Bayan
Mining and Minerals Limited

BAYAN SECURES TRANSFORMATIVE PATENTS IN SOLAR CELL RECYCLING TECHNOLOGY

Highlights

- **Bayan has secured an exclusive license from Macquarie University for "Microwave Joule Heating Technology"** a microwave-based solar panel recycling technology, positioning the company at the forefront of sustainable energy technology solutions.
- The Company intends to commence further research and development to assess the ability to potentially recover valuable metals such as **Silver, Silicon, Gallium and Indium.**
- The basis of the technology platform utilises microwave technology to soften the EVA encapsulant in solar panels, **enabling easy delamination and potential recovery of valuable materials** at room temperature. This approach avoids the need for extreme heat (1400°C) typically required for separating materials like glass and silicon as well as the use of costly hazardous chemicals in traditional processes.
- **Delamination enables selective separation of materials** without the need for mechanical crushing, whereas traditional crushing methods often result in cross-contaminated material and lower recovery rates.
- **The breakthrough technology presents a potential novel pathway for improved recovery of materials** such as silver and silicon from solar panels, critical materials underpinning solar and semiconductor technologies.
- By 2035, Australia is expected to accumulate 1 million tonnes of solar panel waste worth over A$1 billion[1], while the global CIGS (Copper, Indium, Gallium, Selenide) solar cell market is projected to grow to US$12.23 billion by 2032[2].

Bayan Mining and Minerals Ltd (ASX: BMM; "BMM" or "the Company") is pleased to announce that it has reached an agreement to exclusively licence IP from Macquarie University for its Solar Cell Recycling Technology. A summary of the material terms of the agreement are set out in Schedule 1. This agreement is a key milestone in Bayan's strategic growth, enabling the Company to take advantage of a major economic opportunity in the critical mineral recycling/recovery market.

[1] Clean Energy Council. 2025. https://cleanenergycouncil.org.au/for-consumers/fact-sheets/recyling-wind-turbines-solar-panels-batteries

[2] SkyQuest. 2024. https://www.skyquestt.com/report/copper-indium-gallium-selenide-solar-cell-market

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The Technology from Macquarie University

The team from the School of Engineering at Macquarie University, led by Dr Binesh Puthen Veettil, have developed a new microwave technology that will solve the challenge of electronic waste from end-of-life solar panels. Currently, the recycling process is technically challenging with only an estimated 15% of solar panels making it to a recycling facility[3], and the remainder going straight to landfill once they have reached their 20–25-year end of life span. In the rare instance they are recycled, the solar panels, in the traditional method, are crushed and heated at approximately 1400°C before being washed in harsh chemicals to remove the plastics.

Dr Binesh Puthen Veettil's research in collaboration with the School of Photovoltaics at UNSW, the Australian Centre for Advanced Photovoltaics and further supported by the Australian Government through the Australian Renewable Energy Agency highlights the immense need and impact this technology will bring.

In this new method, the microwave energy is used to selectively heat the materials within a solar panel. In this process, the silicon cells and other microwave-absorbing components rapidly heat up, while surrounding materials remain relatively cool. This targeted heating causes the plastic encapsulant, ethylene vinyl acetate (EVA), which holds the panel layers together to soften and degrade.

