

BLUGLASS (ASX:BLG)

ENTERING THE  
GLOBAL LASER  
DIODE MARKET

OCTOBER 2019



# FORWARD LOOKING STATEMENT

This document has been prepared by BluGlass Limited to provide readers with an update of the Company and the Company's technology.

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Information on Service Addressable Markets (SAM) is based on internal BluGlass modelling and assumptions, both of which depend on successful R&D outcomes and results achieved within estimated timetables. BluGlass recommends a cautious interpretation be taken by investors.

# A NEW BLUGLASS BUSINESS



# BLUGLASS TO TARGET MARKET ENTRY IN LASER DIODES – LAUNCHES NEW BUSINESS UNIT

## CAPITALISING ON OUR TUNNEL JUNCTION CAPABILITIES



GaN laser diodes (LDs) represent an emerging market opportunity in need of a competitive technology solution such as RPCVD. It represents a Serviceable Addressable Market (SAM) for BluGlass in excess of **US\$658M by 2025\***



BluGlass is launching a new business unit exploiting **BluGlass' unique RPCVD tunnel junction technology**, expected to enable higher brightness & higher efficiency GaN laser diodes and aims to capture 6-10% of its SAM by 2025



Multiple end-use applications in markets such as industrial cutting / welding (initial target), laser displays, automotive lighting and scientific applications with a combined total application market in excess of **US\$27B in 2025**



Expected LD demonstration and product launch in CY2020, **with growing revenues expected in 2021**. BluGlass is seeking to secure the manufacturing supply chain to support commercialisation of laser diodes



BluGlass has the **pre-installed RPCVD capacity onsite** in Silverwater to grow significant laser diode (high-value and high-margin product) revenues and build a profitable business unit



\* Source: Internal BluGlass modelling

# LASER DIODE BUSINESS UNIT TECHNICAL LEADERSHIP TEAM



**BRAD SISKAVICH**  
Vice President of  
Business Development

20+ years' experience in semiconductor industry leadership with significant laser diode industry expertise and track record in transferring technology from prototype to commercial production. Brad worked in senior research and business development roles at companies that include Emcore, Axcel Photonics, Oxford Instruments and Masimo Semiconductor.



**DR. IAN MANN**  
Chief Operations and  
Technology Officer

20+ years' experience in prototype and product development, commercialisation of intellectual property and technology and engineering team management. Ian brings a wealth of knowledge to the BluGlass technology and commercial teams with deep experience in managing and developing breakthrough high-tech solutions and delivering unique IP to market.



