DMCC

# THE FUTURE OF TRADE

## SPECIAL LAB-GROWN DIAMOND EDITION

## BEYOND JEWELLERY

Growth frontiers in LGD, from luxury and fashion to advanced technology

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# INTRODUCTION

This report serves as the second in-depth thought leadership report from DMCC on the lab-grown diamond (LGD) industry. It has been prepared at a pivotal moment in the evolution of the industry. Lab-grown diamonds are no longer peripheral to the jewellery sector; they have entered the mainstream of consumer markets, redefined the economics of supply, and opened entirely new technological frontiers.

The purpose of this report is not only to document the growth of the LGD industry but also to examine its strategic implications for stakeholders across the value chain — from producers and traders, to retailers, technology companies, investors, and policymakers. It comes following the second edition of the Lab-Grown Diamond Symposium that took place in Dubai, September 2025 - hosted by DMCC in partnership with Original Luxury, and assembling industry leaders, experts and analysts to discuss the future of trade of the LGD industry. By bringing together data, case studies, and foresight analysis, we aim to provide a clear and holistic view of where the industry stands today, the opportunities that lie ahead, and the conditions required for sustainable success.





The LGD sector is at once a consumer story of increasingly brand led storytelling, affordability and ethics, an industrial story of precision and performance, and a technology story of frontier innovation.

The analysis recognises that the LGD sector is at once a consumer story of increasingly brand led storytelling, affordability and ethics, an industrial story of precision and performance, and a technology story of frontier innovation. Each of these narratives intersects in ways that will shape the future of global trade, investment flows, and sustainability norms.

# EXECUTIVE SUMMARY

Lab-grown diamonds (LGDs) have transitioned from scientific curiosity to mainstream commercial force, reshaping both consumer and business markets. Once positioned as a substitute for mined stones, LGDs are increasingly valued as a category in their own right — combining increasing affordability, ethical credibility, and technological promise.

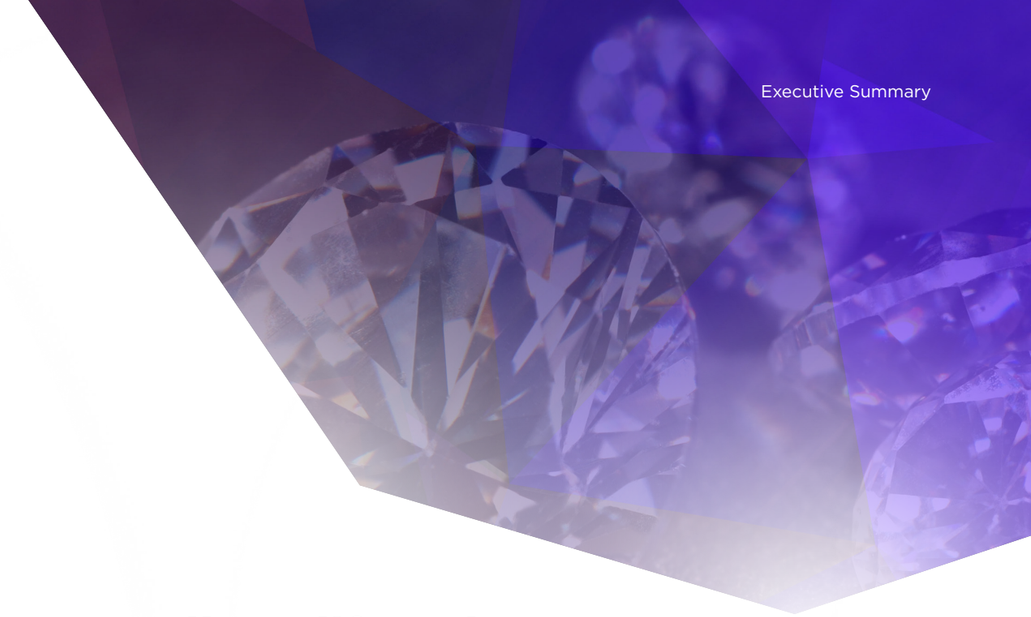
The global LGD market, estimated at $25–35 billion in 2025, is on track to more than double to $60–100 billion by the early 2030s. Three parallel growth tracks underpin this trajectory:

## Industrial applications

Leveraging unmatched hardness and durability, LGDs are gaining share in cutting tools, abrasives, and precision manufacturing, supporting numerous industries from construction to aerospace.