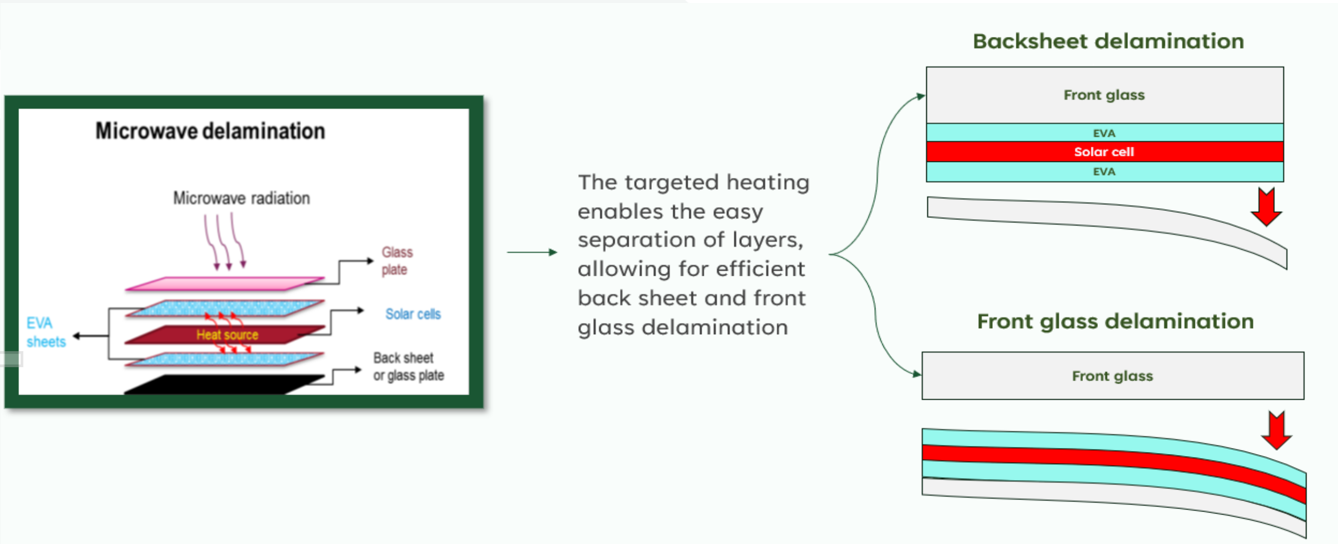

Figure 1 – A visual representation illustrating how microwave radiation selectively targets the plastic encapsulant (EVA) in solar panels, softening it to enable the delamination of solar cells while leaving other materials largely unaffected

[3] Sircel Pty Ltd. 2025. https://sircel.com/services/solar-panel-recycling/

As the EVA loses adhesion, the glass, silicon, and metal components can be easily separated through mechanical peeling rather than through extensive processing. This method eliminates the need for traditional high-temperature baking or energy-intensive chemical treatments such as Nitric Acid (HNO_3), Sulfuric Acid (H_2SO_4) and Hydrogen Fluoride (HF), making delamination more efficient and environmentally friendly. This whole process can be undertaken at room temperature and de-risks the process from potential contamination concerns.

Microwave recycling has a low overall environmental impact compared to traditional recycling methods. One of its key advantages is major energy savings, which significantly reduces the carbon footprint of the process. By eliminating the need for high-temperature furnaces and chemical treatments, this method minimises greenhouse gas emissions and completely removes the risk of toxic chemical waste streams.

The only emissions generated may come from minor fumes released as the encapsulant plastic is heated. However, since the plastic is only softened rather than burned, these emissions are far lower than those produced by thermal incineration. Additionally, no chemical effluent is created, making the process far cleaner and safer than acid-based or solvent-based extraction methods.

By using microwave-based separation, solar panels can be recycled more effectively, preserving valuable materials such as high-purity silicon, silver, and other critical metals for reuse. This innovation represents a breakthrough in sustainable solar panel recycling, reducing energy consumption while improving material recovery rates.

Dr Binesh Puthen Veettil commented *"I'm thrilled to see this technology being adopted to tackle the growing challenge of solar panel recycling on a global scale. This innovation not only provides a sustainable solution to managing end-of-life photovoltaic modules but also lays the groundwork for broader applications in critical mineral recovery. As we refine and expand this approach, I look forward to seeing it evolve into a transformative tool that supports the semiconductor industry and strengthens global supply chains for high-value materials."*

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This innovation offers several key advantages:

- Instantly heats silicon through targeted energy transfer, dramatically reducing energy consumption compared to conventional thermal annealing while maintaining material integrity.
- Enables the exploration and potential of extraction and purification of high-grade silicon, a key material in semiconductors and microelectronics, supporting supply chains for chips, solar panels, and advanced technologies.
- Preservation of valuable materials, including glass, silicon and other critical materials such as, copper, indium, and gallium, enabling the possibility of higher recovery rates and reduced contamination.
- Softens the ethylene vinyl acetate (EVA) encapsulant, enabling easy mechanical separation without the need for aggressive chemical treatments.
- Unlike acid or solvent-based recycling, this process produces no toxic byproducts, reducing the need for complex waste management.
- Operates at room temperatures as opposed to conventional high-heat (1,400°C) and chemical-based recycling methods, making it a more cost-effective and sustainable alternative.
- Can be easily integrated into existing solar panel recycling facilities and scaled for mass production without requiring expensive infrastructure changes.

