

Price Evaluation of Nickel Wire NP1

for

Alkemya Luxembourg Sarl

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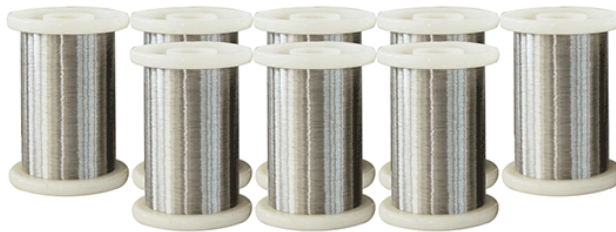


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1. Scope of the appraisal

Alkemya Luxembourg S.A.R.L ("**Alkemya**") is an international high-tech metals firm specialising in sourcing and distributing Rare Earth oxides, Titanium, and Nickel wire, which are increasingly crucial to R&D and manufacturing companies in electronics, aerospace, defence and other high-technology industries. At Alkemya's request, ASACERT UK has appraised the market value for a specific commodity, namely:

- "**Bobbins containing NP1 Nickel Wire - 0.025 mm, 99.99+% purity, hard¹**".

Disclaimer

ASACERT UK has conducted an independent appraisal of the stock of Nickel Wire owned by Alkemya, with the information gathered from these sources is believed to be reliable. No assurances can be given that the information obtained is accurate. Our physical inspection verified the suitability of the storage site from the point of view of microclimate conditions and safety. All rights are reserved.

Privacy Policy

The Data Controller is ASACERT UK. The data management is carried out within the ASACERT UK and in compliance with the provisions established according to and for Data Protection Act 2018 (DPA 2018) and the UK General Data Protection Regulation (UK GDPR).

¹ Confirmed by Allkema Engineering s.r.l. in their certificate of analysis dated 13th December 2022 and also in a report by the Nanyang Technological University, Singapore dated 28th February 2023 and by the Indian Institute of Technology, New Delhi in their laboratory tests completed on 15th March 2023.

2. Framework for Appraisal

Commodities are usually associated with raw materials - a specific category of goods traded on the market without qualitative differences. Moreover, they are fungible; so, products of similar properties can be used interchangeably.

Nickel is a transition element (symbol Ni and atomic number 28) that exhibits properties of both ferrous and non-ferrous metals. Nickel is extracted from laterite ores & sulfide ores. Laterite ores are used to extract Class II Nickel (purity < 99.8%), while sulfide ores are used to extract Class I Nickel (purity > 99.8%). Using High-Pressure Acid Leach (HPAL), laterite ores can also be used to extract Class I Nickel. Through a process of beneficiation, extraction and refining these ores are converted to Nickel Ingots, which are generally divided into Class 1 and Class 2 Nickel.

Nickel Class I describes a group of nickel products comprising electrolytic Nickel, powders and briquettes used for hi-technology applications in Industry 4.0 products in the form of coils, wires, and meshes among others. Nickel Class II comprises of nickel pig iron and ferronickel which due to lower nickel content are used principally in stainless steel production.

At present, global production of Nickel is roughly equally divided between Class 1 (46% of global) and Class 2 (54% of global). In terms of global nickel demand, approximately 74% stems from stainless steel production, which can use both Class 1 and Class 2 Nickel; whilst only about 5-8% of demand currently stems from batteries that require Class 1 Nickel, as the quality and performance of batteries depend on the quality of Nickel used to make them². However, increasingly, new use cases for Class 1 Nickel have emerged across other industries, which are further detailed later and are expected to account for the rise in demand for Class 1 Nickel.

The appraisal is in the context of:

- **Demand and supply factors and its applications:** Commodity markets rely primarily on demand and supply patterns to determine the price of the underlying commodity. Since Nickel has several direct and indirect demand and supply factors, we determined that it would be appropriate to analyse the market for Nickel wire along with its various applications. This would provide meaningful insights into the product's potential and the factors that could impact its value.
- **Market prices:** Pricing of similar products is a crucial indicator of the value arrived at by the demand and supply economics of the commodity. Since the market prices of similar products are available, we have relied on the prices quoted by reputed dealers of Nickel wire in our analysis.

² Source: [Fitch Solutions](#)

3. Evaluation of the Commodity

Nickel wire class "NP1", according to GOST 492 (GOST is an acronym for Gosudarstvennyy Standard) or similarly according to the American Society for Testing and Materials (ASTM) standards, is an ultra-pure Nickel, characterised by a content of Nickel greater than or equal to 99.99%.