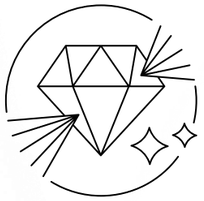
## Jewellery, lifestyle, and fashion

LGDs now account for nearly half of U.S. engagement ring centre stones, with rapid growth in Europe, India, China, and the Middle East. As costs fall and consumer narratives mature, design-led and lifestyle applications are expanding beyond bridal into watches, fashion, and wellness.

## Technology applications

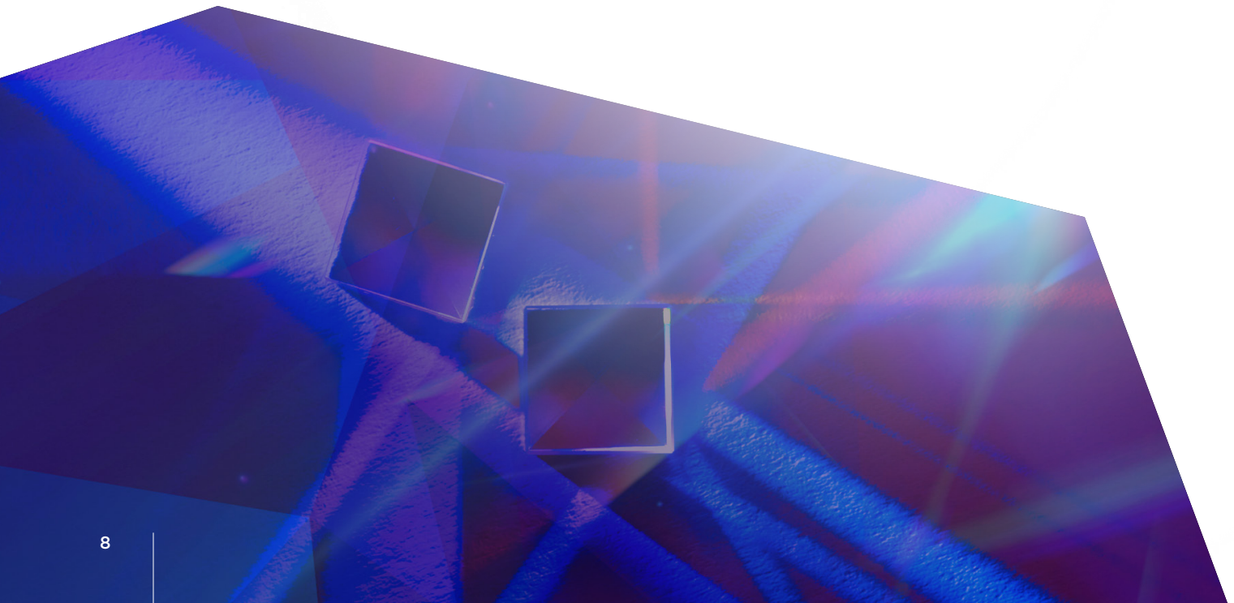
With exceptional thermal conductivity, optical clarity, and even biocompatibility, LGDs are emerging as strategic materials for semiconductors, quantum technologies, advanced optics, medical devices, and energy systems.

Industrial uses such as cutting tools and abrasives are a well-established, understood and mature segment that will continue to evolve incrementally. For this reason, this report concentrates on the two main high growth frontiers – consumer applications (jewellery, lifestyle and fashion) and technology – where the innovation, investment, and policy implications for global trade are most pronounced.



## The Future of Trade of LGDs

The trajectory of LGDs has been predictable through a foresight lens: signals first emerged in the 1950s, coalesced into patterns in the 2000s, and broke out into full-blown trends in the 2010s. The same approach — monitoring new signals and their clustering into patterns — provides vital clues to the industry's future.





Executive Summary

The trajectory of LGDs has been predictable through a foresight lens: signals first emerged in the 1950s, coalesced into patterns in the 2000s, and broke out into full-blown trends in the 2010s.

The trajectory of the LGD sector will be shaped less by short-term turbulence and more by enduring drivers: creativity and innovation, cost reductions, supply reliability, and verified ESG performance. In consumer markets, LGDs are set to remain a fixture in bridal and expand further into fashion-led categories. In technology, signals in semiconductors, quantum sensing, and photonics are clustering into patterns that suggest commercial breakthroughs.

As jewellery and tech demand grow, supply may tighten and struggle to meet varied demand, elevating the potential need for strategic partnerships and supply contracts and even price stabilisation. Those who innovate consistently across one or more growth tracks, scale winning formulas and embed sustainability at the core will define the next chapter of the global lab grown diamond industry.

