Nature of Valuation: This Arrowhead Fair Value Bracket estimate is a relatively prudential estimate as it is based upon the company's business model.

Important Information on Arrowhead Methodology

The principles of the valuation methodology employed by Arrowhead BID are variable to a certain extent, depending on the sub-sectors in which the research is conducted. But all Arrowhead valuation researches possess an underlying set of common principles and a generally common quantitative process.

With Arrowhead commercial and technical due diligence, the company researches the fundamentals, assets and liabilities of a company, and builds estimates for revenue and expenditure over a coherently determined forecast period.

Elements of past performance such as price/earnings ratios, indicated as applicable, are mainly for reference. Still, elements of real-world past performance enter the valuation through their impact on the commercial and technical due diligence.

Arrowhead BID Fair Market Value Bracket

The Arrowhead Fair Market Value is given as a bracket. This is based on quantitative key variable analyses such as key price analysis for revenue and cost drivers or analysis and discounts on revenue estimates for projects, especially relevant to projects estimated to provide revenue near the end of the chosen forecast period. Low and high estimates for key variables are produced as a valuation tool.

In principle, an investor comfortable with the high brackets of our key variable analysis will align with the high bracket in the Arrowhead Fair Value Bracket, and, likewise, in terms of low estimates. The investor will also note the company's intangibles to analyze the strengths and weaknesses, and other essential company information. These intangibles serve as supplementary decision factors for adding or subtracting a premium in the investor's own analysis.

The bracket should be taken as a tool by Arrowhead BID for the reader of this report and the reader should not solely rely on this information to make his decision on any particular security. The reader must also further understand that while on the one hand global capital markets contain inefficiencies, especially in terms of information, on the other, corporations and their commercial and technical positions evolve rapidly. This present edition of the Arrowhead valuation is for a short to medium-term alignment analysis (one to twelve months). The reader should also refer to important disclosures on page 30 of this report.

Appendix

5N Plus Inc. Balance Sheet Forecast

CONSOLIDATED BALANCE SHEET

*all figures in '000 USD,
unless stated differently*

Low-bracket estimates

<i>December Ending</i>	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Total Current Assets	1,87,313	1,86,028	2,04,064	2,22,474	2,47,640	2,77,433	3,08,345	3,31,841
Total Non-Current Assets	1,63,401	1,65,053	1,65,621	1,66,254	1,66,817	1,67,243	1,67,479	1,69,896
TOTAL ASSETS	3,50,715	3,51,082	3,69,685	3,88,727	4,14,457	4,44,676	4,75,824	5,01,737
Total Current Liabilities	81,641	70,312	71,600	68,674	67,978	68,400	66,754	56,310
Total Non-Current Liabilities	1,40,481	1,33,921	1,27,677	1,21,728	1,16,069	1,10,700	1,05,625	1,00,856
TOTAL LIABILITIES	2,22,121	2,04,233	1,99,277	1,90,402	1,84,047	1,79,099	1,72,379	1,57,166
Total Shareholders' Equity	1,28,593	1,46,849	1,70,408	1,98,326	2,30,409	2,65,577	3,03,445	3,44,571
TOTAL LIABILITIES and EQUITY	3,50,715	3,51,082	3,69,685	3,88,727	4,14,457	4,44,676	4,75,824	5,01,737

CONSOLIDATED BALANCE SHEET

*all figures in '000 USD,
unless stated differently*

High-bracket estimates

<i>December Ending</i>	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Total Current Assets	1,91,040	1,94,374	2,16,757	2,40,211	2,71,297	3,07,840	3,46,158	3,77,099
Total Non-Current Assets	1,63,401	1,65,053	1,65,621	1,66,254	1,66,817	1,67,243	1,67,479	1,69,896
TOTAL ASSETS	3,54,442	3,59,428	3,82,378	4,06,465	4,38,114	4,75,083	5,13,637	5,46,995
Total Current Liabilities	81,708	70,745	72,389	69,716	69,312	70,074	68,662	57,816
Total Non-Current Liabilities	1,40,481	1,33,921	1,27,677	1,21,728	1,16,069	1,10,700	1,05,625	1,00,856
TOTAL LIABILITIES	2,22,189	2,04,666	2,00,066	1,91,444	1,85,381	1,80,774	1,74,288	1,58,671
Total Shareholders' Equity	1,32,253	1,54,761	1,82,312	2,15,020	2,52,733	2,94,310	3,39,350	3,88,324
TOTAL LIABILITIES and EQUITY	3,54,442	3,59,428	3,82,378	4,06,465	4,38,114	4,75,083	5,13,637	5,46,995

Analyst Certifications

I, Ayushi Saraswat, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security and the subject company.

I, Sumit Wadhwa, certify that all of the views expressed in this research report accurately reflect my personal views about the subject security and the subject company.

Important disclosures

Arrowhead Business and Investment Decisions, LLC received fees in 2016-23 and will receive further fees in 2024 from 5N Plus Inc. for researching and drafting this report and for a series of other services to 5N Plus Inc., including distribution of this report, investor relations and networking services. Neither Arrowhead BID nor any of its principals or employees own any long or short positions in 5N Plus. Arrowhead BID's principals intend to seek a mandate for investment banking services from 5N Plus in 2024 or beyond and intend to receive compensation for investment banking activities for 5N Plus in 2024 or beyond.

