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ASX Announcement (ASX:**AXE**) 28 January 2020

Second-stage ^{12}CQ development commences

Highlights

- Second-stage development to build the ^{12}CQ room-temperature qubit processor ("chip") commences and will focus on quantum measurements.
- Archer expands chip building capabilities by securing access to world-class infrastructure, equipment, and engineers at EPFL in Switzerland.
- Archer has commenced the quantum measurements required to build a working chip prototype and integration onboard modern devices[1].
- Archer holds an exclusive international licence to patents protecting the chip technology.

Archer Materials Limited ("Archer", the "Company", "ASX:**AXE"**) is pleased to announce that the Company has commenced the next-stage of development to advance the commercial readiness of the ^{12}CQ Project which aims to build a quantum computing qubit processor ("chip"). Archer uses a unique carbon-based qubit material that has the potential to enable chip operation at room-temperature and integration onboard modern electronic devices (see *Quantum Technology & Archer's ^{12}CQ Advantage*).

Commenting on the Company's ^{12}CQ developments, Archer CEO, Dr Mohammad Choucair, said: "One of Archer's key development goals is to demonstrate and accelerate the potential for the ^{12}CQ chip integration in modern devices, particularly over the next 12 months. The quantum measurements [to be performed] form the basis of the chip basic function – which is necessary for quantum information processing. Essentially, the 'quantum' in quantum computing."

"The measurements are not routine; we will now expand on Archer's chip development capabilities to include contributing teams at the world-class EPFL to accelerate the development and commercial readiness of the ^{12}CQ chip."

Archer has begun performing measurements on the chip qubit components at various facilities at École Polytechnique Fédérale de Lausanne ("EPFL") in Switzerland, with Archer CEO Dr Mohammad Choucair recently visiting EPFL to secure the long-term commitment of expert quantum technology R&D personnel, and access to world-class infrastructure and equipment required to advance chip development (Image 1).

The measurements to be performed at EPFL will complement the work undertaken at the University of Sydney ("University") Research and Prototype Foundry ("Foundry"). Archer has commercial access to the Foundry, and the University is not involved in developing the ^{12}CQ room-temperature quantum computing chip technology. The ^{12}CQ Project chip development is being completed by Archer's own in-house team, led by CEO Dr Mohammad Choucair and Quantum Technology Manager, Dr Martin Fuechsle.

Image 1. Archer CEO, Dr Mohammad Choucair, at the world-class institute EPFL, located in Switzerland. EPFL is one of Europe's leading science and technology institutions†. During Dr Choucair's previous employment at the University of Sydney, he led and co-invented the research leading to the patented chip technology with R&D teams at EPFL.

Next Steps

The technical development at the heart of ^{12}CQ is a world-first. Archer intends to devise, design, and perform a number of quantum measurements on the chip prototype qubit componentry over the next 12 months in-line with Archer's strategic chip development roadmap and commercialisation plan.

The outcomes and results of the various quantum measurements will be used to validate claims in the patents protecting the chip technology intellectual property and to advance the commercial readiness of the chip.

Archer intends to commercialise chip products through licencing and direct sales by seeking to establish commercial partnerships with highly resourced organisations including software developers and hardware manufacturers, that could allow for product scale, IP transfer, and distribution channels. More information on Archer's ^{12}CQ Project commercial pathway can be found in ASX Announcement 30 Oct 2019.

^{12}CQ Chip Development Background (First-stage)

Archer has recently accomplished outstanding achievements in chip development, as the Company has advanced the commercial readiness of the chip. With access to world-class facilities to build prototype chips (ASX Announcement 3 Apr 2019); Archer successfully begun assembling chip prototypes (ASX Announcement 26 Jun 2019); and recently demonstrated the possibility of qubit scalability in fabrication by precisely positioning the critical chip qubit component (ASX Announcement 26 Aug 2019) creating few-qubit arrays (ASX Announcement 13 Nov 2019).

†EPFL Annual Report https://rapport-annuel.epfl.ch/en/

Quantum Computing Background and Market Summary

Quantum Technology & Archer's ^{12}CQ Advantage

A qubit processor ("Processor") is the most crucial hardware component of a quantum computer[2]. It consists of a core device (a chip) made from materials capable of processing quantum information (often called qubits) necessary to solve complex calculations. Processors come in a variety of forms depending on the qubit type and materials used. Many quantum computers currently use Processors that can only operate at low temperatures and/or are difficult to integrate in modern electronics, limiting ownership and use.

The successful development of the ^{12}CQ room-temperature qubit processor chip could potentially overcome both the limitations of low operating temperatures and electronic device integration for qubits and would represent a breakthrough solution to the widespread use and ownership of quantum computing powered technology. The development of quantum computers is envisioned to impact industries reliant on computational power, including finance, cryptocurrency and blockchain.

Archer CEO, Dr Mohammad Choucair, invented the first material known to overcome both the limitations of sub-zero (cryogenic) operating temperatures and electronic device integration for qubits. The conducting carbon material was able to process quantum information at room temperature[3] and offered the potential for scalability: a solid-state material of workable dimensions for nanofabrication (less than 100 nanometres in size), easily processed and handled, and produced in quantities useful for quantum computing.

This unique combination of physical, chemical, and structural properties has the potential to reduce commercial barriers to quantum computing and make it globally accessible. The patented device incorporating these materials forms the subject of IP that was exclusively licenced from the University of Sydney by Archer (ASX Announcement 12 December 2018), and the materials are available in Archer's wholly owned subsidiary Carbon Allotropes.

Market and Key Growth Catalysts

Australia forms a significant part of the growing quantum computing economy, however there are currently limited opportunities for on-market investment and exposure to financial returns from quantum computing technology[4]. According to McKinsey[5], currently the highest-value in the quantum computing economy is derived from technology development in the US, EU, and Australia.

Morgan Stanley forecasts that quantum technology could double the value of high-end computers to US$10 billion by 2027.[6-7] Investment bank Goldman Sachs predicts that by 2021, quantum computing could become a $US29 billion industry[8], while the Boston Consulting Group[9] highlighted the dependence of the market size on achieving technical milestones over the coming decades.

Globally, quantum computing forms part of the mature semiconductor and electronic parts manufacturing industry (SEPMI)[10]. The SEPMI is a US$500 billion+ revenue market, with approx. 70% of manufacturing concentrated in Asia. Approximately 40% of costs in the market relate to materials, and the industry sees margins of approximately 10-20%. There are few companies with large market share including Samsung, Intel, and Qualcomm, giving rise to potential opportunities for mergers and acquisitions based on disruptive technology integration.

About Archer

A materials technology company developing materials in quantum computing, biotechnology, and lithium-ion batteries, and exploring for minerals in Australia. The Company has strong intellectual property, broad-scope mineral tenements, world-class in-house expertise, a diverse advanced materials inventory, and access to over $300 million of R&D infrastructure

The Board of Archer authorised this announcement to be given to ASX.

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