Dr Binesh Puthen Veettil, electronic engineer at Macquarie University with a prototype of the Microwave Joule Heating Technology

The team at Macquarie University. From left: Prof. Darren Bagnall, Prof. Shujuan Huang, Dr. Binesh Puthen Veettil and Dr. David Payne

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Why this is important

Australia's renewable energy transition is accelerating, with large-scale photovoltaic (PV) solar panels forming a key component of the national energy mix. However, as these panels approach the end of their 25–30-year lifespan, the industry faces a growing challenge, managing solar panel waste and recovering valuable materials.

By 2035, Australia is projected to accumulate 1 million tonnes of end-of-life solar panels, with a total material value exceeding $1 billion[4]. Globally the solar cell market is project to reach US$39.81 billion by 2037, growing at a compound annual growth rate (CAGR) of around 8.2%[5].

By 2045, Australia is potentially set to dispose of 34.6 GW of serviceable panels that will require recycling or repurposing which is equivalent to the total installed solar capacity in Australia as of August 2024.[6]

The demand for critical minerals continues to surge as the world accelerates its transition to clean energy. Solar panels consist of 95% recyclable materials, including silver, aluminium, silicon, copper, indium, and gallium, all of which are essential to global clean energy supply chains. Rare metals, such as gallium, are essential for solar fuel cells, semiconductor chips, and other high-tech applications, making their recovery from E-waste materials a strategic priority.

Delamination vs. Traditional Methods

Conventional recycling methods for solar panels typically rely on mechanical crushing or shredding, which often results in the loss of high-value materials such as silver and silicon. These materials become embedded in mixed, contaminated waste streams, making recovery difficult or uneconomical.

In contrast, delamination-based recycling offers a more advanced approach by cleanly separating key layers such as the front glass and back sheet without compromising the integrity of the underlying materials. This allows for targeted extraction of valuable components, significantly improving both recovery rates and material purity.

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[4] Clean Energy Council. 2025. https://cleanenergycouncil.org.au/for-consumers/fact-sheets/recyling-wind-turbines-solar-panels-batteries

[5] Research Nester. 2025. https://www.researchnester.com/reports/thin-film-solar-cell-market/6356

[6] Clean Energy Council. 2025. https://cleanenergycouncil.org.au/for-consumers/fact-sheets/recyling-wind-turbines-solar-panels-batteries

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A 2024 life-cycle analysis by MINES Paris and ROSI Solar[7] highlighted the dramatic difference: while traditional shredding processes recover only the bulk materials (glass, aluminium, copper), they leave silver and silicon unrecovered—ultimately lost to landfill. In contrast, ROSI Solar's thermal delamination process applies a controlled heat treatment to separate the panel layers without damaging the embedded materials. This enables the full recovery of previously unrecovered elements, particularly silver and silicon, pushing total material recovery to over 95% by value. Importantly, the recovered material value was shown to be 3–4 times higher than that of traditional shredding.

BMM will seek to further develop the proprietary microwave Joule heating technology while actively exploring its potential for application in advanced solar panel recycling. In particular, the Company will begin assessing the viability of high-yield recovery efforts targeting valuable materials such as silver, silicon, and critical metals from end-of-life modules.

Method	Crushing	Delamination
Process	Mechanical shredding of full panel	Layer-by-layer separation (thermal, chemical, or mechanical)
Material Integrity	High contamination, mixed fragments	Preserves materials in cleaner, separable form
Silvery Recovery	<5% (often lost in residue)	Up to 95–100% (near total recovery possible)
Silicon Recovery	Damaged or unusable	Intact and recoverable
Economic Value	~35% of panel value recovered	Potential for 3–4× higher value recovery compared to crushing
Environmental Impact	Higher waste, more landfill	Enables circular economy, reduces environmental burden

Figure 2 – A table to highlight the benefits of delamination vs traditional crushing methods in relation to valuable material recovery and environmental impacts

[7] Hsin-Hsin Fan, Caterin Salas-Redondo, and Antoine Chalaux. 2024. https://www.epj-pv.org/articles/epjpv/pdf/2024/01/pv230037.pdf

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Silver Market

Silver is a critical material in solar panel manufacturing due to its exceptional conductivity, directly impacting the efficiency of photovoltaic (PV) cells. As the global push for renewable energy accelerates and older solar panels begin to reach end-of-life, the urgency for sustainable silver recovery is rising.