SECTION 1

# UNDERSTANDING INDUSTRY EVOLUTION



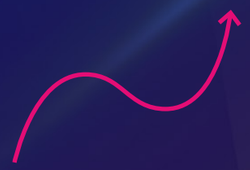


## SIGNALS, PATTERNS, TRENDS

Industries rarely shift in linear fashion but unfold through a sequence of signals, patterns, and trends.

**Signals** are the earliest, often isolated, indicators of change. They might take the form of a patent registration, a niche startup launch, or a scientific breakthrough in a lab. On their own, signals can be weak, ambiguous, and easily dismissed.

**Patterns** form when signals begin to cluster. Multiple signals in the same direction — whether in technology, consumer interest, or regulatory momentum for example — and start to point to a more substantive shift in the making.



**Trends** are the result of patterns that have tipped into the mainstream. By the time a development has become a widely recognised trend, the competitive advantage for early movers has largely been captured.

The LGD sector is a textbook example of how this process unfolds, and in many ways the sector's emergence to date was predictable. Signals of first production appeared in the 1950s, coalesced into patterns of technological refinement and consumer curiosity in the 1990s–2000s, and broke out as a trend in the 2010s with falling costs and mainstream retail adoption.

# PHASES OF LGD EVOLUTION

## **Phase 1:** Discovery and Industrial Use (1950s–1990s)

- **Signals**: GE's breakthrough with High Pressure High Temperature (HPHT) synthesis in the 1950s; early patents; first use of synthetic diamonds in industrial cutting and drilling tools.
- Market perception confined to "synthetic" and utilitarian functions.

## **Phase 2:** Entry into Jewellery and Consumer Markets (1990s–2010s)

- **Emerging signals**: advances in Chemical Vapor Deposition (CVD); gem-quality lab-grown diamonds becoming technically feasible.
- **Pattern formation**: small-scale jewellery offerings, early direct-to-consumer entrants, and growing consumer interest in ethical alternatives.






## **Phase 3:** Mass Market Adoption and Vertical Integration (2015–2020)

- **Signals**: rapid fall in production costs, entry of De Beers' Lightbox brand, and widespread retail adoption in the U.S. market.
- Regulatory tailwinds such as the FTC's updated guidelines legitimised LGDs as diamonds and the term "lab-grown."
- Vertical integration emerged as retailers sought security of supply and control over value chains.

## **Phase 4:** Maturity, Diversification and Tech Integration (2020–2025)

- **Consolidation**: LGDs now mainstream in engagement rings and fashion jewellery.
- **Diversification**: applications beyond jewellery into lifestyle products, watches, and wellness sectors.
- **Integration with technology**: expansion into semiconductors, photonics, and quantum computing.
- LGDs now established as both a consumer luxury product and an advanced material with frontier applications

# TRIPLE GROWTH TRACKS

LGDs are experiencing rapid expansion across three distinct tracks:

(1) Industrial applications,
(2) Jewellery, lifestyle, and fashion, and
(3) Technology.

While industrial uses remain the foundation of the LGD market, the most transformative frontiers lie in jewellery and technology, where innovation, consumer adoption, and investment are redefining the global value chain. Near-term opportunities centre on thermal management and optics, with longer-term potential in semiconductors, photonics, and quantum technologies.

Global market growth estimates vary by source and scope (e.g., jewellery track vs all sector tracks). Triangulating recent data indicates a current total market of $25–35 billion (2024–2025), projected to reach $60–100 billion by 2032–2034 (assuming CAGR of 9–14%). This growth is fuelled by industrial demand, ethical consumer preferences, and technological advancements.

Meanwhile, Dubai has firmly established itself as the world's leading diamond hub and is rapidly emerging as a centre of gravity for LGDs. DMCC anchors a vibrant diamond ecosystem of over 1,350 precious stones companies.

**"Recent data indicates a market projected to reach $60–100 billion by 2032–2034. This growth is fuelled by industrial demand, ethical consumer preferences, and technological advancements."**



SECTION 1: Understanding Industry Evolution

**"Lab-grown diamonds is unequivocally a growth market."**

**Paul Zimnisky**
leading industry analyst

The LGD ecosystem is scaling quickly, with more than 30 specialised firms already active, including market leaders, and LGD rough and polished trade in Dubai exceeding $1 billion in 2024.

