PyroGenesis Announces Improved Economics for Fumed Silica Reactor Project

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MONTREAL, Jan. 11, 2024 (GLOBE NEWSWIRE) -- PyroGenesis Canada Inc. (http://pyrogenesis.com) (TSX: PYR) (OTCQX: PYRGF) (FRA: 8PY), a high-tech company (the “Company” or “PyroGenesis”) that designs, develops, manufactures and commercializes advanced plasma processes and sustainable solutions which are geared to reduce greenhouse gases (GHG) and address environmental pollutants, is pleased to announce that, further to the press release of HPQ Silicon Inc. (“HPQ”) dated January 10, 2024 , the recent completion of an internal economic and technical study produced more favorable results than were previously indicated by HPQ for its Fumed Silica Reactor (FSR) technology project. This latest study was carried out at the request of a third-party corporation, which will not be named pursuant to the terms of a non-disclosure agreement. According to HPQ, this latest study confirms the viability of, and advantages from, scaling up the FSR from the current 50 tonnes per year (TPY) pilot plant configuration to a 1,000 TPY commercial configuration. [1] [2]

According to HPQ’s release, “the study unveiled its robust economic potential, emphasizing potential EBITDA margins three times higher than the industry average of 20% [3] and a capital investment 93% less than that required for building a conventional Fumed Silica plant [4]”.

As stated in PyroGenesis’ news release dated November 9, 2023, the production of the fumed silica reactor pilot plant is already underway, with a planned completion by Q2 2024. The Company confirms this timeline to be on track.

The FSR, another plasma-based process developed by PyroGenesis, converts quartz into commercial-grade fumed silica (or Pyrogenic Silica) in a single and eco-friendly step. By eliminating the use of harmful chemicals generated by conventional methods, the groundbreaking FSR approach, if successfully applied on a commercial scale, will contribute to the repatriation of silica production to North America.

With respect to the results of this latest study, the Company, in conjunction with management of HPQ Polvere (the HPQ subsidiary which owns the FSR technology), used a rough order of magnitude study regarding the cost of building the first 1,000 TPY Fumed Silica Reactor. HPQ’s management then used selling prices for the Fumed Silica and potential operating costs from information derived from third party sources and publicly available data.

The salient points of the internal economic study indicate that the FSR will have:

- Capex between US$ 9.00 and US$ 10.00 cost per Kg of annual capacity [5]
- Energy consumptions between 10 –15 KWh per Kg of Fumed Silica [6]
- EBITDA margins between 60% and 65% [7]
- Payback period per 1,000 TPY Reactor of around 1.7 years [8]

“If these salient points of the internal economic study are proven out, then HPQ will be able to build facilities with significantly lower CAPEX and energy consumption while generating significant margins,” said Mr. P. Peter Pascali, President and CEO of PyroGenesis. “The payback of approx. 1.7 years will enable them to roll out significantly faster and with less capital. Not only does this speak for significant financial gains, but given this revolutionary plasma-based technology eliminates all harmful chemicals, it is environmentally friendly. It also underscores PyroGenesis' commitment to sustainable development. This once again, reflects the potential of HPQ Polvere's fumed silica reactor which we developed, and aligns perfectly with our commitment to environmental responsibility. Conventional fumed silica processes, which rely on silicon metal (Si) as raw material, not only have a significant carbon footprint of around 9.5 tonnes of CO_2 equivalent per tonne of fumed silica, but also present complex process challenges which include, but are not limited to, using hazardous materials.[9] These latest economic and technical indicators provide more evidence that the technology developed by PyroGenesis for HPQ Polvere will offer significant economic and environmental advantages over conventional manufacturers – improving profitability, but also reducing the environmental footprint associated with fumed silica production.”

PyroGenesis is an exclusive service provider for HPQ Polvere in respect of the FSR project. As part of the terms on their commercial engagement, PyroGenesis will receive royalty payments representing 10% of HPQ Polvere’s eventual sales, with set minimums. In addition, PyroGenesis may, at any time, convert its right to this royalty stream into a 50% ownership stake in HPQ Polvere remaining equity in HPQ Polvere.

