

/ AGM Presentation

**ARCHER**

Excellence in materials technology.  
30 October 2019

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Certain statistical and other information included in this presentation is sourced from publicly available third party sources and has not been independently verified.

# Archer Exploration Limited ASX: AXE

## / Board and Executive Management



**Executive Chairman**  
Greg English  
LLB, BE (Mining)



**Non-Executive Director**  
Alice McCleary  
DUniv, BEc FCA FTIA FAICD



**Non-Executive Director**  
Paul Rix  
B.Com FAICD



**Chief Executive Officer**  
Mohammad Choucair  
PhD, FRACI FRSN GAICD



**Chief Financial Officer &  
Company Secretary**  
Damien Connor  
CA GAICD AGIA B.Com





## / Capital Structure & Overview

**\$1.4m**

Cash at bank as of 30 Sept 2019

**197.1m**

Number of ordinary shares on issue

**\$0.13**

Share price (29 Oct 2019)

**\$25.6m**

Market capitalisation (29 Oct 2019)

**28%**

Of issued shares held by top 20 shareholders

**8%**

Of issued shares held by Archer's Board and Executive Management

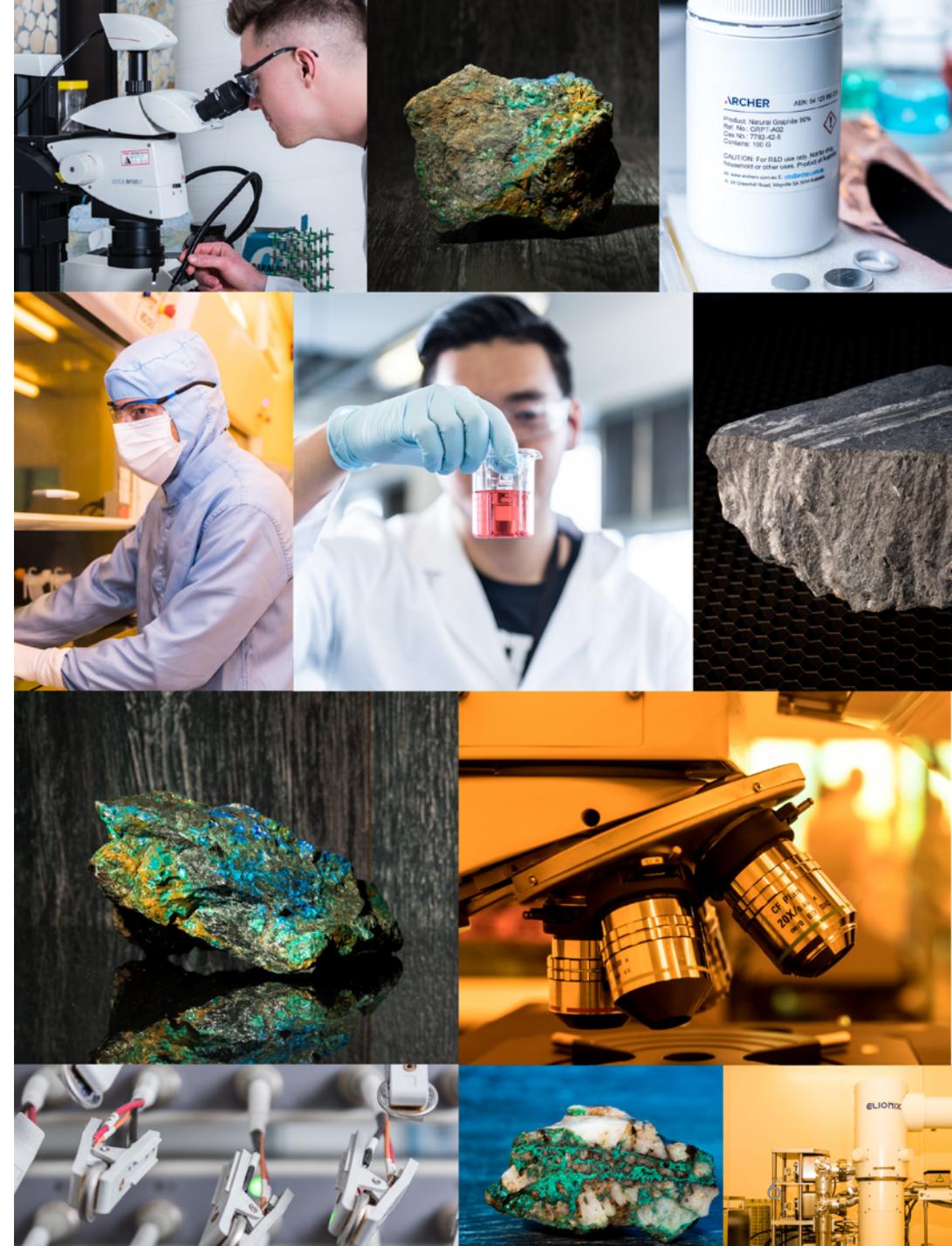
- + No corporate debt.
- + No unlisted options or performance rights.

# Archer provides shareholders exposure to financial returns from innovative technologies and the materials that underpin them

Our strategy is to build an industry-leading Materials Technology company, that delivers maximum value to our shareholders through the commercialisation of assets at various stages of the materials lifecycle.

Our execution priorities are:

- + Commercialising the  $^{12}\text{CQ}$  quantum computing chip.
- + Patenting printable graphene biosensors.
- + Integrating the Campoona graphite project.
- + Monetising our mineral exploration tenements.



**Materials are the tangible  
basis of all technology.**



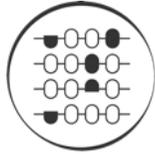
Archer affiliate preparing carbon electrodes with materials from Carbon Allotropes' inventory.

## The acquisition of Carbon Allotropes enabled Archer to expand its market position

Archer's growth involves contributing to complex global challenges. Archer is uniquely positioning to meet global markets' needs through a number of key strengths:

- + Strong, globally filed patents protecting credible, internationally validated disruptive technology & IP.
- + World-class in-house expertise, with pioneers in nanotechnology leading Archer's projects.
- + Access to over \$300 million of state-of-art R&D infrastructure to build and test technology products.
- + A diverse advanced materials inventory for rapid device prototyping and integration.