Delamination-based processes have proven particularly effective for silver recovery. By cleanly separating the cell layers, these methods preserve the silver contacts embedded within, enabling nearly complete extraction. In comparison, traditional crushing methods tend to scatter or destroy the fine silver content, making recovery economically unviable.

BMM, with its background in precious minerals, is strategically positioned to explore this emerging opportunity. By aligning its operational strengths with cutting-edge recycling technologies, BMM aims to play a pivotal role in scaling up silver recovery from decommissioned solar panels, contributing to both resource sustainability and circular economy goals.

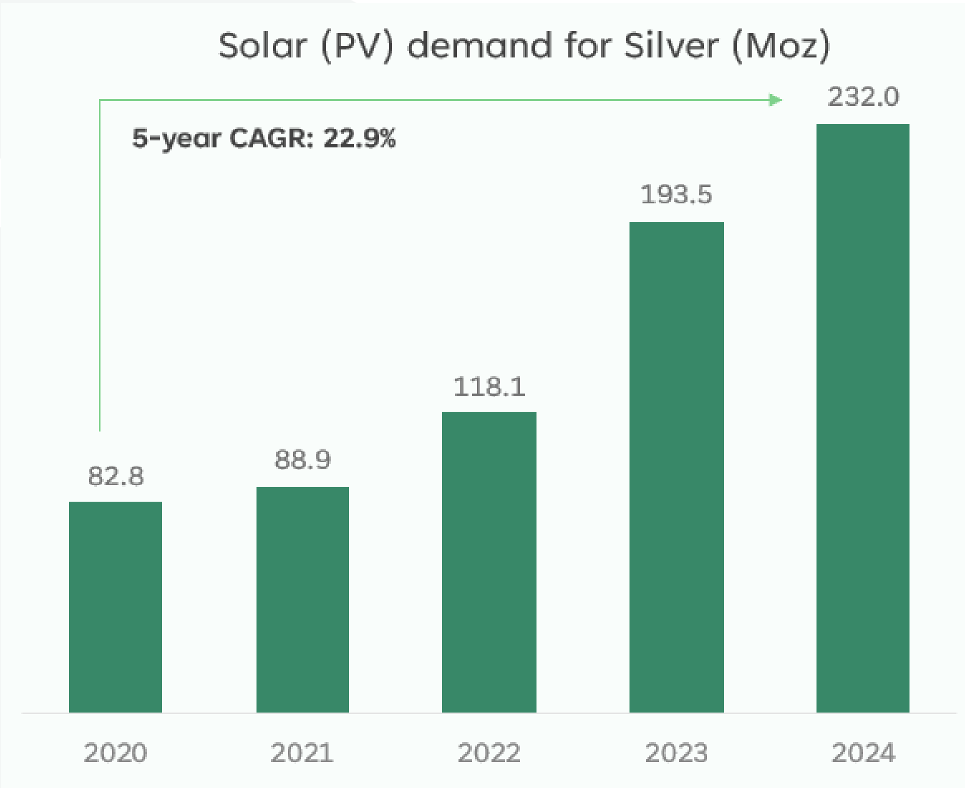

Figure 3 – A chart to demonstrate the growth of silver demand for use in Solar Panels.

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Silicon Market

Silicon is essential in both the semiconductor and solar energy industries, forming the foundation of microchips, photovoltaic (PV) cells, AI processors and 5G infrastructure. The global semiconductor silicon wafer market was valued at US$12.7 billion in 2023 and is projected to exceed US$17.8 billion by 2033[8], driven by rapid advancements in artificial intelligence, quantum computing, and renewable energy technologies.

In solar panels, silicon is the primary semiconductor material, enabling the conversion of sunlight into electricity. Crystalline silicon (c-Si) is used in over 90% of all solar panels, making it the industry standard due to its high efficiency, durability, and abundance. However, the rising demand for both semiconductors and solar energy has led to supply chain constraints, increasing the urgency for sustainable silicon recovery and recycling.