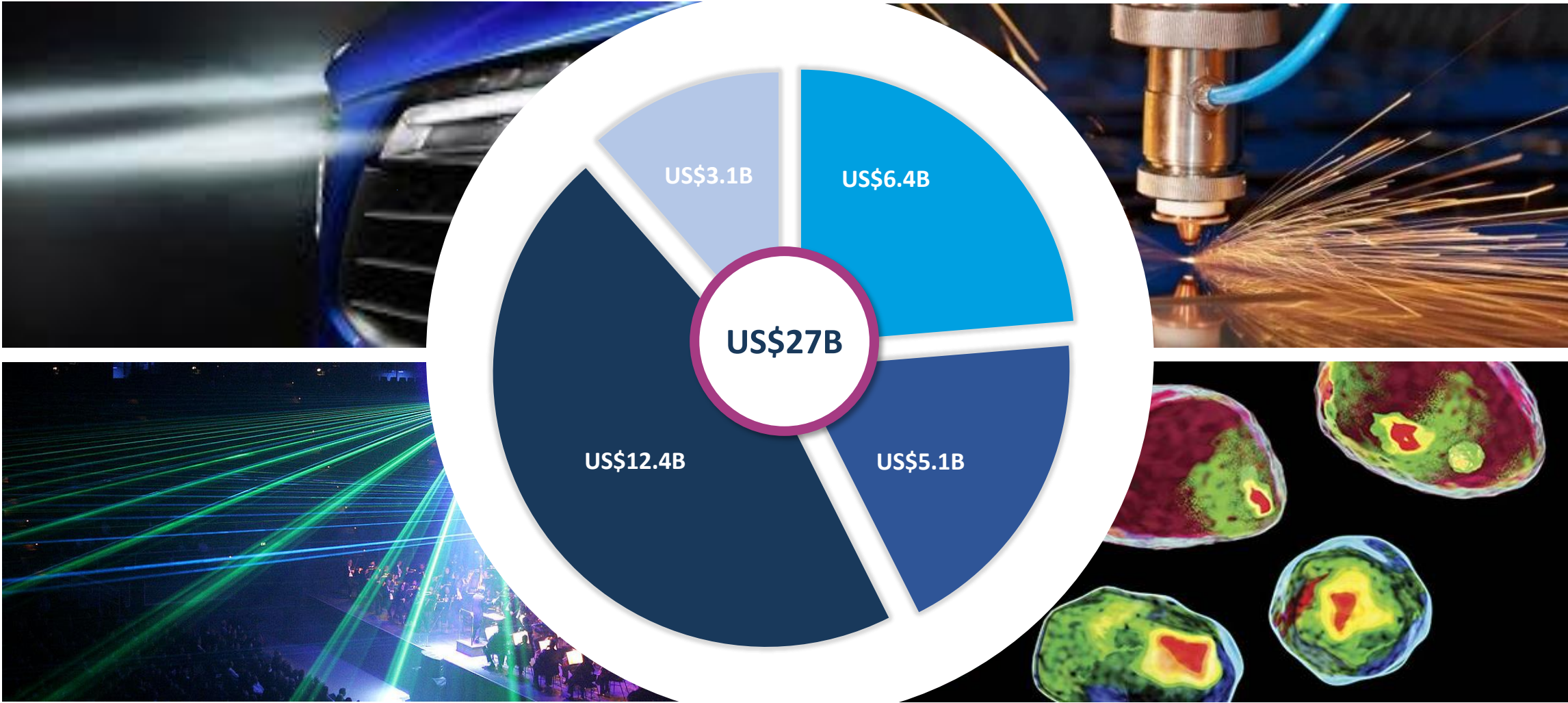
**DR. JOSH BROWN**  
Head of Epitaxy

Senior Process Engineer with extensive MOCVD and RPCVD epitaxial expertise developing LEDs, microLEDs, laser diodes and power electronics. Since 2017 Josh has led the EpiBlu epitaxy foundry services arm of BluGlass providing custom R&D and epitaxy solutions to customers around the world using BluGlass' MOCVD and RPCVD platforms.



DEFINING THE LASER DIODE  
MARKET OPPORTUNITY FOR  
BLUGLASS

# GLOBAL LASER END-MARKET FORECAST BY APPLICATION SEGMENTS (2025)



Source: Internal BluGlass modelling based on industry sources

■ Industrial cutting/welding ■ Life sciences ■ Laser display ■ Automotive

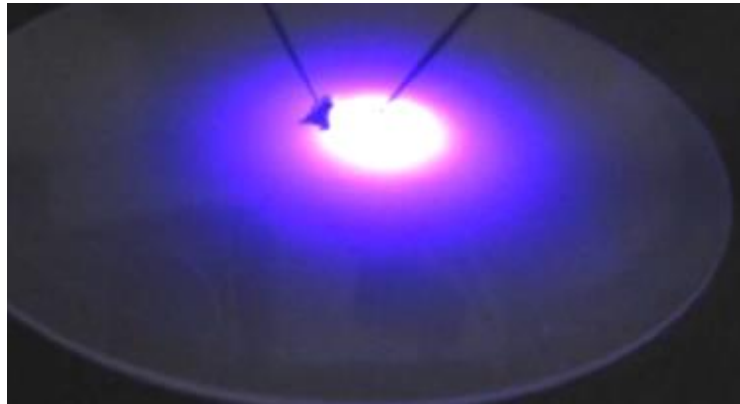
# THE COMMERCIAL LASER DIODE OPPORTUNITY

## The Need

- The market now demands high-brightness, high-efficiency GaN laser diodes, for a wide variety of end-use customers, in multiple applications:
  - Industrial cutting/welding (initial target), laser displays, automotive lighting and scientific applications
- Affordable, high-performance, high-efficiency laser diodes will be required for this next phase of market growth and GaN LD technology adoption
- Many unmet needs for custom LD development exist within select low-volume yet high value applications

## The Solution

- BluGlass' RPCVD and Active-As-Grown (AAG) epitaxial growth technology enable a new Tunnel Junction-integrated GaN laser diode
- This new design and associated manufacturing technology exploits our existing, patented, RPCVD process
- Enables high-brightness and high-efficiency laser diodes to be produced at commercial scale
- Barriers to entry to the market (long development times of novel technology, high capital investment, IP protection) all work in BluGlass' favour, and protect BluGlass from other new entrants





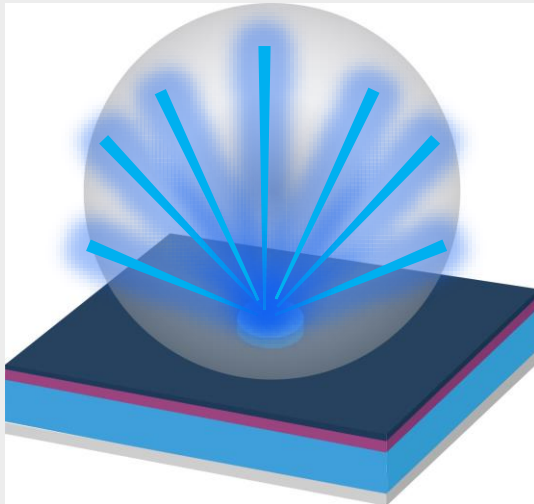
THE GaN LASER DIODE  
OPPORTUNITY IS A GOOD  
FIT FOR BLUGLASS



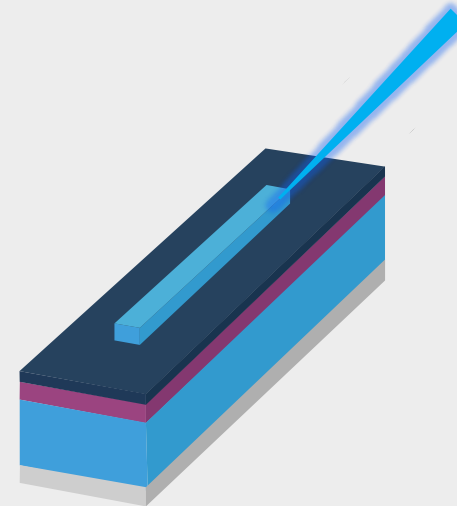
# LED v. LASER DIODE LIGHT EMISSION

GaN laser diodes and LEDs (light emitting diodes) are semiconductor devices grown under similar conditions - using the same III-nitride materials (BluGlass' area of expertise) - but grown with different internal epitaxial structures to engineer different light characteristics, intensities and applications.