PyroGenesis’ involvement in developing fumed silica from quartz is part of PyroGenesis’ three-tiered solution ecosystem that aligns with economic drivers that are key to global heavy industry. High-purity silicon is part of PyroGenesis’ Commodity Security & Optimization tier, where the recovery of viable metals and the optimization of production to increase output helps to maximize raw materials and improve the availability of critical minerals. Silicon has been identified as a critical mineral by many governments worldwide.

REFERENCE SOURCES

[1] The scale-up from the 50 TPY pilot plant to a commercial 1,000 TPY represents a factor of 20. Literature on the subject, such as 'Plant Design and Economics for Chemical Engineers' by Peters & Timmerhaus, suggests that scale-ups of pilot equipment to industrial scale, by a factor of 5, 10, or 20, are reasonable and easily achievable.

[2] HPQ Silicon June 13, 2023, and November 8, 2023 releases

[3] Average EBITDA margins of 20% are derived from two sources, with Link #1 leading to Source #1 and Link #2 leading to Source #2 (Specialty Additives division). Management has calculated the EBITDA margins for the Fumed Silica Reactor (FSR) based on proprietary operational data accumulated over the years. These figures will be updated upon completion of the pilot testing phase. The 5% range in HPQ Polvere's EBITDA margins takes into account PyroGenesis' option to convert its 10% royalties into a 50% ownership stake in HPQ remaining equity in HPQ

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[4] Traditional Fumed Silica manufacturing involves a complex three-step process. Step 1: Conversion of Quartz to Silicon Metal (Si), with an average Capex of around US$9.38 per kilogram of annual capacity (for reference, the PCC BakkiSilicon Plant in Iceland cost US$300 million for an annual capacity of 32,000 tonnes). Step 2: Conversion of Si to Silicon Tetrachloride (SiCl4), with an average Capex of approximately US$125.00 per kilogram of annual capacity (e.g., Wacker Chemie AG Polysilicon's US production plant cost US$2.5 billion for an annual capacity of 20,000 tonnes). Step 3: Burning Silicon Tetrachloride (SiCl4) with Hydrogen and Oxygen to produce Fumed Silica (SiO2), incurring an average Capex of around US$11.54 per kilogram of annual capacity (Wacker Chemie AG's US Fumed Silica plant cost US$150 million for an annual capacity of 20,000 tonnes). The combined Capex for these three steps averages at US$145.92 per kilogram of annual capacity. According to a rough order of magnitude study by PyroGenesis, our one-step process for making Fumed Silica is estimated to have an average Capex per kilogram of annual capacity between US$9.00 and US$10.00, which is approximately 93% less than traditional processes.

[5] According to a rough order of magnitude study by PyroGenesis, the one-step process for making Fumed Silica is estimated to cost about CAD$13 million, which equals an average Capex per kilogram of annual capacity between US$9.00 and US$10.00.

[6] The 1 Kg eq of CO2 per Kg of Fumed Silica is based on Hydro Quebec data that indicate in Quebec 1.3 g of CO_2 are generated eq per KWh. While the 2.5 is based on the Canadian average for electricity generation carbon intensity of 150 g per KWh.

[7] Management has calculated the EBITDA margins for the Fumed Silica Reactor (FSR) based on operational data accumulated over the years. These figures will be updated upon completion of the pilot testing phase. The 5% range in HPQ Polvere's EBITDA margins takes into account PyroGenesis' option to convert its 10% royalties into a 50% ownership stake in HPQ Polvere's remaining equity."

[8] Management has calculated the Payback for the Fumed Silica Reactor (FSR) based on operational data accumulated over the years. These figures will be updated upon completion of the pilot testing phase.

[9] 2012 – Executive summary: "SILICON-CHEMISTRY CARBON BALANCE. AN ASSESSMENT OF GREENHOUSE GAS EMISSIONS AND REDUCTIONS", Covering the Production, Use and End-of-Life of Silicones, Siloxanes and Silane Products in Europe, North America, and Japan. [Pages 20 to 21] (Commissioned by Global Silicones Council, Centre Européen des Silicones, Silicones Environmental, Health and Safety Council of North America Silicone Industry Association of Japan).