Delamination presents a viable pathway for preserving silicon's structural integrity during the recycling process. By separating the encapsulant layers without mechanical destruction, the silicon cells can be reclaimed in a purer, more usable form—supporting reuse in both solar and semiconductor applications.

As market demand continues to surge, silicon recovery from end-of-life panels represents a major opportunity for BMM to support material circularity, reduce dependency on virgin extraction, and contribute to a more resilient and sustainable supply chain.

CIGS (Copper Indium Gallium Selenide) solar cells

A key application for the new microwave radiation technology are CIGS based solar cells which are a high-efficiency thin-film photovoltaic solution valued for their flexibility and performance. To unlock the full value of CIGS solar panels, delamination is an essential first step. Unlike traditional crushing methods, delamination separates the panel layers—such as glass, thin-film coatings, and backsheet—without compromising the integrity of critical materials like gallium, indium, and copper. This clean separation process enables targeted recovery and reduces contamination, improving both yield and material purity. When paired with microwave-based technologies, delamination enhances scalability and selectivity, positioning BMM to capture high-purity metals more efficiently while aligning with circular economy and ESG objectives.

The CIGS solar cell market was valued at US$2.09 billion in 2023 and is projected to grow to US$12.23 billion by 2032, reflecting a compound annual growth rate of 17.8%.[9] This rapid growth underscores the urgent need for a scalable and efficient recycling

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[8] Imarc Group. 2024. https://www.imarcgroup.com/silicon-wafer-market

[9] SkyQuest. 2024. https://www.skyquestt.com/report/copper-indium-gallium-selenide-solar-cell-market

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solution to recover valuable materials such as gallium, indium, and copper from decommissioned solar modules and spent manufacturing waste.

Without effective recycling solutions, end-of-life solar panels risk becoming an environmental burden. Bayan's investment in microwave radiation technology for solar recycling directly addresses these concerns, offering a scalable, economically viable process to reprocess valuable materials while ensuring compliance with environmental and regulatory requirements. By taking this first step in this approach, Bayan strengthens its position as a leader in sustainable resource recovery and clean energy innovation.

Critical Metals Demand & Market Trends

As industries accelerate their transition to electrification, 5G technology, and renewable energy, the demand for Silicon, Gallium, Indium, and Copper continues to rise due to their critical role in semiconductors, telecommunications, and solar energy technologies. However, with China controlling over 50% of the global supply of indium and gallium, these essential metals are increasingly vulnerable to geopolitical tensions and trade restrictions. As the demand for high-tech materials surges, supply chain vulnerabilities have become a growing concern for industries dependent on these resources, highlighting the urgent need for sustainable recycling and alternative sourcing strategies.

- **Gallium Market**: Demand is expected to rise significantly due to its use in semiconductors, optoelectronics, and 5G technology. Governments and major tech firms are increasingly stockpiling gallium, creating supply constraints and price volatility.
- **Indium Market**: The global indium market reached 990 tons in 2023 and is projected to reach 1,225.56 tonnes by 2032, growing at a compound annual growth rate of 2.40%[10]. Increased demand for touchscreens, LCDs, OLED displays, and thin-film solar panels continues to drive pricing trends.
- **Copper Market**: Prices have surged due to post-COVID recovery efforts, growing adoption of electric vehicles (EVs), and expansion of renewable energy projects. Copper remains a critical material in solar panels, electrical wiring, and industrial applications.

[10] Imarc Group. 2024. https://www.imarcgroup.com/indium-pricing-report

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Executive Director Fadi Diab, commented:

"At BMM, we are committed to building a future where sustainability and innovation go hand in hand. Our investment in advanced recycling technologies, such as microwave-based delamination, is a strategic step toward that vision. This initiative not only enhances our ability to recover critical materials efficiently but also reinforces our leadership in the transition to a circular, clean-energy economy."

Use of Funds and Strategic Direction

The Company does not view this strategic direction as amounting to a diversion from the Company's main undertaking and considers it to align with the Company's previously announced commitment to innovation in clean technology and sustainable resource recovery.

The Company will continue operations as a mineral exploration company following the execution of the IP licensing agreement and remains focused on its exploration and evaluation activities at the Bayan Springs projects in Nevada, USA, at the Pepita Gold project in Brazil and at the Company's Ontario and Quebec projects in Canada. The Company will therefore continue to have the same main undertaking of exploration for minerals.