SECTION 2

# LGDS IN JEWELLERY

Lab-grown diamonds have rapidly shifted from niche to mainstream within the global jewellery sector. Once a production-driven market defined by supply expansion and novelty, the category is now increasingly demand-led, driven by affordability, ethical positioning, and design flexibility. Importantly, the narrative is also maturing: brands are moving beyond rational price-and-ethics arguments toward emotionally resonant storytelling emphasising love, individuality, and modern style.

The global LGD jewellery market was valued at circa $30-35 billion in 2025 and is projected to rise to $55-60 billion by 2032. By volume, LGDs make up 15-20% of global diamond market sales, though revenues are lower due to pricing discounts compared to mined diamonds. Alongside gains in the bridal/engagement market share, there is a noticeable shift into design-led creations overlapping with the fashion sector—trend jewellery, coloured or unusual shapes, sets, and lifestyle pieces are gaining share.

**The global LGD jewellery market was valued at circa $30-35 billion in 2025 and is projected to rise to $55-60 billion by 2032**

# CONSUMER AND MARKET DRIVEN

**FIGURE 1**

**Relative affordability comparison for Solitaire engagement ring**

Lab-Grown

Now + Forever Lab-Grown Diamonds Solitaire Engagement Ring 2 ct tw 14K White Gold (F/S12)
**$4,999.99**

Natural

2 CT. Certified Diamond Solitaire Six Prong Engagement Ring in 14K White Gold (I/I2)
**$12,999.99**

**Source:** Signet Sept 2025. Lab grown option from Kay Jewelers, Natural from Zales

**Affordability**: LGDs typically retail at 50-70% less than comparable mined stones, allowing consumers to choose larger stones, more complex designs, or colours that would be cost-prohibitive otherwise.

**Design Appeal**: Beyond affordability, consumers are increasingly seeking distinctive design, including coloured stones, fancy cuts, or bespoke settings. LGDs give designers more leeway to innovate.

**Ethics and Sustainability**: Consumers, especially younger demographics such as Millennials and Gen Z, increasingly demand transparency about sourcing, conflict-free provenance, and environmental impact. LGDs can meet many of these concerns, reinforcing ethical luxury positioning provided claims can be evidenced – see Sustainability section.



SECTION 2: LGDs in Jewellery

**“Consumers, especially Millennials and Gen Z, increasingly demand transparency about sourcing, conflict-free provenance, and environmental impact.”**

# RETAIL AND BRAND DEVELOPMENTS

**Geographies**: In the United States, recent data indicates that LGDs account for at least 46% of engagement ring stones (centre stones) in 2025, up from ~12% in 2019 by volume[1].

The U.S. remains the core market, but Europe, India, China, and the Middle East are increasingly important. In Europe, LGDs are estimated to hold ~25-30% of the jewellery market in 2025 with a projected CAGR of ~5.3% through 2032.

In the UAE, estimates vary but coalesce around 10-12% market share.

In India, LGD penetration is nascent but growing and is currently estimated at somewhere between 2-4% of total diamond jewellery sales, with similar early-stage levels of penetration reported for China.

**A widening consumer base:**: LGDs' affordability is a key driver in widening the diamond consumer base and in so doing, adding incremental to global jewellery sales.

**"In the United States, LGDs account for at least 46% of engagement ring stones (centre stones) in 2025, up from 12% in 2019."**

[1] Accio/Tenoris

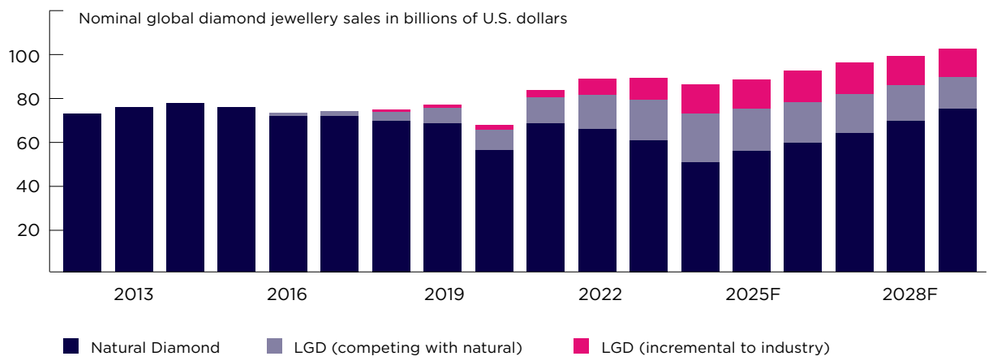




**CHART 1**

**LGDs are adding a tier of incremental demand (Paul Zimnisky, 2025)**

All based on Paul Zimnisky Estimates and Forecasts




**Source:** PaulZimnisky.com, 2025

# RETAILER/ BRAND ACTIONS

Most major U.S. retailers continue to carry lab-grown diamonds, both in bridal and in fashion jewellery. For example, Signet (owner of Kay, Zales, Jared, and other brands) recently reported that lab-grown diamond fashion pieces now make up ~14% of its fashion category sales, particularly in product lines under $1,000. They also disclosed that the inventory of lab-grown jewellery items priced below $1,000 has roughly tripled compared to the previous year, with especially strong growth in sub-$500 price points. Strong retail margins on jewellery featuring LGDs act as a strong incentive for retailers to stock and push sales.