# / Significant Developments in 2018-2019



## Quantum Technology

- + Archer obtains exclusive licence to quantum technology IP (QTIP)
- + QTIP patents lodged in Australasia, the US, and EU
- + Pioneering quantum physicist Dr Martin Fuechsle joins Archer
- + Access agreements signed to access chip building foundry and  $^{12}\text{CQ}$  commences
- + First components of  $^{12}\text{CQ}$  qubit processor chip assembled



## Human Health

- + High quality graphene inks prepared and tested for printed biosensing technologies
- + Provisional patent lodged for graphene-ink biosensing technology
- + Material transfer agreement signed with German biotech
- + Human antibodies printed on graphene biosensors



## Reliable Energy

- + Collaboration & access agreements to build & test Li-ion battery cells
- + Full-cell Li-ion batteries produced with Campoona graphite in-line with industry state-of-art requirements
- + Spherical graphite produced from Campoona graphite matching market requirements for Li-ion batteries
- + Li-ion batteries produced using Campoona spherical graphite



/ Quantum Technology

**$^{12}\text{CQ}$**

**Building a world-first  
qubit processor chip**



Successful commercialisation of Archer's  $^{12}\text{CQ}$  chip technology could catalyse a global multibillion dollar industry

**\$30b**

Forecast size of quantum computing industry in 2022<sup>1</sup>

**\$715b**

Global semiconductor industry revenue<sup>2</sup>

**70%**

Of semiconductor manufacturing located in Asia<sup>2</sup>

**50%**

Global quantum computing funding in EU, North America, AU<sup>3</sup>

**\$4b**

Revenue in Australian consumer electronics market<sup>4</sup>

**88%**

Australians now own a smartphone<sup>5</sup>

<sup>1</sup>Quantum Computers: Solving problems in Minutes, not Millennia. Goldman Sachs. Feb 2018.

<http://www.goldmansachs.com/our-thinking/pages/toshiya-hari-quantum-computing.html>

<sup>2</sup>Global Semiconductor and Electronic Parts. IBISWorld Industry Report. May 2018.

<sup>3</sup><https://www.bcg.com/en-au/publications/2018/next-decade-quantum-computing-how-play.aspx>

<sup>4</sup>Statista. Consumer Electronics. 2019.

<https://www.statista.com/outlook/251/107/consumer-electronics/australia>

<sup>5</sup>Deloitte. Mobile Consumer Survey. 2017.

[http://landing.deloitte.com.au/rs/761-IBL-328/images/tmt-mobile-consumer-survey-2017\\_pdf.pdf](http://landing.deloitte.com.au/rs/761-IBL-328/images/tmt-mobile-consumer-survey-2017_pdf.pdf)

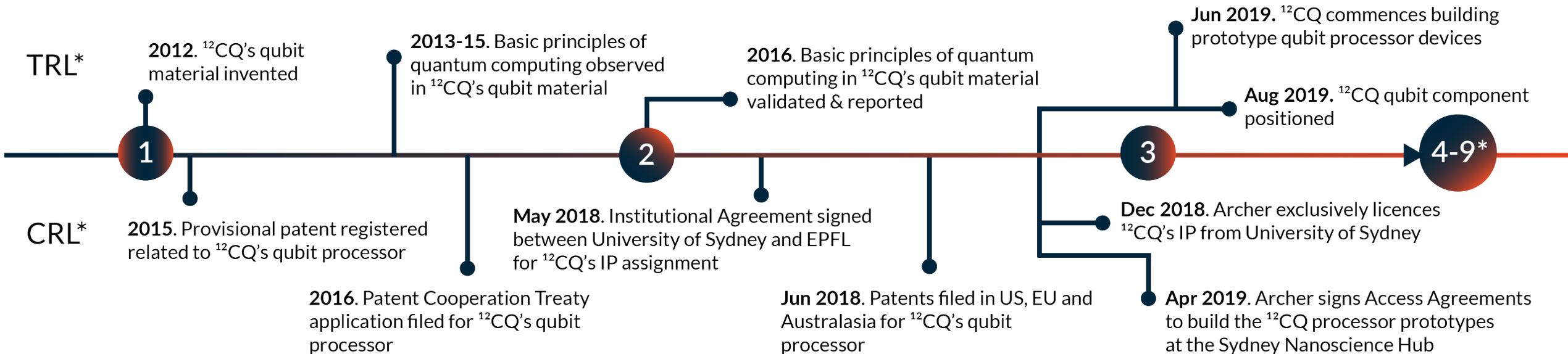
## Successful development of Archer's $^{12}\text{CQ}$ chip could enable widespread ownership of quantum computing powered technology

- 1 World-record room-temperature qubit stability**  
Archer is using the only reported conducting material capable of stable and robust quantum information processing at **room temperature**<sup>6</sup>.
- 2 Practical quantum computing on-board devices**  
**No need for low temperatures**, well-defined crystals, atomic manipulation, photonics, or the use of metals; all barriers to current qubit chip development and use.
- 3 Pioneers in nanotechnology & quantum computing**  
 $^{12}\text{CQ}$  team is led by Dr Mohammad Choucair, **RACI Medallist** for best Chemistry PhD in Australia, & Dr Martin Fuechsle, **AIP Medallist** for best Physics PhD in Australia.