An LED emits a top dispersive light



A laser diode is a focused edge emitter with a highly converged light emission

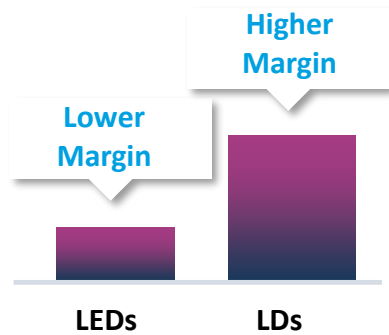


# LEDs VS LASER DIODES

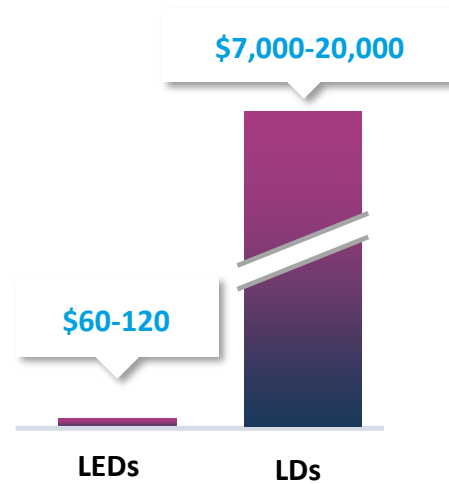
The GaN LED and laser diode markets differ greatly in value, margin and volume, warranting a different market entry strategy.

BluGlass will take a direct commercialisation path in the high-value, high-margin, defined volume, laser diode market due to a number of market factors including:

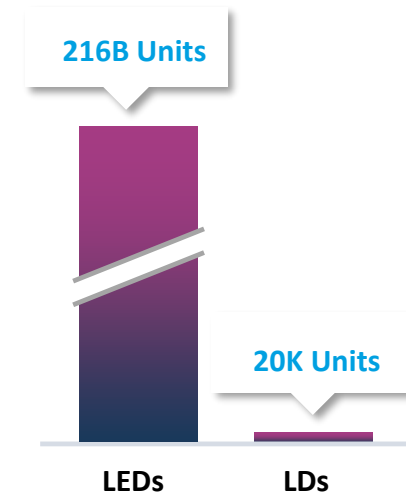
LED/LD WAFER GROSS MARGIN



LED/LD WAFER SALE PRICE

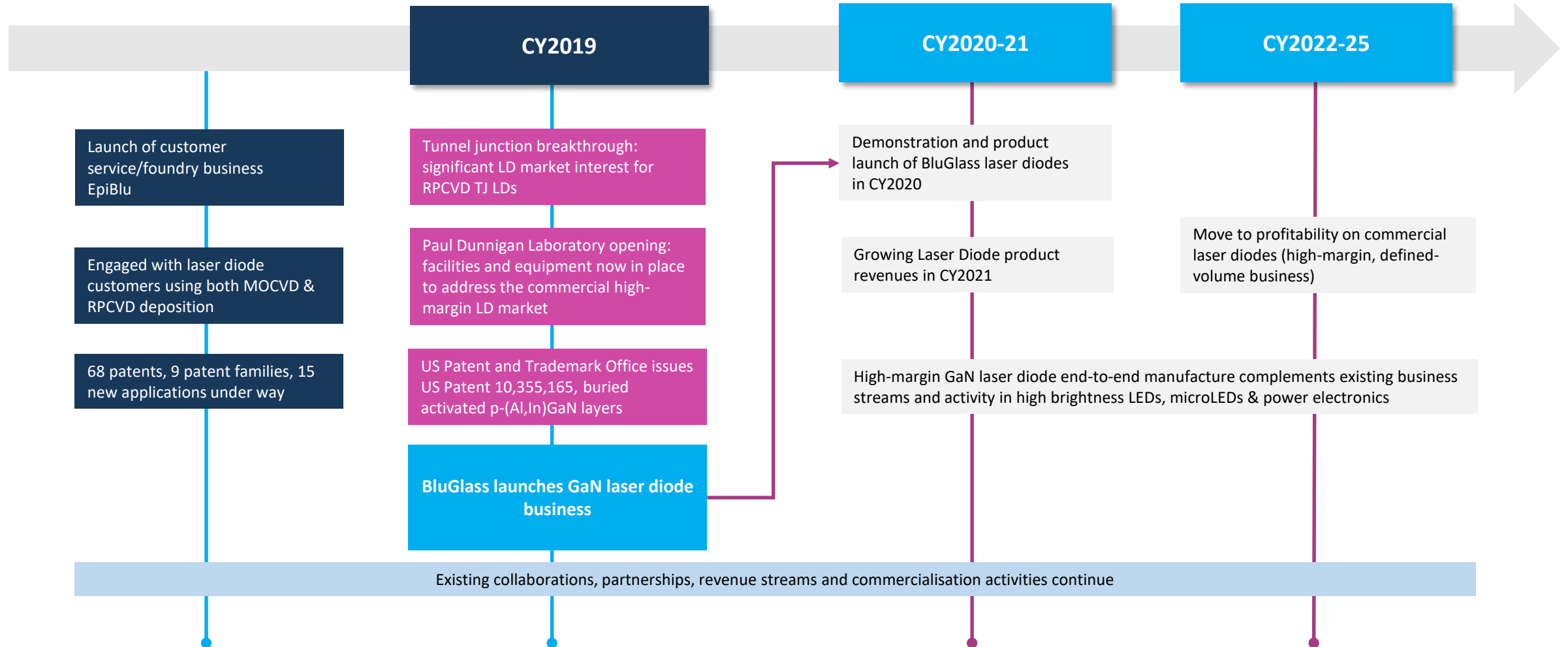


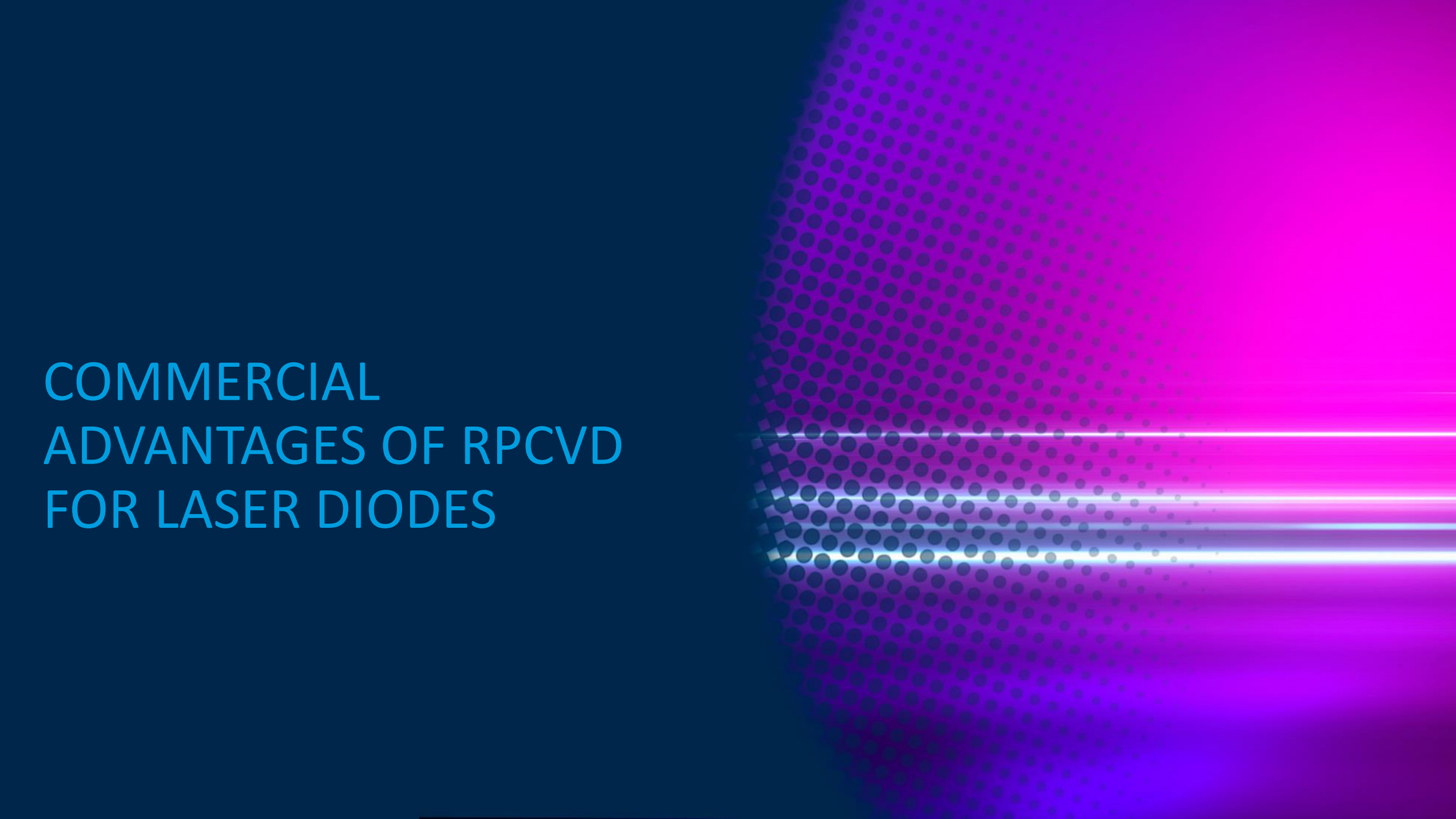
UNITS SOLD PER ANNUM



# LASER DIODE DEVELOPMENT PROGRESS & PATH TO COMMERCIALISATION

A new business, now possible on the foundations already built and in place, that creates revenue as new global GaN device supply chain expertise is built