As retail sales prices have declined, any margin compression is likely being managed through cost control, product mix, and value tiering.

# STANDARDS AND GOVERNANCE

In recent years, industry standards and governance around LGDs have evolved as the category matures.

The U.S. Federal Trade Commission (FTC) set the benchmark with its 2018 Jewellery Guides revision. This ruling removed the word “natural” from the definition of diamond, legitimised terms such as *lab-grown* or *laboratory-created* when clearly disclosed, and restricted misleading descriptors like “real” or “genuine” that might imply mined origin. While these Guides are not law, they carry considerable weight in shaping U.S. advertising and retail practice, not least because the United States is the world’s largest jewellery market.

Since then, other bodies have evolved their guidance. CIBJO (the World Jewellery Confederation) has progressively expanded its governance framework:

In **2022** it updated its Laboratory-Grown Diamond Guidelines, mandating clear differentiation between natural and lab-grown diamonds in invoices, promotional materials, and labelling

In **2024** it issued a set of ESG principles tailored for LGD producers, encouraging more transparent and responsible practices.

In **2025** CIBJO went further with detailed guidelines for measuring ESG performance across the jewellery supply chain — moving the industry from broad aspirations toward measurable accountability.






The Responsible Jewellery Council’s Laboratory-Grown Materials Standard (LGMS) became mandatory in 2025 for all RJC members working with lab-grown materials. The LGMS sets requirements for disclosure, ethical sourcing, and ESG performance, reinforcing supply chain transparency and traceability.

**Dubai as a hub**: Dubai is rapidly emerging as a global hub for LGDs, building on its long-standing role as a trading and retail centre for natural diamonds. The city now hosts dedicated LGD jewellery showrooms, a growing cluster of wholesale distributors, and industry events positioning it as the global gateway for both consumers and traders. Supportive government policies, tax advantages, and Dubai’s reputation as a luxury destination make it an increasingly important node in the international LGD supply chain.

**“Dubai now hosts dedicated LGD jewellery showrooms, a growing cluster of wholesale distributors, and industry events positioning it as the global gateway for both consumers and traders.”**

# MIDSTREAM AND MANUFACTURING SHIFTS

The grading and certification landscape for lab-grown diamonds is undergoing rapid change, with important implications for consumer trust and market positioning:

- IGI (International Gemmological Institute) remains the most significant player in the LGD certification space and continues to provide full 4C-based grading reports. For the majority of the LGD industry, IGI reports remain the standard of record, reflecting the high proportion of LGDs that now achieve top colours and clarities.
- Other laboratories have taken different stances. HRD Antwerp recently announced it will stop issuing grading reports for loose polished stones, while continuing to grade LGDs set in jewellery. The GIA (Gemological Institute of America) also recently shifted its position, moving away from detailed 4C reports for lab-grown diamonds it first introduced in 2019, to revert to a new framework, where LGDs will be described in broad categories such as Premium or Standard, or more simplified colour descriptors such as White.





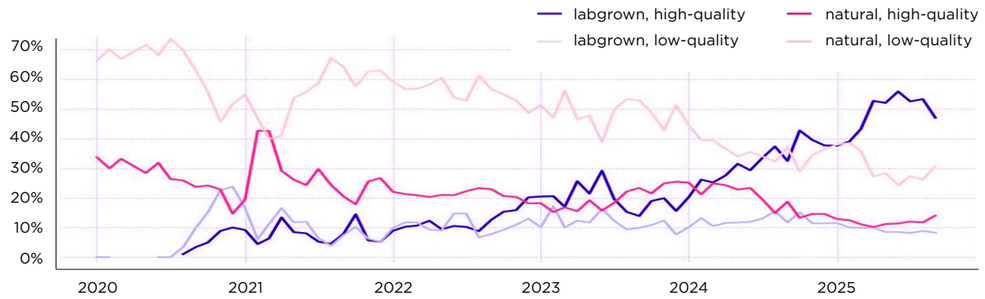
One driver for these changes is economics; with the fall in lab grown wholesale prices, the cost of full certification as a share of total polished diamond cost is rendering reporting by some labs uneconomic. However, the changes and inconsistencies in stance run the risk of creating consumer confusion. It also results in an interesting dynamic with growth methods delivering consistently high-quality outputs:

- Whereas natural diamond production produces a wide spread of quality, with only a modest proportion qualifying as high colour and clarity, LGDs are now routinely grown to premium quality specifications.
- This means most LGDs will either be accompanied by full 4C grading (IGI) showing their high colour and high clarity attributes, or by broad descriptors (GIA) that effectively place them in a high-quality bracket.

**Grading norms are evolving in a way that underscores the difference between mined and lab-grown supply: natural diamonds vary widely in quality, while lab-grown production increasingly delivers uniformity in high quality and colour output.**

**CHART 2**

**An increasing proportion of all polished LGDs are high colour (D-F) and high quality (VS2+)**




**Source:** Nivoda

# PRODUCTION AND SUPPLY-SIDE DYNAMICS

Cost declines: Production costs have fallen dramatically—from ~$4,000/ct over a decade ago to $300-500/ct by 2018, and more recently in many efficient operations to below $100/ct marginal cost.

Technology and scale: Improvements in both CVD/HPHT methods, automation, AI process control, and scale economies in producers in the US, India and China have driven much of this cost reduction.

Capacity expansion and slowing growth: Following a period of explosive investment in synthesis capacity, growth in new large-scale facilities has slowed, in part because price declines have lengthened return on investment timelines—the "capex payback" is now longer.

Diversifying output: While most LGD production still flows into jewellery, more capacity is being reserved or optimised for high-tech uses (e.g., purity, crystal size, doping). The choices producers made in terms of the technology they have invested in will either help or hinder their ability to develop outputs to fully unlock the growth potential in both jewellery and high-tech growth tracks.

**"LGD are maturing into a large demand-driven market segment, fuelled by strong cultural resonance, broad consumer acceptance, and increasingly sophisticated brand narratives."**





**"We need to create our own voice, own story, far from the cost price, because at the end the consumer doesn't buy that at all, they buy a product, a beauty, a design, a service, an experience, and we need a common voice."**

**Arnaud Flambeau**
CEO, 2Dot4

LGDs in jewellery are no longer a novelty. The category is maturing into a large demand-driven market segment, fuelled by strong cultural resonance, broad consumer acceptance, and increasingly sophisticated brand narratives—with hubs such as Dubai expanding their global influence. Scalability is increasingly being seen as a virtue, and an imperative in order to create an offering to a large, underserved consumer market.

# IN FOCUS
# SWAROVSKI

## Strategic Continuity and Brand DNA

The company's decision to enter LGDs is presented as a natural evolution of its 130-year heritage. Just as Swarovski became synonymous with crystal cutting and the play of light, LGDs as part of its Luxignite strategy are seen as reinforcing a legacy of craftsmanship, innovation, and artistry in human-created brilliance.





## Consumer Resonance and Global Scale

From a 2022 pilot across just eight U.S. stores, Swarovski has expanded rapidly to a global rollout across over 450 stores in more than 20 countries. This rapid scaling reflects strong consumer acceptance and, more importantly, an emotional connection with the idea of lab-grown as aspirational rather than second-best. Dedicated "Created Diamond" rooms in flagship stores, proprietary cuts such as the 'Octagon', and a strict no-discounting policy have reinforced pricing integrity and elevated LGDs as a premium category. As Peter Widmann, Global General Manager of Swarovski created diamonds states "Product is King, Customer is Queen".

**Peter Widmann, Global General Manager of Swarovski, in discussion with Felicitas Morhart of Original Luxury at the second Lab-Grown Diamond Symposium by DMCC (2025)**

## Luxignite and Brand Elevation

Within the Luxignite strategy, LGDs sit at the very top of Swarovski's brand pyramid. A central theme of Swarovski's approach is that value is brand-made, not material-given. Consumers do not simply purchase a lab-grown diamond — they purchase Swarovski's interpretation of it, imbued with the company's heritage, proprietary design language, and promise of aspiration. Swarovski asserts that value comes from craftsmanship and design, not commoditised production. By maintaining pricing discipline and investing in retail theatre, Swarovski has ensured that LGDs elevate rather than dilute the brand's positioning.