<sup>6</sup><https://www.nature.com/articles/ncomms12232>



# / Commercial Pathway



## TRL of Current Quantum Computing Technology\*\*

- 1 Topological (e.g. Microsoft)
- 3 Silicon (e.g. Silicon Quantum Computing)
- 3 Photonic (e.g. Xanadu)
- 4 Trapped Ion (e.g. IonQ)
- 5 Superconducting (e.g. IBM, Rigetti, D-Wave, Intel)

## Current Global Investment^

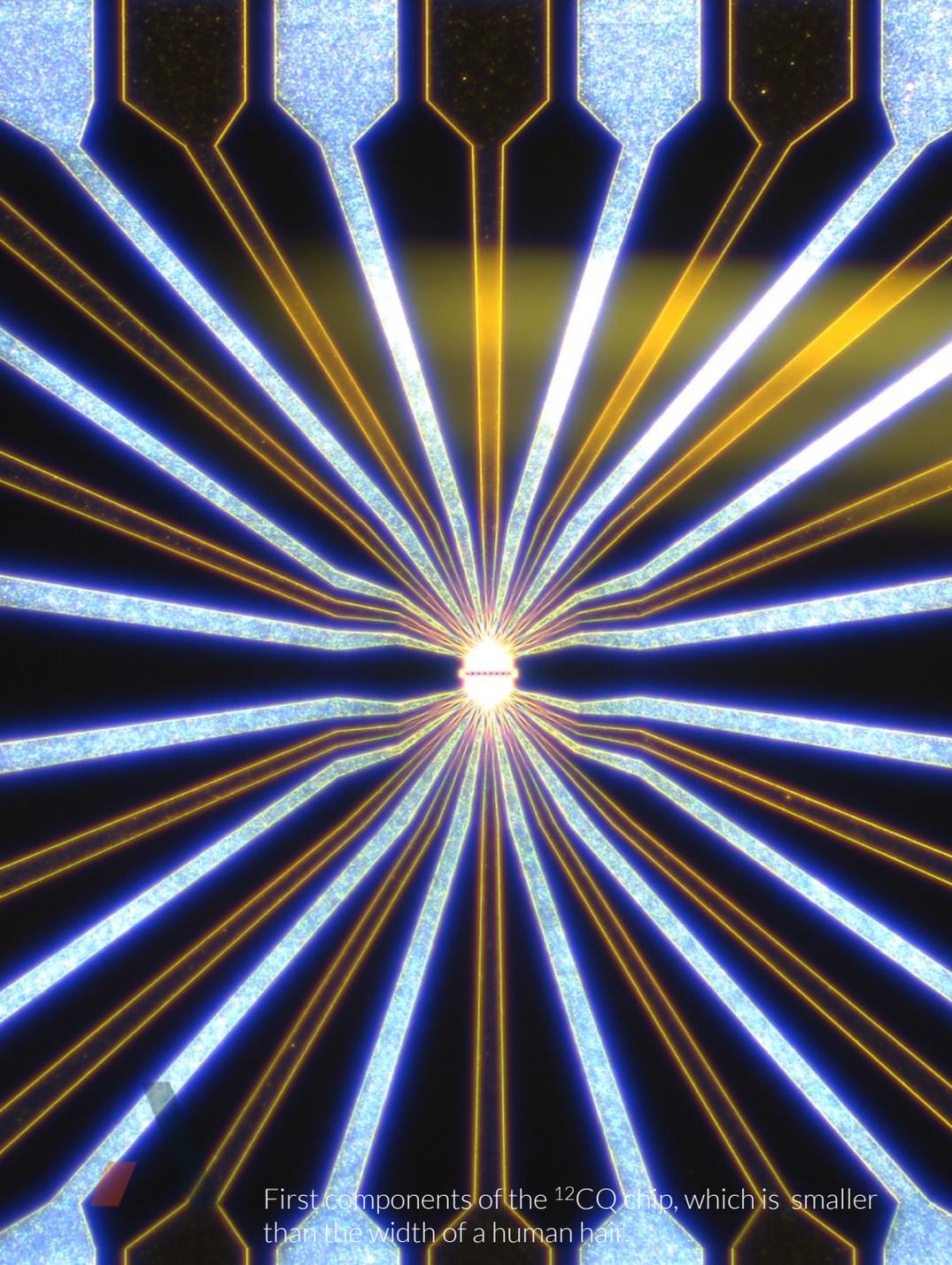
|             |         |
|-------------|---------|
| China       | +\$3b   |
| US          | +\$1.3b |
| EU          | +\$1.1b |
| UK          | +\$0.4b |
| AU, CA, ISR | +\$0.1b |

## First Sales of Quantum Computers^^

|                  |   |
|------------------|---|
| <b>D-Wave</b>    | +\$10m per unit   |
| <i>Customers</i> | Lockheed Martin, Google, Volkswagen<br>Los Alamos National Laboratory,<br>Oak Ridge National Laboratory |

\*Archer self assessed Technology Readiness Level and Commercial Readiness Level. See Appendices.

\*\*BCG assessed TRL; examples may currently vary in TRL. See: ^<https://www.bcg.com/en-au/publications/2018/next-decade-quantum-computing-how-play.aspx> and <https://www.bcg.com/publications/2019/quantum-computers-create-value-when.aspx> ^^[www.dwavesys.com](http://www.dwavesys.com)



First components of the  $^{12}\text{CQ}$  chip, which is smaller than the width of a human hair.

## The commercialisation pathway involves applying well-established business models in the semiconductor industry

Our strategy is to develop a qubit processor chip that can be directly sold and the intellectual property rights to the chip technology sublicensed by:

- 1 De-risking the  $^{12}\text{CQ}$  Technology**  
Building a room-temperature operational qubit processor chip prototype involves assembling and testing chip components by applying a deep understanding of nanotechnology, materials chemistry, and quantum physics.
- 2 Minimum Viable Product Solution**  
Establishing partnerships with highly resourced organisations in the semiconductor industry, and prosecuting patent applications in Australasia, Europe and the US, to provide the commercial freedom to operate.

# Printable graphene biosensors





Archer affiliates preparing materials and chemical precursors at the ARC Graphene Hub.

Successful commercialisation of Archer's biosensor technology could disrupt a global multibillion dollar industry

**\$27b**

Forecast size of biosensor industry in 2022<sup>7</sup>

**43.5%**

Cash refund of annual R&D spend in Australia for SMEs<sup>8</sup>

**\$20b**

Australian industry spend on R&D 2018<sup>8</sup>

**140+**

Life sciences companies on the ASX in 2018<sup>8</sup>

<sup>7</sup>Biosensors Market by Application, Global Forecast to 2022. Market and Markets, 2017.