The asset/property under price evaluation is Class NP1 0.025 mm, 99.99% Hard Nickel Wire.

3.1 Demand Supply and Applications

The diagram below shows the different stages of Nickel Class 1 wire processing:

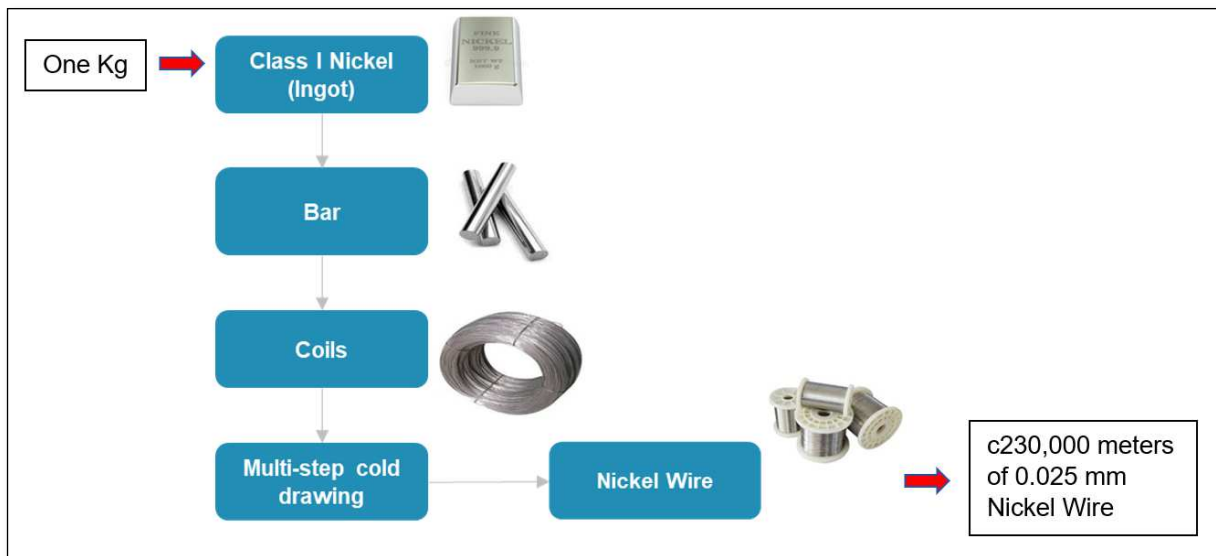


Figure 1 - Conversion of Ingot to Wire

As can be seen, the conversion of 1 Kg of Class 1 Nickel ingot to 0.025 mm Class NP1 Nickel wire is an extremely sophisticated and time and capital-intensive process. Pristine Nickel has unique physical, mechanical, electrical, and magnetic properties which are uniform, predictable and repeatable. Given its unique physical properties, Class 1 Nickel wire derives its value from multiple use cases in aerospace, military applications, microelectronics, electric vehicles (EVs), etc. This is especially applicable for high-value-added applications, such as in advanced microelectronic systems in the communications, aerospace and defence industries. It is also useful where excellent ductility values in the hardened state, extremely high corrosion resistance, along with low density, high thermal and electrical conductivity values are required. It is resistant to corrosion in air or water, and hence is used as a protective coating. It is readily soluble in dilute acids but is unaffected by alkalis. Examples of use are in hydrometallurgical processes, electromagnetic shielding, etc. Nickel wire has widespread uses, and over the past few years, it has become the material of choice, especially for Industry 4.0 applications. Nickel wire being a

versatile material, has applications across a variety of engineering disciplines ranging from automotive to aerospace.