## Cultural Relevance and Next-Gen Appeal

For Swarovski, LGDs are more than a product; they are a cultural statement. By framing LGDs as design-led and innovation-driven, Swarovski positions itself as a cultural protagonist, resonating especially with Gen Z and Gen Alpha consumers. Collaborations, storytelling, and emphasis on emotional experiences transform LGDs into symbols of aspiration and self-expression. As Peter Widmann put it: "We don't sell diamonds. We sell dreams."

## The Lesson

Swarovski's Luxignite strategy illustrates a vital lesson for the wider industry: LGDs succeed most powerfully not when they are positioned defensively against mined diamonds, but when they are framed as culturally relevant, emotionally aspirational, and brand-anchored experiences. By embedding LGDs at the heart of its brand elevation, Swarovski is bridging the worlds of art, fashion, luxury and craftmanship and acting as a cultural protagonist, expanding and shaping the cultural and commercial horizons of the LGD category itself.

**"We position lab-grown diamonds as the pinnacle of the brand. It creates a halo effect – just having them in the store elevates the entire assortment and increases sales of our crystal jewellery."**

**Peter Widmann**
Global General Manager,
Swarovski

SECTION 3

# EMERGING USE CASES IN FASHION AND LIFESTYLE

**“The creative opportunities are mind-blowing, so much fun.”**

**Margot Stuart**
Co-founder, Original Luxury



SECTION 3: Emerging Use Cases in Fashion and Lifestyle

**Diversification is driven by a combination of lower costs, design flexibility, and consumer appetite for ethical sparkle across categories that go well beyond the traditional jewellery box.**

While jewellery remains the anchor category, recent years have seen a clear expansion into fashion and lifestyle sectors, signalling that LGDs are increasingly being valued not only as symbols of love and luxury, but also as a versatile new material that is opening a range of creative possibilities. This diversification is driven by a combination of lower costs, design flexibility, and consumer appetite for ethical sparkle across categories that go well beyond the traditional jewellery box.

One of the earliest signs came from the watch industry. Heritage brands such as Breitling released lines incorporating LGDs, positioning them as cutting-edge accents for high-end timepieces. Further innovation is underway through companies like ID Geneve pioneering the use of a lab grown diamond on top of glass to replace the traditional use of sapphire.

**TAG Heuer Carerra Plasma Diamant D’Avant-Garde watch with LGD crown**

Fashion is a new high potential growth horizon with active experimentation by companies evident across handbags, sneakers, clothing and glasses. Experimentation in artistic expression is also underway with early examples of diamond and gem ‘paintings’, diamond nails and even scented diamonds.

**LGDs on sneakers by 33 caretmaster in Machine, January 2025**

**LGD Diamond Nails by Capsoul**


**Sandra Czich mindset design celebrating LGDs and Dubai’s iconic landmarks. Unveiled at the 2nd LGD symposium by DMCC.**

Fashion houses have also begun experimenting. Prada, for instance, have launched couture collections featuring lab-grown diamonds in bold statement pieces, re-framing diamonds from being solely heirloom items to becoming fashion-forward, seasonal accessories. This repositioning of diamonds into high-style, high-rotation fashion categories would have been unthinkable a decade ago, but LGDs — with their lower unit costs and scalable supply — make such experimentation feasible.





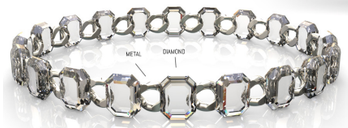
## “Scaling to match the cadence of the fashion industry is a key challenge.”

**Arnaud Flambeau**
CEO, 2Dot4

Lifestyle applications are widening too. LGDs are being experimented with in wellness and symbolic products, from luxury crystal-infused skincare packaging to limited-edition tech accessories and even home decor.

Other avenues for experimentation are being witnessed in automotive with Rolls Royce incorporating diamonds and diamond accents into clocks and interior trims in some of their cars.

**Capsoul has developed a proprietary process to emboss patterns onto diamond surfaces, unlocking creative possibilities**




**Diamonds grown around metal to create ‘one piece’ jewellery**

**LGDs featured in the Rolls Royce Adamas interior**

Taken together, these developments point to a shift where LGDs are no longer confined to permanent, once-in-a-lifetime purchases like engagement rings. Instead, they are increasingly embedded in broader consumer experiences and consumption occasions. These are large potential markets but unlocking their full potential will require greater material access to feed creative possibilities, close collaboration between the LGD sector and fashion and lifestyle companies and patient capital as R&D style experimentation unearths winning formulas that could be scaled over time.