<sup>8</sup><https://www.nature.com/articles/d41586-018-05092-2>

## Successful development of Archer's printable biosensor could enable rapid & customised multi-disease detection

- 1 World-first graphene biosensor materials**  
Archer is using the only reported **graphene materials** capable of stable and robust selective hierarchical chemistries compatible to the single molecule level<sup>9,10</sup>.
- 2 Simple to integrate functionality & detection**  
By **digitising** the manufacture of biosensor componentry we are overcoming key commercial and technological barriers to current printable biosensor development.
- 3 Best-in-class biosensor device prototyping**  
The graphene ink formulations form the most crucial component of a **printable biosensor** to allow multiplexing function under practical detection conditions.

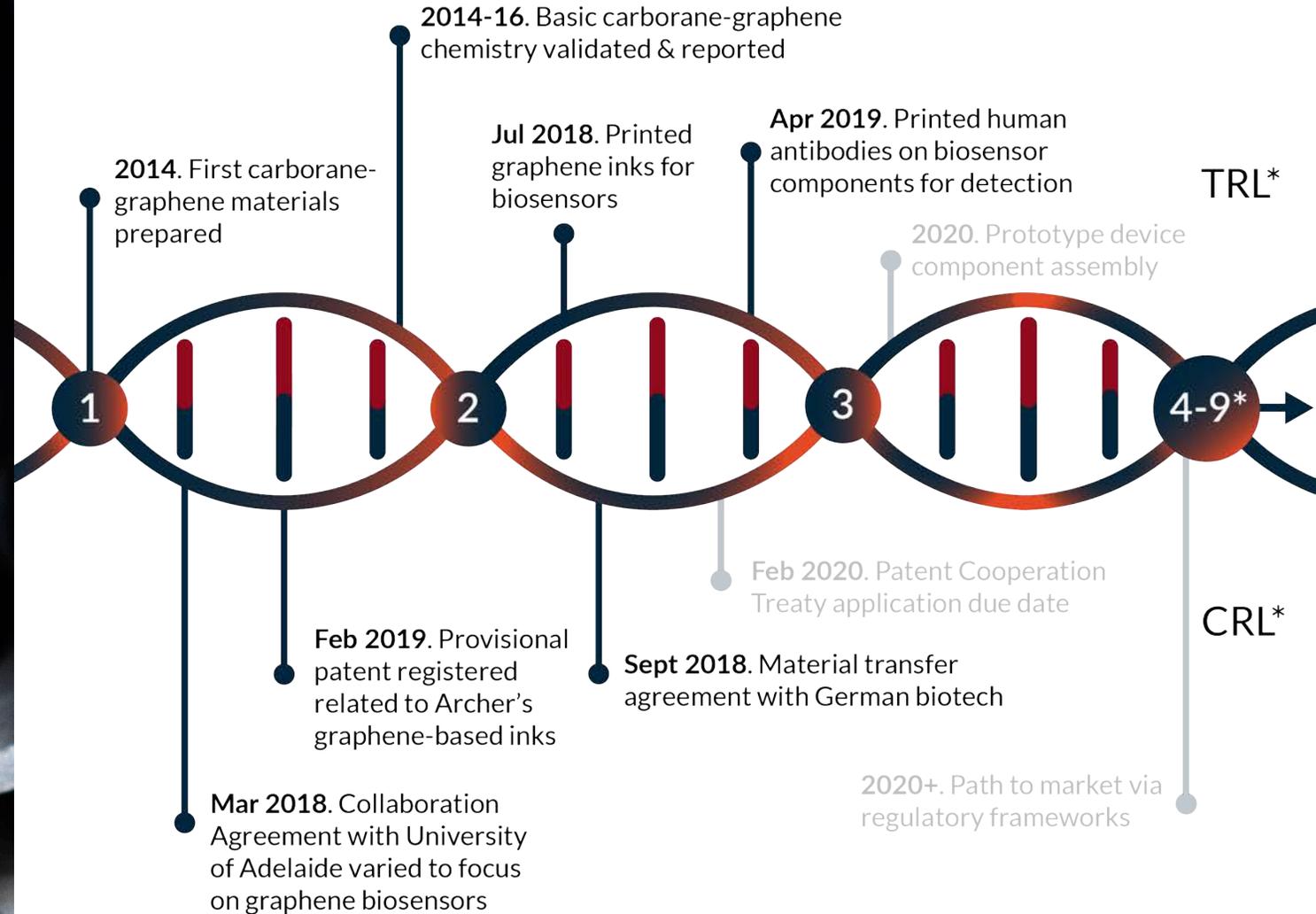
<sup>9</sup><https://pubs.rsc.org/en/content/articlelanding/2014/cc/c4cc04521a#!divAbstract>

<sup>10</sup><https://pubs.rsc.org/en/content/articlelanding/2016/CC/c5cc07611k#!divAbstract>



Printers used at the ARC Graphene Hub to prepare graphene-based electrode components.