In terms of expenditure, the Company has set an initial budget of $180,000 over the next 12 months towards the research and development of the Microwave Joule Heating Technology. The Company also seeks to obtain external grant funding to contribute to this research and development expenditure.

Furthermore, as noted above, the Company confirms that entering into the IP licensing agreement will not constitute a change in the nature and scale of the Company's activities as the IP licencing agreement represents an increase of less than 25% to the Company's total consolidated assets, total equity and its budgeted expenditure for the next 12 months. For this reason, the Company will not seek shareholder approval to enter into the IP licensing agreement.

Authorised for release by the Board of Bayan Mining and Minerals Limited

-ENDS-

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Forward-looking Statements

Certain statements included in this release constitute forward-looking information. Statements regarding BMM's plans with respect to its mineral properties and programs are forward-looking statements. There can be no assurance that BMM's plans for development of its mineral properties will proceed as currently expected. There can also be no assurance that BMM will be able to confirm the presence of additional mineral resources, that any mineralisation will prove to be economic or that a mine will successfully be developed on any of BMM's mineral properties. The performance of BMM may be influenced by a number of factors which are outside the control of the Company and its Directors, staff, and contractors.

These statements include, but are not limited to statements regarding future production, resources or reserves and exploration results. All such statements are subject to certain risks and uncertainties, many of which are difficult to predict and generally beyond the control of the Company, that could cause actual results to differ materially from those expressed in, or implied or projected by, the forward-looking information and statements.

The Company confirms that is it not currently aware of any environmental restrictions or requirements that would impede the continuation of planned activities.

Except for statutory liability which cannot be excluded, each of BMM, its officers, employees and advisors expressly disclaim any responsibility for the accuracy or completeness of the material contained in these forward-looking statements and excludes all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in forward-looking statements or any error or omission. BMM undertakes no obligation to update publicly or release any revisions to these forward-looking statements to reflect events or circumstances after today's date or to reflect the occurrence of unanticipated events other than required by the Corporations Act and ASX Listing Rules. Accordingly, you should not place undue reliance on any forward-looking statement.

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Schedule 1- Key terms for the Solar Cell Recycling Technology IP Licencing Agreement.

Territory:

- Worldwide *(Patents registered in Australia & United States of America)*

Payments:

- **Reimbursement Registration Cost:** $33,900
- **Annual Licence Fee:** $20,000 payable annually to Macquarie University (MQU) by Bayan by direct transfer to the bank account nominated by MQU, within 30 days of the end of each anniversary of the Commencement Date during the Term, commencing from 2027 and continuing until 2042.

Royalty:

- 3% of annual gross sales of products and/or services using the Licensed IP achieved by or on behalf of Bayan, payable quarterly to MQU by Bayan by direct transfer to the bank account nominated by MQU, within 30 days of the end of each Quarter during the Term. The Royalty payment will be a minimum of $5,000 per annum commencing from the anniversary of the Commencement Date that falls within 2033.

Milestone Fee:

- Bayan must notify MQU in writing of the achievement of each Milestone. Upon the occurrence of each Milestone, MQU will be entitled to receive either of the following as selected by MQU:
  - $100,000 cash by direct transfer to the bank account nominated by MQU; or
  - fully-paid ordinary shares in Bayan equal to the aggregate value of $100,000 with the same full voting, dividend, distribution and other rights that apply in respect of all other ordinary shares issued in Bayan and with the share price to be based on the 15-day volume-weighted average price (VWAP) preceding the date of issuance (Milestone Equity). The issue of shares will be subject to shareholder approval. In the event that shareholder approval is not received, MQU will receive the Milestone Equity in cash.

  MQU shall notify Bayan of its selection within 30 days of being notified by Bayan of each Milestone achievement. If the University elects to receive Milestone Equity, Bayan must issue the relevant shares to an MQU Nominee Entity nominated by MQU in writing to Bayan. Bayan must complete payment of the relevant Milestone Fee within 30 days of the written notice of MQU's selection.

Impact/Performance Criteria:

- Phase 1: R&D completed by 2027
- Phase 2: Pilot testing and validation completed by 2030
- Phase 3: Commercial deployment and first sales by 2032.

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