About PyroGenesis Canada Inc.

PyroGenesis Canada Inc., a high-tech company, is a proud leader in the design, development, manufacture and commercialization of advanced plasma processes and sustainable solutions which reduce greenhouse gases (GHG) and are economically attractive alternatives to conventional "dirty" processes. PyroGenesis has created proprietary, patented and advanced plasma technologies that are being vetted and adopted by multiple multibillion dollar industry leaders in four massive markets: iron ore pelletization, aluminum, waste management, and additive manufacturing. With a team of experienced engineers, scientists and technicians working out of its Montreal office, and its 3,800 m^2 and 2,940 m^2 manufacturing facilities, PyroGenesis maintains its competitive advantage by remaining at the forefront of technology development and commercialization. The operations are ISO 9001:2015 and AS9100D certified, having been ISO certified since 1997. For more information, please visit: www.pyrogenesis.com.

About HPQ Silicon

HPQ Silicon Inc. (TSX-V: HPQ) is a Quebec-based TSX Venture Exchange Tier 1 Industrial Issuer.

HPQ is developing, with the support of world-class technology partners PyroGenesis Canada Inc. and NOVACIUM SAS, new green processes crucial to make the critical materials needed to reach net zero emissions.

HPQ activities are centred around the following four (4) pillars:

1. Becoming a green low-cost (Capex and Opex) manufacturer of Fumed Silica using the **FUMED SILICA REACTOR**, a proprietary technology owned by HPQ being developed for HPQ by PyroGenesis.

2. Becoming a zero CO_2 low-cost (Capex and Opex) producer of High Purity Silicon (2N+ to 4N) using our ***PUREVAP™ "Quartz Reduction Reactors" (QRR),*** a proprietary technology owned by HPQ being developed for HPQ by PyroGenesis.

3. Becoming a producer of silicon-based anode materials for battery applications with the assistance of NOVACIUM SAS.

4. HPQ SILICON affiliate NOVACIUM SAS is developing a low carbon, chemical base on demand and high-pressure autonomous hydrogen production system.

For more information, please visit HPQ Silicon web site.

Cautionary and Forward-Looking Statements

This press release contains "forward-looking information" and "forward-looking statements" (collectively, "forward-looking statements") within the meaning of applicable securities laws. In some cases, but not necessarily in all cases, forward-looking statements can be identified by the use of forward-looking terminology such as "plans", "targets", "expects" or "does not expect", "is expected", "an opportunity exists", "is positioned", "estimates", "intends", "assumes", "anticipates" or "does not anticipate" or "believes", or variations of such words and phrases or state that certain actions, events or results "may", "could", "would", "might", "will" or "will be taken", "occur" or "be achieved". In addition, any statements that refer to

expectations, projections or other characterizations of future events or circumstances contain forward-looking statements. Forward-looking statements are not historical facts, nor guarantees or assurances of future performance but instead represent management's current beliefs, expectations, estimates and projections regarding future events and operating performance.

Forward-looking statements are necessarily based on a number of opinions, assumptions and estimates that, while considered reasonable by the Company as of the date of this release, are subject to inherent uncertainties, risks and changes in circumstances that may differ materially from those contemplated by the forward-looking statements. Important factors that could cause actual results to differ, possibly materially, from those indicated by the forward-looking statements include, but are not limited to, the risk factors identified under "Risk Factors" in the Company's latest annual information form, and in other periodic filings that the Company has made and may make in the future with the securities commissions or similar regulatory authorities, all of which are available under the Company's profile on SEDAR+ at www.sedarplus.ca, or at www.otcmarkets.com. These factors are not intended to represent a complete list of the factors that could affect the Company. However, such risk factors should be considered carefully. There can be no assurance that such estimates and assumptions will prove to be correct. You should not place undue reliance on forward-looking statements, which speak only as of the date of this release. The Company undertakes no obligation to publicly update or revise any forward-looking statement, except as required by applicable securities laws.

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