## / Commercial Pathway



# The commercialisation pathway involves applying the triple-helix business model<sup>+</sup> for biotechnology innovation

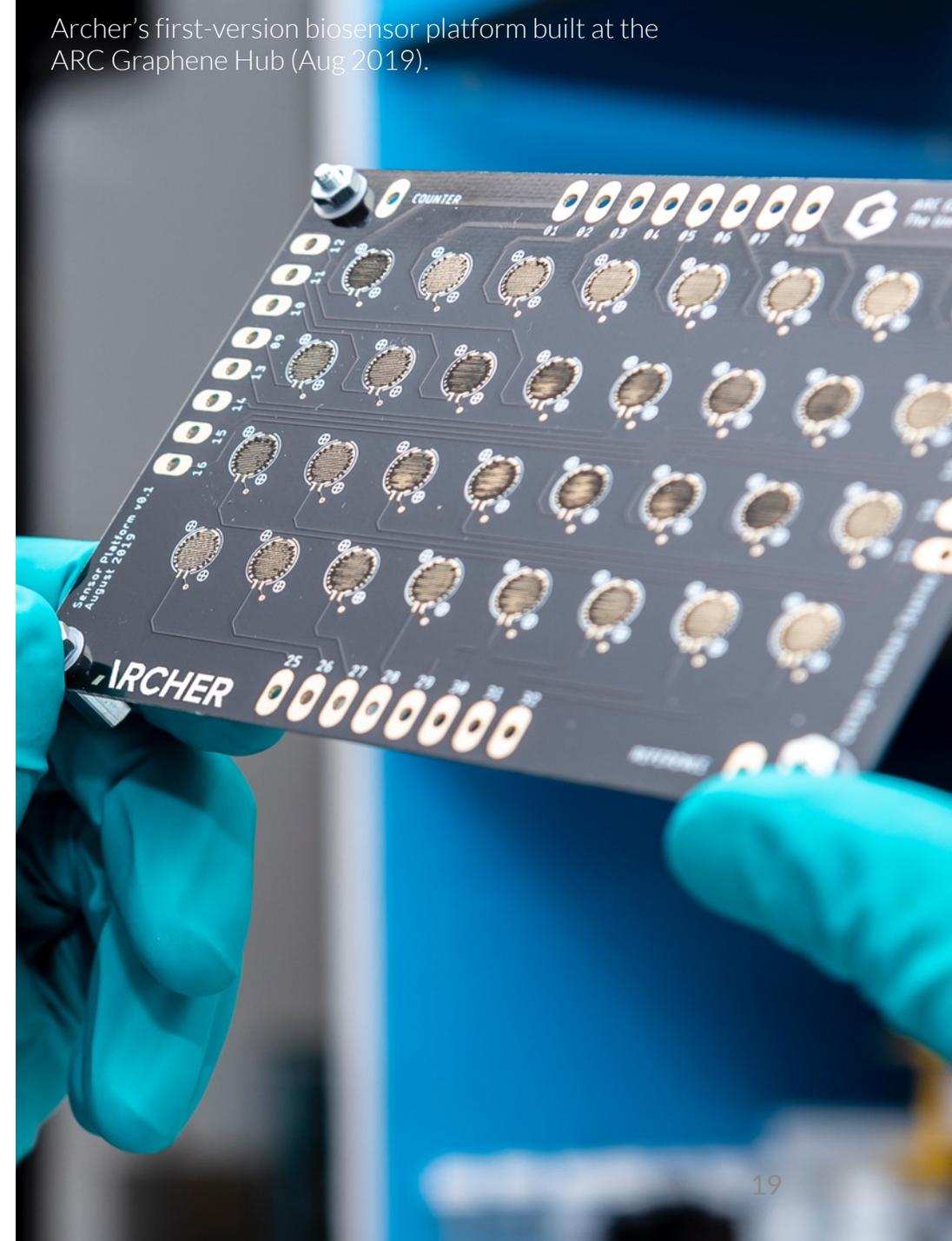
Our strategy is to develop printable graphene-based biosensor componentry and sublicense the associated intellectual property rights by:

## 1 Proof-of-concept Validation

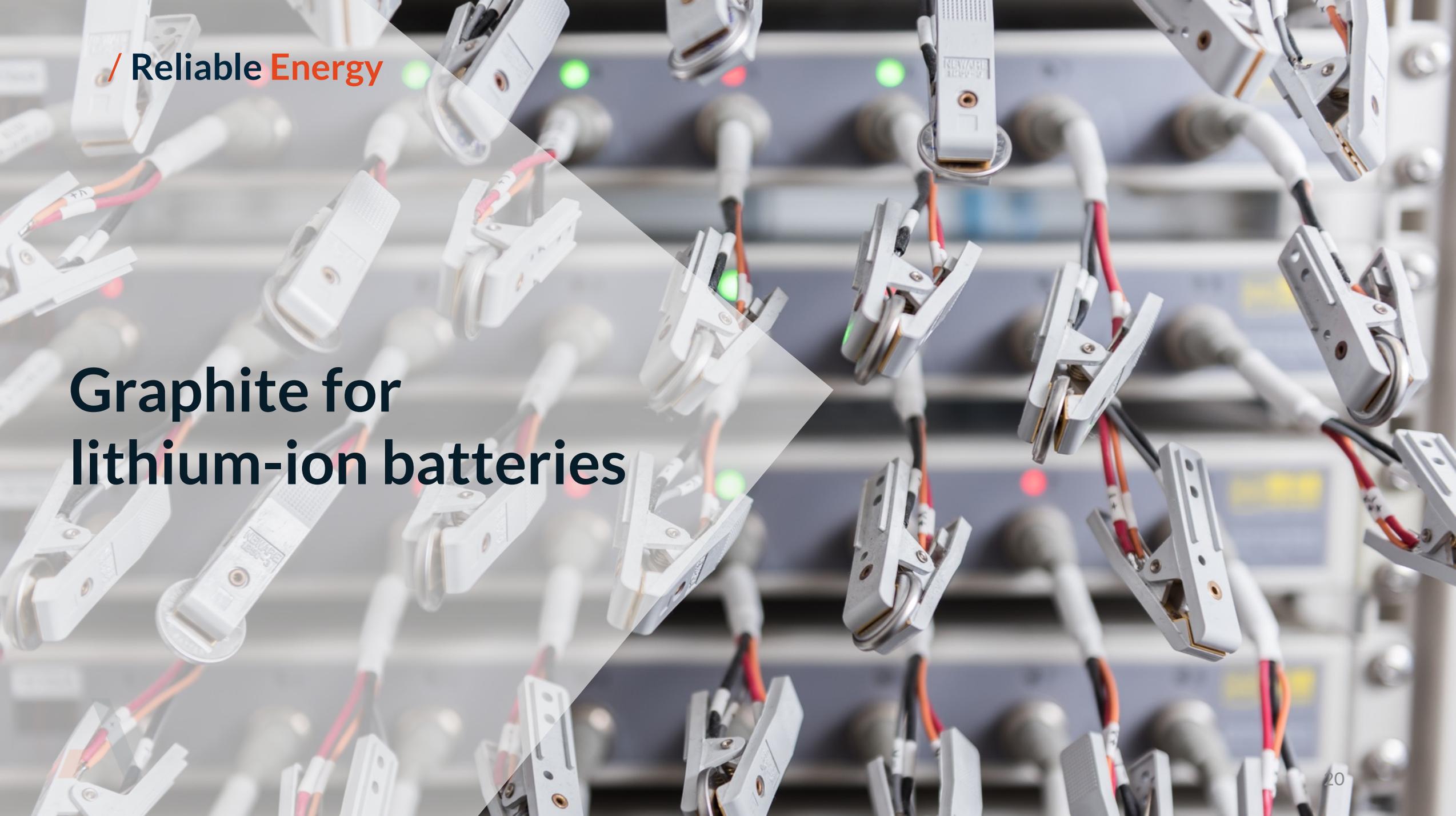
Developing commercial prototype *in-vitro* diagnostic biosensing devices by assembling and testing proprietary graphene-based componentry capable of enabling rapid multi-disease detection and device integration.