A brief potential of **Nickel wire's application** in various new use cases has been provided below:

- **Microelectronics:** Nickel wire is the material of choice in products that require shielding from radio frequency (RF) and thermal emissions. These include microelectronics, rechargeable batteries, navigation devices and high-precision electrical devices. Additionally, many equipment components need to be protected from polluting electromagnetic interference, and Nickel wire cladding or mesh is a preferable antidote. It reliably enhances connectivity while being economical and advantageous compared to its potential substitutes such as Gold and Silver. This is by far the largest segment that would find applications of the Class 1 99.99% pure-Nickel wire; therefore, commercialisation is the only next logical step.
- **Chemical industry:** Nickel wire mesh is now widely used in the chemical industry in product and process functions. The common process applications include Nickel filtration media, Nickel catalyst and as electrodes. These media, in turn, have applications in desalination plants, recovery of rare earths and Platinum Group Metals (PGMs) from e-waste and catalytic converters, etc. Class 1 Nickel wire meshes are also used in nutraceutical and pharma applications, maintaining hydraulic and fuel hygiene in aero engines and systems, etc. Use of Nickel wire meshes as filters for sea water cooling systems used in nuclear power plants is under investigation, as its resistance to microbial organisms is significant in flowing water.
- **Military aircrafts:** Nickel wire, due to its excellent magneto strictive properties and its workability, is finding applications as radar absorbent material (RAM) on military aircrafts, unmanned aerial vehicles (UAVs) and other platforms as RAM meshes. Particularly in the case of military aircrafts, these meshes require about 5,500 linear meters of wire to make just one sq. m. of 400 grade Nickel wire mesh. In fact, Class1 Nickel Wire meshes are already being used on the F-22 and F-35 fighter aircrafts, to improve their stealth features.
- **5G systems:** Ultra-thin Nickel wire/mesh has potential applications as a flexible antenna in 5G systems and products. This is currently being investigated and if found suitable would naturally fit into futuristic 6G systems as well.
- **Satellites:** Nickel wire is used in the construction of the electronic circuits for satellites, where properties such as thermal stability, lightness, resistance to oxidation are considered essential for the success of missions and to increase the

operational life of satellites. A similar requirement is felt for long storage weapons such as missiles and torpedoes which must remain 100 % functional whenever required, even though they may be stored for several years.

- **Electric vehicles (EVs) and renewable energy systems:** Only Class 1 Nickel wire is used as an electrode for solar panels, wind turbines and other renewable energy sources, including fuel cell and batteries. The major advantage of using Class 1 Nickel in batteries is that it helps deliver higher energy density, longer life and greater storage capacity at a lower cost. Further advances in battery chemistry using Nickel as an electrode, implies that it is set for an increasing role in energy storage systems, helping make the cost of each kWh of battery storage more competitive and overall cost of intermittent renewable energy sources (such as wind and solar) more viable.

Moreover, EV batteries need NP1 pure-Nickel to manufacture cathodes³. Compared to other types of wire mesh, Nickel wire mesh have better electron conduction properties and they also have good electrical, thermal and magnetostrictive property making them a unique option for hydrogen fuel cells in the transportation and renewable energy segment. The successful conversion of Class 2 Nickel to Class 1 Nickel remains technically and environmentally challenging at this stage; hence, Class 1 Nickel will remain the only option at least into the medium term for this sector.

Based on market statistics and rising use cases, the global market of high purity Nickel has been on a steady rise over the last decade and is expected to continue its growth over the next few years, especially with more and more key players adopting new use cases to substitute existing materials with Nickel and design new systems using high purity Nickel. A key point to note here is that pure Nickel is 100% recyclable and thus contributes to the global thrust on sustainability and the circular economy.

Hence, it is clear that demand for ultra-pure ultra-thin Nickel wire for applications across different industries is substantial and is rising year-on-year. Moreover, as these industries mature, the total annual demand across the legacy and emerging use cases may exceed several billion linear meters of wire, in the medium term itself. The primary driver for demand and supply mechanics of the asset, is driven by applications and not merely by the base metal price. Moreover, given the constraints of technology and capital on the supply side, buoyancy in Nickel wire prices is a reasonable expectation over the medium term.

³ The global green transition and electrification of transport has started a paradigm shift in the demand dynamics of metals, with metals required in the low-carbon future set to experience a significant boost in demand in the coming decade at least. Battery grade Nickel, or Class 1 Nickel (containing more than 99.8% Nickel content), used in rechargeable batteries is a major beneficiary, especially as the configuration of Lithium Nickel Manganese Cobalt (LNMC) oxide batteries, used in electric vehicles (EV), is changing, with a shift from a 1:1:1 ratio (meaning Nickel, Manganese and Cobalt were used in the same proportion) to 5:3:2, and now to the latest 8:1:1 (with eight parts Nickel to one part of Manganese and Cobalt each). Source: [Fitch Solutions](#)