Aside from certain reports published on a periodic basis, the large majority of reports are published by Arrowhead BID at irregular intervals as appropriate in the analyst's judgment.

Any opinions expressed in this report are statements of our judgment to this date and are subject to change without notice.

This report was prepared for general circulation and does not provide investment recommendations specific to individual investors. As such, any of the financial or other money-management instruments linked to the company and company valuation described in this report, hereafter referred to as "the securities," may not be suitable for all investors.

Investors must make their own investment decisions based upon their specific investment objectives and financial situation utilizing their own financial advisers as they deem necessary. Investors are advised to gather and consult multiple information sources before making investment decisions. Recipients of this report are strongly advised to read the information on Arrowhead Methodology section of this report to

understand if and how the Arrowhead Due Diligence and Arrowhead Fair Value Bracket integrate alongside the rest of their stream of information and within their decision-making process.

Past performance of securities described directly or indirectly in this report should not be taken as an indication or guarantee of future results. The price, value of, and income from any of the financial securities described in this report may rise as well as fall and may be affected by simple and complex changes in economic, financial and political factors. Should a security described in this report be denominated in a currency other than the investor's home currency, a change in exchange rates may adversely affect the price of, value of, or income derived from the security.

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Other than disclosures relating to Arrowhead Business and Investment Decisions, LLC, the information herein is based on sources we believe to be reliable but is not guaranteed by us and does not purport to be a complete statement or summary of the available data.

Notes and References

ⁱ Bloomberg as on December 21, 2023

ⁱⁱ Bloomberg as on December 21, 2023

ⁱⁱⁱ 3-month average volume from Bloomberg as on December 21, 2023

^{iv} Bloomberg as on December 21, 2023

^v Source: Company Filings

^{vi} Source: MDA FY 2021 & 2019.

^{vii} Source: Company Filings

^{viii} Source: Company Filings MDA

^{ix} Source: Company Filings

^x Source: Company Website, AIF

^{xi} Source: AIF

^{xii} Source: Company Filings

^{xiii} Source: <https://www.industryarc.com/Report/19363/multi-junction-solar-cells-market.html#:~:text=Multi%2DJunction%20Solar%20Cells%20Market%20is%20forecast%20to%20reach%20%243.5,the%20multi%2DJunction%20solar%20cell>.

^{xiv} Source: <https://www.edge-ai-vision.com/2020/07/medical-imaging-semiconductor-technology-is-a-key-enabler-for-truly-dedicated-solutions/>

^{xv} Source: https://siliconsemiconductor.net/article/100096/Medical_Imaging_Chip_Global_Unit_Volume_To_Soar_Over_the_Next_Five_Years

^{xvi} Source: <https://passive-components.eu/wide-bandgap-materials-the-future-of-high-power-density-high-efficiency-circuits/>

^{xvii} Source: <https://www.transparencymarketresearch.com/pressrelease/wide-band-gap-semiconductor-market.htm>

^{xviii} Source: <https://www.newswire.ca/news-releases/5n-plus-enters-additive-manufacturing-am-market-substantially-expanding-the-company-s-total-addressable-market-for-engineered-powders-859671299.html>

^{xix} Source: <https://matmatch.com/learn/material/metal-powders-3d-printing>

^{xx} Source: <https://www.webmd.com/vitamins/ai/ingredientmono-1502/bismuth>

^{xxi} Source: <https://www.persistencemarketresearch.com/market-research/bismuth-market.asp>

^{xxii} Source: https://microbioncorp.com/_news/5n-plus-acquires-stake-in-microbion-and-secures-drug-substance-manufacturing-rights

^{xxiii} Source: <https://www.vetalis.fr/en/importance-trace-elements/>

^{xxiv} Source: <https://www.researchandmarkets.com/reports/4515660/feed-minerals-market-growth-trends-and>

^{xxv} Source: <https://www.marketdataforecast.com/market-reports/global-feed-mineral-market>

^{xxvi} Source: <https://www.newswire.ca/news-releases/5n-plus-announces-entry-into-specialized-materials-for-feed-additives-industry-662536923.html>

^{xxvii} Source: <https://www.william-rowland.com/news/item/low-melting-po-what-are-they#:~:text=A%20low%20melting%20point%20alloy,melted%20at%20a%20low%20temperature.&text=They%20are%20also%20commonly%20eutectic,temperature%20like%20a%20pure%20metal>.

^{xxviii} Source: https://www.globalspec.com/learnmore/materials_chemicals_adhesives/metals_alloys/nonferrous_metals_alloys/lead_tin_low_melting_alloys_white_metals

^{xxix} Source: Company Website

^{xxx} Source: <https://www.britannica.com/technology/pigment>

^{xxxi} Source: <https://www.pcimag.com/articles/105162-report-predicts-metallic-pigments-market-to-reach-23-billion-by-2024>

^{xxxii} Source: <https://www.sciencedirect.com/topics/materials-science/vanadate>

^{xxxiii} Source: Company Filings MDA

^{xxxiv} Source: Company Filings

^{xxxv} Source: Bloomberg as on December 21, 2023

^{xxxvi} Source: Company Website

^{xxxvii} Source: Company Website

^{xxxviii} Bloomberg as on December 21, 2023

^{xxxix} Source: Google finance As on December 21, 2023