## 2 Securing Intellectual Property Requirements

Filing a strong Patent Cooperation Treaty application for prosecution in jurisdictions including Australia, the US and EU while establishing partnerships with highly resourced organisations in the biotechnology industry.



<sup>+</sup>[https://triplehelix.stanford.edu/3helix\\_concept](https://triplehelix.stanford.edu/3helix_concept)



/ Reliable Energy

# Graphite for lithium-ion batteries



Archer affiliates preparing lithium-ion batteries for testing with Archer graphitic materials at UNSW.

Successful commercialisation of Archer's graphite could secure supply-side markets in a global multibillion dollar industry

**\$130b**

Forecast size of Li-ion battery industry in 2028<sup>11</sup>

**\$7k/t**

Spherical graphite materials entry point for Li-ion batteries<sup>12</sup>

**30m**

Forecast number of sales of electric vehicles (EV) by 2030<sup>13</sup>

**39%**

Of global EV market forecast in China by 2030<sup>14</sup>

<sup>11</sup><https://www.idtechex.com/research/reports/li-ion-batteries-2018-2028-000557.asp>

<sup>12</sup><https://www.benchmarkminerals.com/heilongjiang-china-tops-90000-tpa-spherical-graphite-output-as-evbattery-demand-surges/>

<sup>13</sup><https://bnef.turtl.co/story/evo2018?teaser=true>

<sup>14</sup><https://www.bcg.com/documents/file36615.pdf>

# Successful development of Archer's graphite could address the trade-off between cost and battery performance

## 1 High-quality graphite materials

We have confirmed Archer's Campoona graphite is **structurally near-perfect** down to the atomic scale and is suitable for use in batteries<sup>15</sup>.

## 2 High-value graphitic material feedstocks

We have prepared **spherical graphite materials** that meet key established market requirements for use in lithium-ion battery applications<sup>16</sup>.

## 3 Best-in-class battery testing and validation

Archer has formulated, built, and tested full-cell lithium-ion batteries using **Campoona graphite** derived anodes with different end-use cathode chemistries<sup>17</sup>.

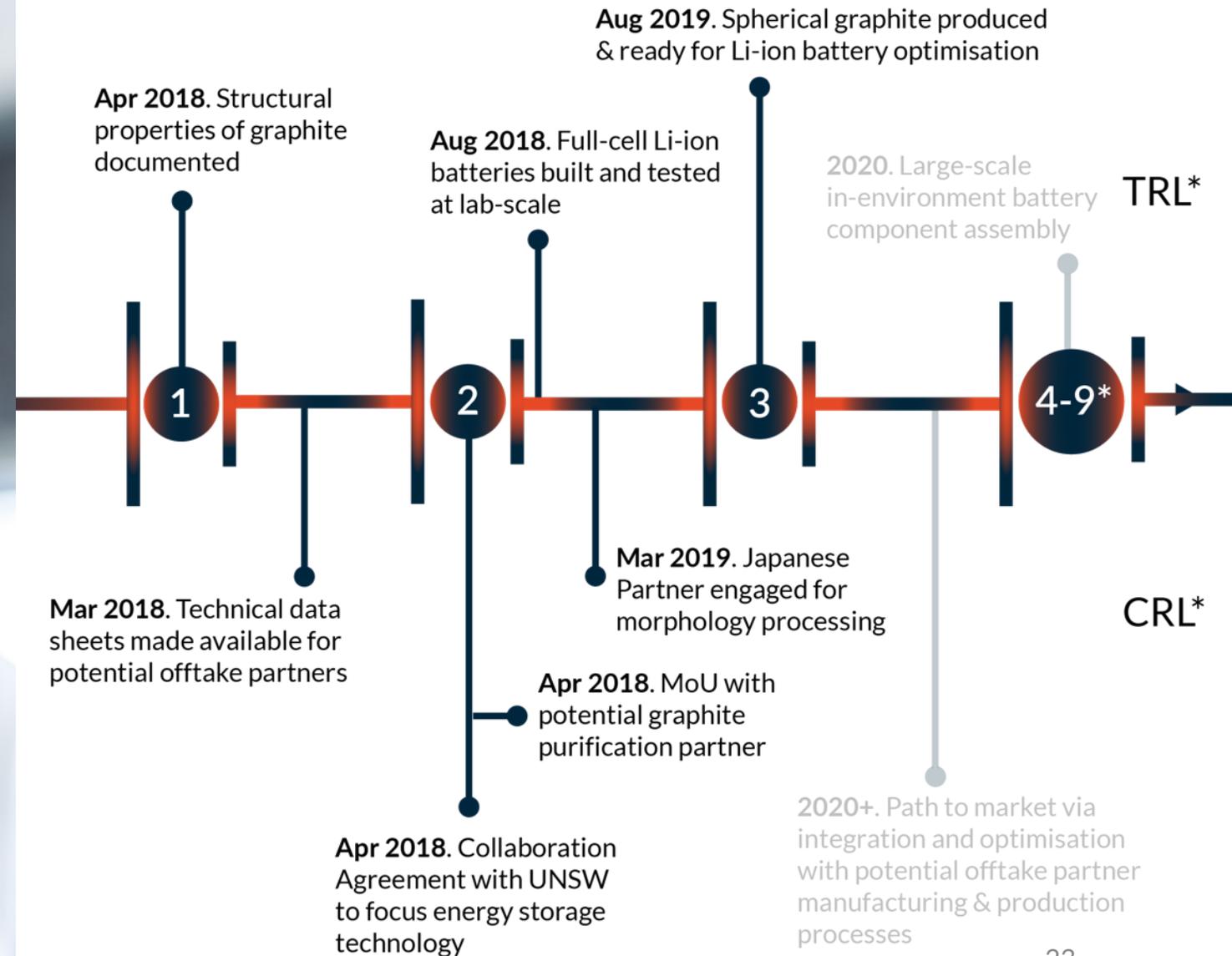
<sup>15</sup>[https://archerx.com.au/src/uploads/2018/04/20180406\\_Technical-analysis-proves-high-quality-of-Campoona-graphite-ASX-Release.pdf](https://archerx.com.au/src/uploads/2018/04/20180406_Technical-analysis-proves-high-quality-of-Campoona-graphite-ASX-Release.pdf)