3.2 Alternative Metal Wires – Properties vs Price Comparison

Amongst a wide variety of available metals, drawing very fine wires (whose diameter is below 0.1 mm) from the bulk starting material is challenging and requires the material to be ductile and yet retain tensile strength. This has been illustrated in Figure 1 above. Pure (i.e., unalloyed) metals with the Face Centred Cubic (FCC) crystal structure, namely Nickel (Ni), Gold (Au), Silver (Ag), Copper (Cu), Aluminium (Al), Platinum (Pt), Palladium (Pd) are highly ductile and can be drawn into wires of the desired fine diameter. While aluminium has the lowest density, its melting point is low and it has poor corrosion resistance. Whereas densities of Platinum, Palladium, Gold, and Silver are quite high. However, the raw material costs of these metals are also high since they are precious metals.

More importantly, Nickel is one of the four ferromagnetic elements. The others are Iron, Cobalt and Gadolinium. However, the crystal structures of these three elements does not make them amenable to draw fine wires, which are as long and as thin as is feasible in the case of pure Nickel. Consequently, Nickel offers distinct advantages for ferromagnetic applications where specifically, weight, strength, ductility, and malleability to form specific meshes and weaves are the primary design considerations.

Therefore, Nickel stands out as the material of choice, owing to its relatively low density (8.908 g/cm³), high melting point (1455 °C), higher corrosion resistance (compared to aluminium), and high strength (compared to Copper, Silver, Gold, etc.) and is far less expensive (compared to Gold, Silver, and other precious metals). Thus, Nickel has the potential of delivering an excellent value-for-money proposition, especially in certain functional applications, such as aerospace and defence, 5G, etc.⁴

⁴ Source: Research note, “Properties of NP1 CLASS 0.025 mm diameter Nickel wire – test results and observations,” by Professor Upadrasta Ramamurty at the Nanyang Technological University date 28th February 2023

4. Comment on market Value

To arrive at the final cost of production, various fixed and flexible costs need to be captured and accounted for:-

$$C_F = C_M + C_L + C_P$$

Where C_F = Final cost

C_M = Basic material cost

C_L = Logistics cost

C_P = Production cost (HR + Energy + Utilities + Depreciation + Machinery)

And then,

$$\text{Sales Price} = C_F + \text{Overheads} + \text{Taxes} + \text{Profit}$$

An objective estimation of the sale price of the Nickel wire requires an extensive amount of data and a deep understanding of the process, regulatory and compliance environment and tax regime. This is not available at a third-party level. Hence for valuation purposes, an empirical market intelligence-driven approach has been adopted.

Since Class 1 Nickel wire, as stated above, is an intermediate and bespoke product where a Nickel ingot is converted into a refined wire of the required specifications and properties through a sophisticated engineering process for each specific application ranging from aerospace to automotives, there is a daily published price. There are engineering companies that have the capacity to manufacture NP1 0.025 mm diameter of 99.99% or 99.98% purity level (metals basis) wires on a bespoke basis, who publish catalogue prices on the internet.

Crucially, the actual price paid for Nickel wire of this purity, or the 'market' price, is not published given the over the counter ("OTC") nature of buying and selling. The OTC price paid is a function of the quantity ordered. Smaller the quantity ordered, classified as retail orders, say 1 to 5 or 5 to 10 linear metres, usually less than 100 metres (the retail breakpoint is 25,000 metres), which is the usual order size from R&D laboratories, the higher the price, as the cold press refining engineering process is an expensive process to run and therefore has a higher breakeven production cost, especially for small lot sizes. Two empirical examples in support of this phenomenon are: i) the UK, where Alfa Aesar⁵ indicates a published catalogue price of GBP 264/metre⁶ and ii) Japan, where Alfa Aesar indicates a published catalogue price of GBP 343.20/metre⁷; albeit for 40672 Nickel wire, 0.025 mm dia., hard, 99.98% (metals basis) product, which is a grade lower than the asset under evaluation. These two markets are known to be the active buyers of Nickel wire of this purity level for R&D purposes carried out at universities and research centres. Alfa Aesar publishes catalogue prices for most countries, but they are understood to underscore the fact that the Company is able to quote a price only if requested and against a firm order. However, the lower price published is not the OTC price level.

Hence, this should not be taken as the 'traded market price'. It is merely an indicative OTC price level as these are nominal orders, mostly for R&D applications. Moreover, the California Fine Wire Company indicates that it can supply Nickel wire as well, but every OTC order must be confirmed by paying a 10 % non-refundable deposit.