# COMMERCIAL ADVANTAGES OF RPCVD FOR LASER DIODES

# BLUGLASS LASER DIODE VALUE PROPOSITION: RPCVD-ENABLED DIODES

	Description	RPVCD	MOCVD
<b>Active-As-Grown (AAG) Technology</b>	Unique technology advantage proprietary to BluGlass' RPCVD deposition technology	✓	✗
<b>Higher performing devices</b>	<ul style="list-style-type: none"> <li>• Higher LD brightness and efficiencies</li> <li>• Reduced optical loss</li> <li>• Lower contact and device resistance</li> </ul>	✓	✗
<b>Productivity and cost improvements</b>	<p>New LD epitaxy design enables downstream process optimisation:</p> <ul style="list-style-type: none"> <li>• Fewer process/fabrications steps</li> <li>• Lower LD cost to end-user</li> </ul>	✓	✗
<b>Unique Laser Diode Design</b>	<p><b>RPCVD's Active As Grown</b> p-GaN technology enables the use of tunnel junctions and n-AlGaIn layers in the LD design</p> <ul style="list-style-type: none"> <li>• n-AlGaIn layers can be used to efficiently confine the light within the laser diode; removes performance constraints currently inherent in laser diode devices by reducing optical losses and improving laser diode brightness and efficiency</li> <li>• RPCVD can deliver the tunnel junctions and n AlGaIn layers at commercial wafer scales to deliver these laser diode performance advantages</li> </ul>	✓	✗
<b>IP protection</b>	RPCVD hardware and process technology and AAG epitaxial growth techniques for laser diodes are extensively covered by <b>68</b> patents within <b>9</b> patent families, with <b>15</b> new applications under way	✓	

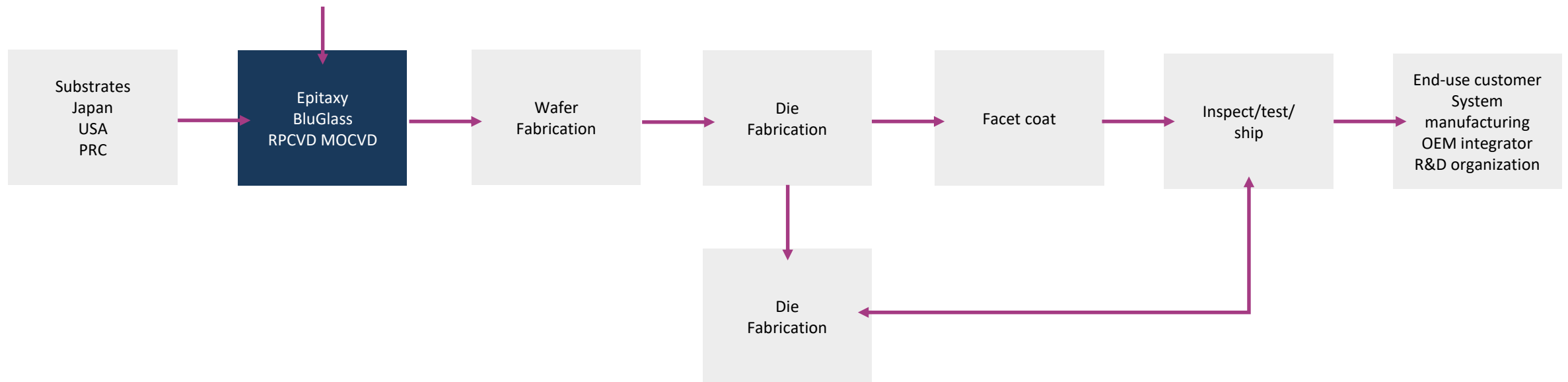


# THE LASER DIODE MARKET OPPORTUNITY FOR BLUGLASS

# BLUGLASS LASER DIODE SUPPLY CHAIN PROPOSITION

BluGlass aims to position its unique tunnel junction platform laser diode design as the industry benchmark for performance and efficiency. To achieve this, BluGlass aims to gain control and oversee fabrication end to end – from epitaxial growth through to testing and reliability, enabling close interaction with end-use customers

Where BluGlass operates in the supply chain today:

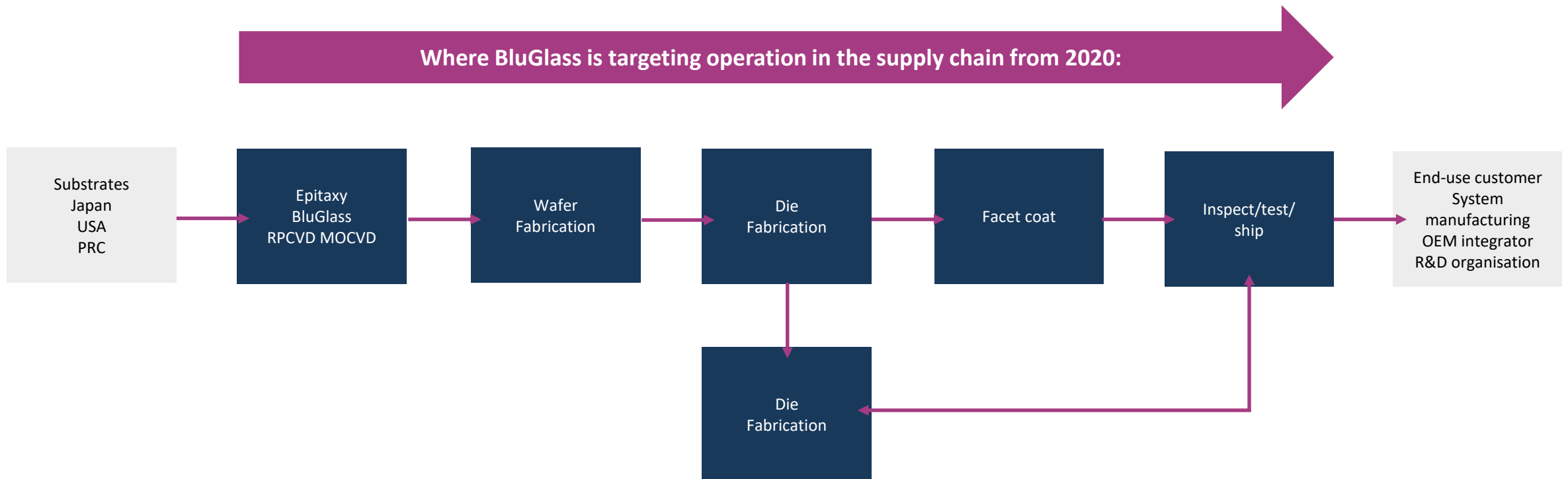




# BLUGLASS LASER DIODE SUPPLY CHAIN PROPOSITION

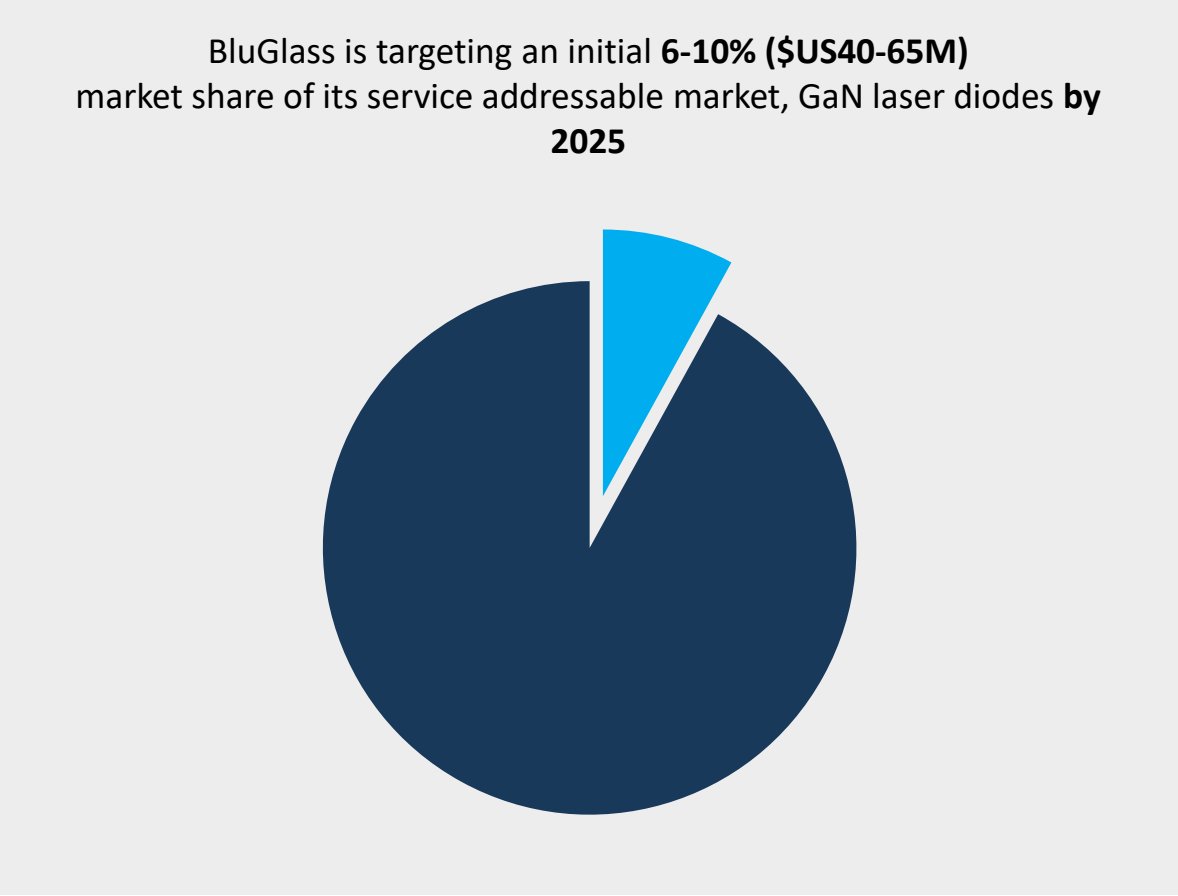
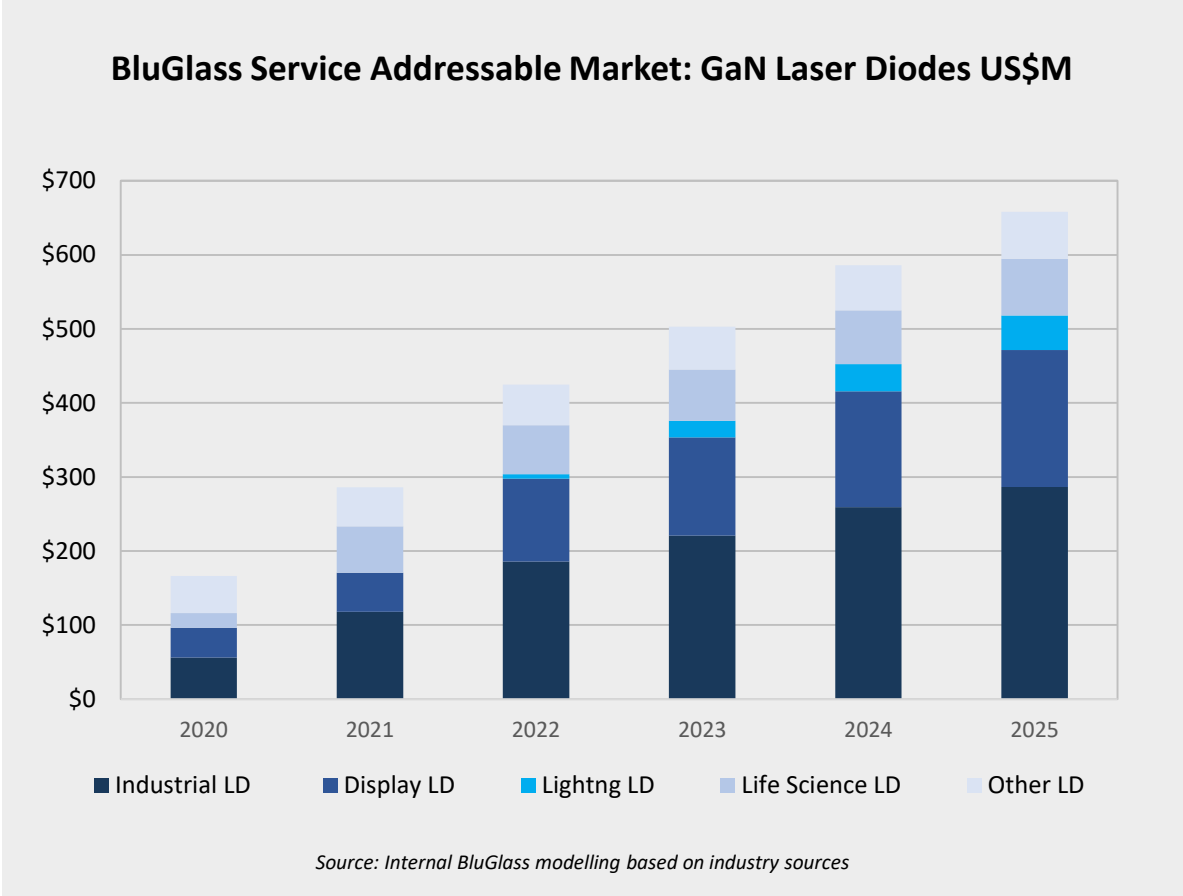
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Where BluGlass is targeting operation in the supply chain from 2020:



# SERVICE ADDRESSABLE MARKET FOR GaN LASER DIODES

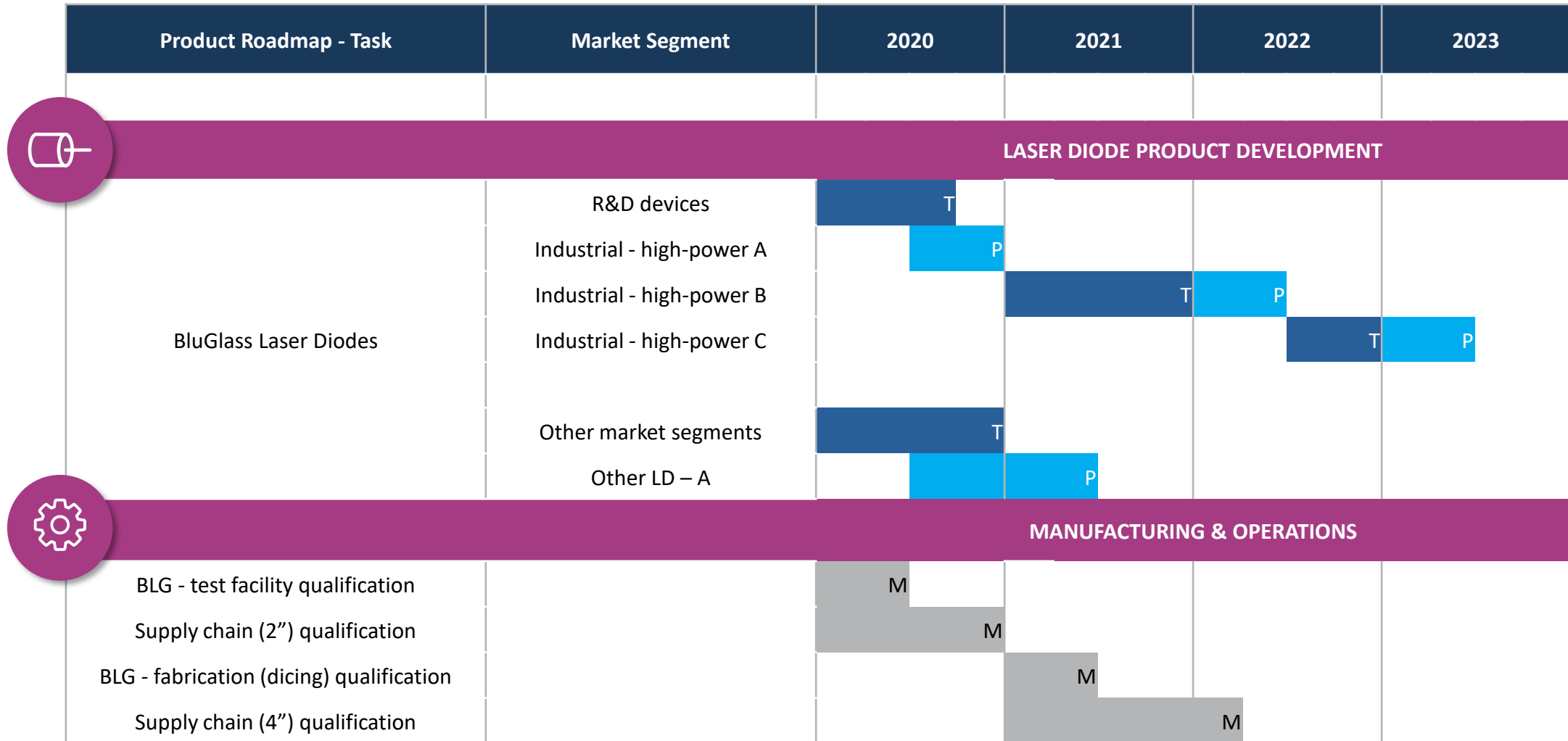
BluGlass has taken a conservative approach to analysing the growth opportunities (addressable markets) for high-performance GaN LDs