<sup>16</sup>[https://archerx.com.au/src/uploads/2019/03/20190312\\_Spherical-graphite-produced-from-Campoona-deposit-ASX-Release.pdf](https://archerx.com.au/src/uploads/2019/03/20190312_Spherical-graphite-produced-from-Campoona-deposit-ASX-Release.pdf)

<sup>17</sup>[https://archerx.com.au/src/uploads/2019/08/20190808\\_Campoona-spherical-graphite-ready-for-battery-optimisation-ASX-Release.pdf](https://archerx.com.au/src/uploads/2019/08/20190808_Campoona-spherical-graphite-ready-for-battery-optimisation-ASX-Release.pdf)

Archer affiliates preparing chemical adducts & precursors to materials' syntheses at UNSW.

## / Commercial Pathway



# The commercialisation pathway involves downstream product integration in the lithium-ion battery supply chain

Our strategy is to establish customer relationships that underpin the development of our substantial Campoona graphite resource by:

## 1 Materials Integration & Optimisation

Developing and testing the high value-added graphite materials products and processes, in real-world full-scale lithium-ion batteries, to meet minimum performance requirements and market accepted benchmarks.

## 2 Validating Customer Solutions

Establishing commercial viability in efficiently scaling post-concentrate processes with industry partners for potential off-take agreements so that our graphite resource can be successfully developed.

Archer graphite materials used to prepare lithium-ion battery coin-cells.



# Exploring for critical minerals





Archer rock sample containing copper from Yanlowinna.

Successful monetisation of Archer's tenements could be vital for securing critical minerals for global economies

**\$60b+**

Approx. global market value of critical minerals in Australia<sup>18</sup>

**\$300m+**

Invested by the Australian Government to de-risk mineral exploration in Australia<sup>18</sup>

**50+**

Critical minerals listed by the Australian and US Governments<sup>19</sup>

**87.6%**

Of all Australian mining exports accounted by China, Japan and South Korea<sup>20</sup>

<sup>18</sup><https://www.industry.gov.au/sites/default/files/2019-03/australias-critical-minerals-strategy-2019.pdf>

<sup>19</sup><https://www.ga.gov.au/about/projects/resources/critical-minerals>

<sup>20</sup><https://www.ibisworld.com.au/industry-trends/market-research-reports/mining/mineral-exploration.html>

## Successful exploration of Archer's tenement areas could lead to significant mineral discoveries

- 1 A broad-scope portfolio of tenement interests**  
Archer maintains 100% ownership of 22 Exploration Licences for a **diverse range of minerals**, and 1 Mining Licence for Graphite, all of which are located in Australia.
- 2 Increased potential for capturing large targets**  
Archer's exploration spans district to deposit scales with ongoing activity targeting prospective areas for high-value commodities like **copper, gold, cobalt, & graphite**.
- 3 Effective technical & operational capabilities**  
We have managed ongoing **successful drilling programs** to identify geological anomalies and prospective areas defined by intersections of such anomalies<sup>†</sup>.

<sup>†</sup>Archer Exploration Limited Annual Report (2019) pages 21 – 31.  
<https://archerx.com.au/src/uploads/2019/09/Archer-Annual-Report-WEB-small.pdf>



## / Key Mineral Exploration Projects



Graphite



Tin



Tungsten



Copper



Alumina



Gold



Magnesite



Nickel



Cobalt



Manganese

Al

We announced<sup>s</sup> an Exploration Target for our Eyre Peninsula **High Purity Alumina Project** located 12km south of Kimba, South Australia:

- + Based on historical drilling that intersected substantial widths of HPA mineralisation over an extensive area.
- + Ideally situated close to existing rail, power, gas and other significant infrastructure.
- + HPA is critical to a number materials technology applications.

Ni

Independent review<sup>f</sup> confirmed our Albion Downs **Nickel Project** is prospective for nickel mineralisation, 18km NNW of Mt Keith, Western Australia:

- + Historical work found the same types of rocks containing nickel compounds as present at the nearby Mt Keith nickel mine.
- + The tenement adjoins the tenements of the world's two biggest nickel miners, BHP Billiton and MPI Mines' (Norilsk).
- + Nickel is a high-value critical mineral.