The larger orders, classified as wholesale orders, placed by industrial companies are sold at a volume discount that is bilaterally negotiated given its specialised applications and industrial use. Since there is no ready stock of NP1 CLASS 0.025 mm diameter Nickel Wire of 99.99% purity available (owing to the higher cost of capital to manufacture and stock it), the sellers determine the price and the discount for each customer. Bulk orders, in whatever way defined, are expected to be priced uniquely on a case-by-case basis, depending upon the application, required quantity and delivery schedule.

⁵ Alfa Aesar is a subsidiary of Thermo Fisher Scientific Corporation (www.thermofisher.com). Thermo Fisher Scientific is a New York Stock Exchange listed company (NYSE Stock Symbol: TMO). It is one of the world's leading scientific companies that provides specialised products including smaller quantities of Nickel wire to the leading research and industrial laboratories and institutes. To check the price, please go to the Alfa Aesar website (<https://www.alfa.com/en/catalog/040672/>). This will provide you with the Nickel wire prices for 40672 Nickel wire, 0.025 mm dia., hard, 99.98% (metals basis) product which is not 99.99% purity level product offered by Alkemya. If you logged on to this website from your home country, then you will need to go down to the bottom right-hand corner of the web page where you will see a light green link for Region/Language. You will need to switch it to Japan or United Kingdom and save the change as your location and you will see the current price quote as of that date on per linear meter basis for 40672 Nickel wire, 0.025 mm diameter, hard, 99.980% on a metals basis.

⁶ Source: [Alfa Aesar by Thermo Fisher Scientific](#) - Country selected - the UK

⁷ Source: [Alfa Aesar by Thermo Fisher Scientific](#) - Country selected - Japan

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In view of the above, it would be fair to say that the smaller retail orders owing to the higher cost of production, are sold at higher prices and the larger wholesale orders are sold at a volume discounted price, subject to delivery schedules.

Therefore, to objectively arrive at an indicative price of the Nickel wire, recourse was taken from the [M/s Goodfellow](#) website. The Company was established in London in 1946 and has been supplying the world of R&D and various industries with materials and solutions for over 75 years. The following information was obtained from their website:

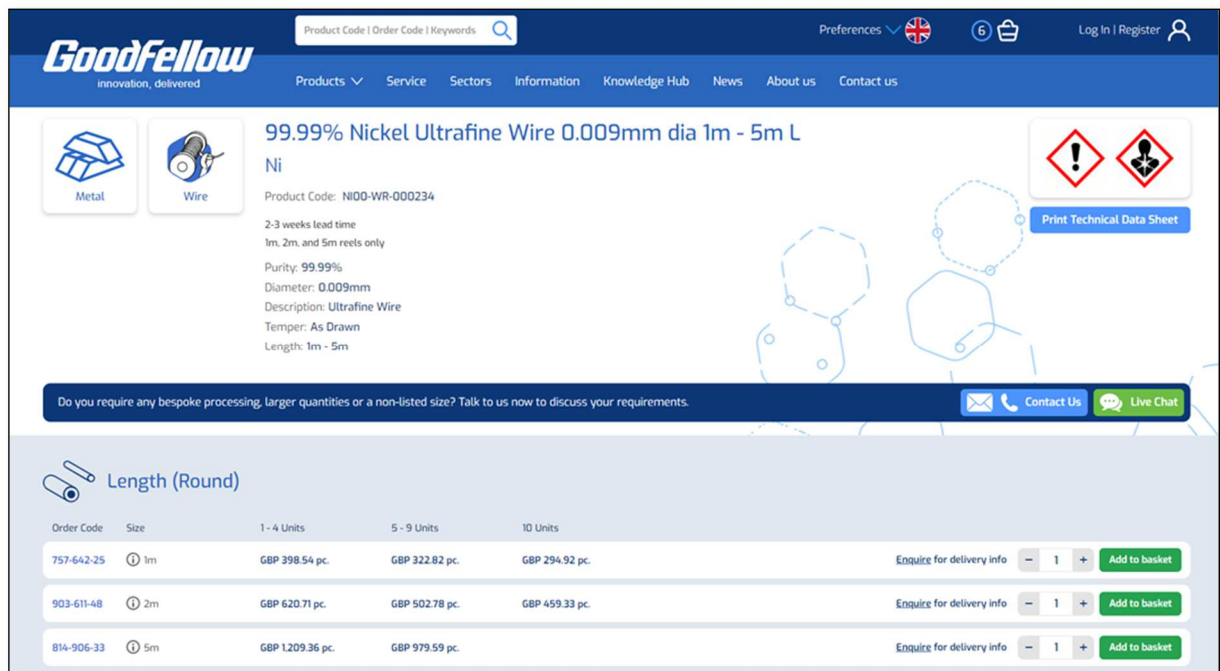


Figure 2 - Screenshot of Goodfellow website taken on 23 Mar 2023

It should be noted from Figure 2 that this price is for the nearest equivalent product that is comparable to the asset undervaluation. For this product, the price per linear meter varies from GBP 398.54 per piece of 1 m length to GBP 979.59 per piece of 5 m length. On a conservative basis, the lower price is taken, which is GBP 979.59 / 5 m or GBP 195.92 per meter. As per preliminary discussion, the discount that may be available, depending upon delivery periods and packaging requirements would not exceed 10%. Therefore, the best price per linear meter for this product would be approximately GBP 176.33 per meter.

Further, the wire diameter (0.009 mm) of this product is thinner than the diameter (0.025 mm) of the asset undervaluation. By extrapolation, the price per meter – balancing larger metal and lesser cold drawing requirements due to increased diameter, the price may further reduce, but by no more than 5%.

Hence, it is a reasonable expectation that for smaller volumes of Class 1 Nickel Wire of size 0.025 mm, the price point may be in the range of GBP 165 - 170 per meter or GBP 167.5 per linear meter on an average, as a working estimate. For bulk orders, quantity discounts may or may not be available depending upon the delivery schedule, the application, the

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availability of stock, etc. Therefore, no discount is factored in this evaluation, as no hard evidence was uncovered during the review and valuation process.

Considering all of the above, a reasonable appraised value of NP1 CLASS 0.025 mm diameter Nickel wire of 99.99% purity owned by Alkemya, which is held at Helvetic Securgest SA ("**Helvetic Securgest**"), a third-party custodian located at Piazzetta Santa Lucia, Lugano, Switzerland⁸, can be arrived at and is summarised in the Table 1 shown below:

Stock Held (m)	Price (GBP/m)	Value in GBP	Price (USD/m)	Value in USD
6,403,333.33	167.5	1,072,558,333	205.81	1,317,852,423
623,571.43	167.5	104,448,215	205.81	128,335,521
7,026,904.76	167.5	1,177,006,547	205.81	1,446,187,945

Table 1 - Valuation of Asset

Note: 1 GBP = 1.2287 USD⁹: Hence, price per linear meter is USD 205.81 (i.e., GBP 167.5 x 1.2287)

⁸ Nickel wire quantity. Source: Asacert Physical Inventory Inspection Report dated 6th December 2022, includes Allkema Engineering s.r.l. laboratory test results, confirming the Nickel wires' chemical composition and 99.99% purity and the Safe Keeping Receipts (SKRs) issued by Helvetic Securgest, confirming the quantity and ownership.
⁹ Source: Bloomberg - Closing rate as of 23 Mar 2023 used; accessed at 1545 hrs IST on 24 Mar 2023.

5. Conclusion

As evident from the above, Nickel's unique properties offer better value for Industry 4.0 applications. Since Nickel wire NP1 has significant demand potential and limited supply expansion opportunities, the fact that Alkemya already owns ~ 7 million linear meters of ultra-pure ultra-thin Nickel wire, should enable it to command a price premium over the medium term.

Please note that a real price discovery may only be possible on the basis of a firm contract, signed off on a particular date and for a specific delivery period. To avoid any doubt, the commercial prices at which the actual sales are completed would depend on individual circumstances and may vary from the price derived in this valuation. This appraisal is only intended to provide an estimation of the fair market valuation of the asset.

Our judgement is that the asset is valued at about **USD 1,446,187,945**.

The Client may request the removal, integration or addition of assets to be included in the appraisal as necessary. ASACERT S.r.l., having evaluated the request, will amend or rectify the file, also in the event of any incorrect information or documentation supplied, provided that the relative notification is received by the Assessment Company within 30 days from the sending of the file.

Please do not hesitate to contact us for any further information, kindest regards.

Manchester, 5 May 2023

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