BLUGLASS GO-TO-  
MARKET STRATEGY  
FOR LASER DIODES

# BLUGLASS LASER DIODE PRODUCT & SUPPLY ROADMAP & TIMETABLE



P: Product Launch

T: Technology Demonstration Milestone

M: Manufacturing Milestone

# BLUGLASS LASER DIODE COMMERCIALISATION PLAN

BluGlass will target business opportunities in the global photonics industries as follows:

## Demonstrate technical performance and long-term reliability

- Launch RPCVD TJ laser prototypes at major laser conference – SPIE Photonics West & Laser World of Photonics (2020/21)
- Demonstrate performance and reliability data for specific end-use products (industrial, life science, other)
- Develop technical literature and application notes for Initial BLG TJ laser diode product launch

## Highly Experienced Direct Sales Force & Application Lab

- A dedicated US based direct sales (1-2) team will focus upon a few key early adopters in the Industrial Laser Market
- Leverage US applications facility and proximity of tech team to Supply Chain for customization of TJ LD form factors
- Leverage RPCVD facility (NSW) for customization and iterations of epitaxy structure design

## Expand Product Portfolio and Market Segments

- Customize TJ LD products for End-Use customers (Biotech & Other) having strong packaging & integration capabilities
- Leverage early success within OEM's and laser equipment suppliers to create pull for follow-on BLG LD product offerings
- Develop non-standard or customised GaN laser diode products for R&D firms / govt. agencies

## Support High Growth Applications & Markets

- Develop Global Account Management Team (3-5) to support high growth accounts starting in CY2022
- Close multi-year supply agreements for Tier 1 (TJ LD enhanced performance) accounts
- Commence second-source pilot production with Tier II (Industry Standard LD) system manufacturers

# BLUGLASS GaN LASER DIODE – BUSINESS RISK ASSESSMENT

## Technology Risk

### Laser diode long-term reliability

- Laser diode burn-in and long-term reliability testing & verification required prior to commercial volume manufacturing of laser diodes
- Initial 100% LD testing will be implemented prior to product shipment to ensure product quality and limit performance variation

### Development delays in proving competitive advantages

- BluGlass will work closely with the laser diode fabrication suppliers to accelerate development iterations and will bring laser diode design capabilities in house
- BluGlass will leverage its many years of LED development that carries over to laser diode design and production

### RPCVD Uniformity

- The latest BLG-300 and G4 RPCVD chamber designs will be implemented in our new expanded facility and used for both the development and production of laser diodes

### Substrate supply

- BluGlass aims to ensure reliable and repeatable supply of free-standing GaN substrates as vendor quality can impact LD performance and vendor substitution requires re-qualification

## Market Risk

### Macro-economic conditions slow the adoption rates laser cutting and welding systems

- As a technology platform, the TJ LD design can be rapidly tailored to meet the needs of alternative market segments such as Life Science & Consumer (display & AR/VR)

### Regulatory hurdles slow adoption of laser lighting in automotive and general lighting segments

- BluGlass is entering the industrial and “other” traditional markets segments first as the quickest path to market, and will simultaneously address qualification and product requirements for more heavily regulated secondary market segments such as automotive and general lighting

# NEW BUSINESS BUILDS ON EXISTING BLUGLASS COMMERCIALISATION STRATEGY



**Leveraged to large and growing markets:** Application of BluGlass' RPCVD technology to multiple high-growth markets. RPCVD technology has demonstrated performance advantages in a number of photonics market segments: **laser diode**, LED, microLED, power electronics



**Strong patent portfolio:** 68 patents granted in key semi-conductor markets (USA, Europe, Asia). Key US Tunnel Junction Patent for multiple applications granted in 2019



**Accelerated global commercialization of RPCVD technology:** Demonstrated competitive advantages with applications across multiple markets. New laser diode business complements BluGlass' existing partnerships and commercial plans by driving commercial application and early significant ROI of intensive RPCVD R&D



**Several commercialisation paths:**

- New laser diode product business to deliver clear path to significant revenues
- Licence fees & royalties, delivering medium return repeat revenue (LED market strategy)
- Equipment sales with equipment partner(s)
- Equipment retrofit of installed base
- Epitaxy wafer sales (EpiBlu foundry)



# THANK YOU

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