<sup>s</sup>[https://archerx.com.au/src/uploads/2019/08/20190819\\_Eyre-Peninsula-High-Purity-Alumina-Exploration-Target-ASX-Release-1.pdf](https://archerx.com.au/src/uploads/2019/08/20190819_Eyre-Peninsula-High-Purity-Alumina-Exploration-Target-ASX-Release-1.pdf)

<sup>f</sup>[https://archerx.com.au/src/uploads/2019/10/20191008\\_Albion-Downs-Nickel-Project-update-ASX-Release.pdf](https://archerx.com.au/src/uploads/2019/10/20191008_Albion-Downs-Nickel-Project-update-ASX-Release.pdf)



Graphite ore from Archer's Campoona deposit.

## The commercialisation pathway involves the monetisation of globally in-demand tenements for exploration and mining

Our strategy is to identify a pipeline of economically proven resources for the future development, production and export of critical minerals by:

### 1 Exploring for Mineral Deposits

Manage a number of exploration projects to locate ore bodies in Australia that may be mined and provide the necessary data to potential development partners and independent reviewers for the evaluation of prospect viability.

### 2 Acquisition and Sale of Assets

Realising value and value-add returns by strategically acquiring new tenements and/or selling the rights to existing tenements; with Archer having successfully sold over \$11m in assets since 2012, including to BHP Billiton<sup>‡</sup>.

<sup>‡</sup>Archer Exploration ASX Announcement (April 2012)  
<https://www.asx.com.au/asxpdf/20120430/pdf/425x9jbj97wjcd.pdf>

/ Strategic Direction

# The Path Forward

## / Company News Flow

Over the next 12 months key aspects of our strategy to provide shareholder returns include:

- + **Accelerating  $^{12}\text{CQ}$  toward commercialisation**  
World-first componentry assembly and device testing, and engagement with quantum computing industry partners.
- + **Patenting & developing graphene biosensors**  
Patent Cooperation Treaty application decision point, and development milestones in building proof-of-concept devices.
- + **Integrating & advancing the Campoona graphite project**  
Producing high-value downstream graphite materials and identification of project co-development partners.
- + **Monetising our mineral exploration project pipeline**  
The effective, timely, and strategic exploration, sale, and acquisition of value-added mineral exploration tenements.



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LinkedIn: <https://au.linkedin.com/company/archerexplorationltd>  
YouTube: <https://bit.ly/2UKBBmG>

Sign up to our Newsletter: <http://eepurl.com/dKosXI>



# Appendices

## Board and Executive Management (Slide 4)

**Greg English** LLB, BE (Mining)  
*Executive Chairman*

Greg English is the co-founder Archer. He has been Chairman of the board since 2008 and has overseen Archer's transition from a South Australian focussed minerals exploration company to a diverse materials technology company. He has more than 25 years of engineering and legal experience and has held senior roles for Australian and multinational companies. Greg has received recognition for his work as a lawyer in The Best Lawyers® in Australia, 2020 Edition in the area of Commercial Law.

**Alice McCleary** DUniv, BEc FCA FTIA FACID  
*Non-executive Director*

Alice McCleary is a Chartered Accountant. She is Deputy Chair of the Uniting Church of South Australia's Resources Board. She is a former Chairman of ASX Listed Company Twenty Seven Co. Limited (ASX:TSC) and former Director of Adelaide Community Healthcare Alliance Inc. (ACHA), Benefund Ltd and Forestry Corporation of South Australia. Previous leadership roles include Vice-President of the South Australian Chamber of Mines and Energy (SACOME), Deputy Chancellor of the University of South Australia and National President of the Taxation Institute of Australia. Alice's professional interests include financial management and corporate governance.

**Paul Rix** B.Com, FACID  
*Non-executive Director*

Paul Rix was appointed as a Director of the Company on 8 February 2016. Paul Rix is an experienced mining professional with more than 30 years' experience in the marketing of industrial minerals and products. From 2003 – 2013, Paul worked for Queensland Magnesia Pty Ltd (QMAG) as General Manager Marketing where he was responsible for the development and implementation of QMAG's long term marketing strategy, focusing on diversification of magnesia products and markets whilst maintaining high plant utilisation. His magnesia marketing responsibilities stretched across six continents and more than 30 countries.



# Appendices

## Board and Executive Management (Slide 4)

**Mohammad Choucair** *PhD, FRACI FRSN GAICD*  
*Chief Executive Officer*

Dr Mohammad Choucair was appointed Chief Executive Officer on 1st December 2017. Dr Choucair has a strong technical background in nanotechnology, and has spent the last decade implementing governance, control and key compliance requirements for the creation and commercial development of innovative technologies with global impact. Dr Choucair served a 2-year mandate on the World Economic Forum Global Council for Advanced Materials and is a Fellow of both The Royal Society of New South Wales and The Royal Australian Chemical Institute. He has a strong record of delivering innovation and has been recognised internationally as a forward thinker.

**Damien Connor** *CA GAICD AGIA B.Com*  
*Chief Financial Officer & Company Secretary*

Damien Connor was appointed Company Secretary on 1 August 2014. Damien performs the financial/accounting role in the Company as well as the secretarial duties. Damien has been a member of the Institute of Chartered Accountants since 2002 and is a Graduate of the Australian Institute of Company Directors and a Member of the Governance Institute of Australia. Damien has been employed in the resources sector since 2005. He also provides Company Secretary and Chief Financial Officer services to other ASX-listed and unlisted entities.



# Appendices

Reference to Technology Readiness Level (“TRL”) and Commercial Readiness Level (“CRL”) on Slides 13, 18, and 23.

## Commercial Readiness Level

- 1 IP requirements identified
- 2 Secured entry to sub-sectors of market
- 3 Minimum viable product solution
- 4 Customer problems validated
- 5 Customer relationships established
- 6 Revenue model verified
- 7 Prototype solution validation
- 8 Growth model realisation
- 9 Customers acquired

## Technology Readiness Level

- 1 Scientific research begins
- 2 Basic principles observed & reported
- 3 Proof-of-concept validation
- 4 Basic technology elements integrated
- 5 Validation in relevant environment
- 6 Prototype demonstration (controlled)
- 7 System prototype demonstration (operational)
- 8 Systems integration at scale
- 9 System validation