SECTION 4

# TECHNOLOGY APPLICATIONS (B2B)

SECTION 4: Technology Applications (B2B)

Lab-grown diamonds are moving beyond their role as luxury goods and are increasingly positioned as strategic materials in industrial and high-tech industries. Their unmatched physical properties make them uniquely suited for use in current and next generation computing, electronics, optics, energy, and advanced manufacturing.

LGDs' physical advantages:

## Thermal conductivity

~22 W/cm·K, about 5x better than copper, the best conventional metal for heat transfer.

## Hardness

Hardest known material, outperforming tungsten carbide and boron nitride.

## Wide bandgap

5.45 eV, enabling high-voltage and high-temperature operation where silicon breaks down.

## Electrical breakdown strength

10 MV/cm, ~30x higher than silicon.

## Optical transparency

Transmits from ultraviolet (UV) through infrared (IR), unlike most optical materials.

## Biocompatibility

Non-toxic, stable, and safe for medical applications.

**Innovation cycles in semiconductors, quantum technologies, and energy systems strongly suggest that LGDs are poised to shift from niche adoption to mainstream high tech relevance over the next decade.**

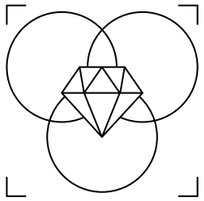
It is still early days for many of these application areas, with most use cases in either pilot or early commercialisation stages. However, history shows that materials with such exceptional properties tend to find breakthrough roles over time. Innovation cycles in semiconductors, quantum technologies, and energy systems strongly suggest that LGDs are poised to shift from niche adoption to mainstream high tech relevance over the next decade.

Market potential is significant: established industrial uses already account for several billion dollars annually while emerging high-tech applications could create tens of billions in new markets by the 2030s.





# ESTABLISHED USE CASES



## Semiconductor Thermal Management

**What**

Diamonds are used as heat spreaders and cooling substrates in high-power electronics such as EV inverters, 5G/6G telecom, and AI data centres.

**How it works**

LGDs act like “super-efficient heat sinks.” Because they transfer heat away faster than any other known material, they prevent chips and power modules from overheating.

**Why it matters**

**Semiconductors explained**: A semiconductor is a material whose ability to conduct electricity can be precisely controlled — the foundation of modern computing and electronics. For decades, silicon has been the dominant material because it is abundant, inexpensive, and easy to manufacture at scale. However, silicon is reaching its physical limits: it cannot handle the ever-higher heat and power demands of today’s electronics.

**Why LGDs matter**: Diamonds offer superior thermal and electrical properties, making them strong candidates to complement or displace silicon in specific high-performance roles.

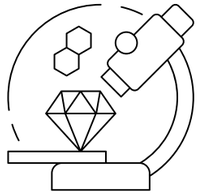
**The bigger picture**: The digital era is driving an unprecedented surge in demand for high-power compute — from the AI revolution, Web3 and blockchain platforms, to cloud computing and next-generation telecom infrastructure. LGDs address one of the hardest challenges in this transition: managing heat while pushing computing performance higher.

**“We have a new “4C’s” for LGDs’ role in high tech – Consistency, Cost, Control and Collaboration.”**

**Vinit Joghani**
Director, Lemon Consultech







# Optical Windows and Lenses

**What**

An optical window is a transparent piece of material that allows light to pass through while protecting sensitive equipment from heat, dust, or mechanical damage. LGDs are used in specialised optical windows and lenses for lasers, sensors, and semiconductor inspection equipment.

**How it works**

Diamonds are transparent to infrared light and resistant to scratching, meaning they can transmit powerful light beams without degradation.

**Why it matters**

Reliability in these components ensures accuracy in chip-making and durability in high-power defence and medical laser systems. The optical diamond components market is estimated to be a very large and growing market.

# Electrochemical Applications

**What**

Boron-doped diamonds (BDD) are used as electrodes in water purification, wastewater treatment, and chemical sensors.

**How it works**

Doping means deliberately adding a small amount of another element to change a material's properties. By adding boron atoms into the diamond structure, the otherwise insulating diamond becomes electrically conductive. This allows it to act as an electrode that can drive powerful electrochemical reactions.

**Why it matters**

BDD electrodes can break down stubborn pollutants at the molecular level, offering a highly effective solution for environmental cleanup. This segment is small but growing, with potential in the multi-billion-dollar global water treatment market.

**"LGDs have great potential to step in as a strategic material to support the growth in today's compute and next gen compute like Quantum."**

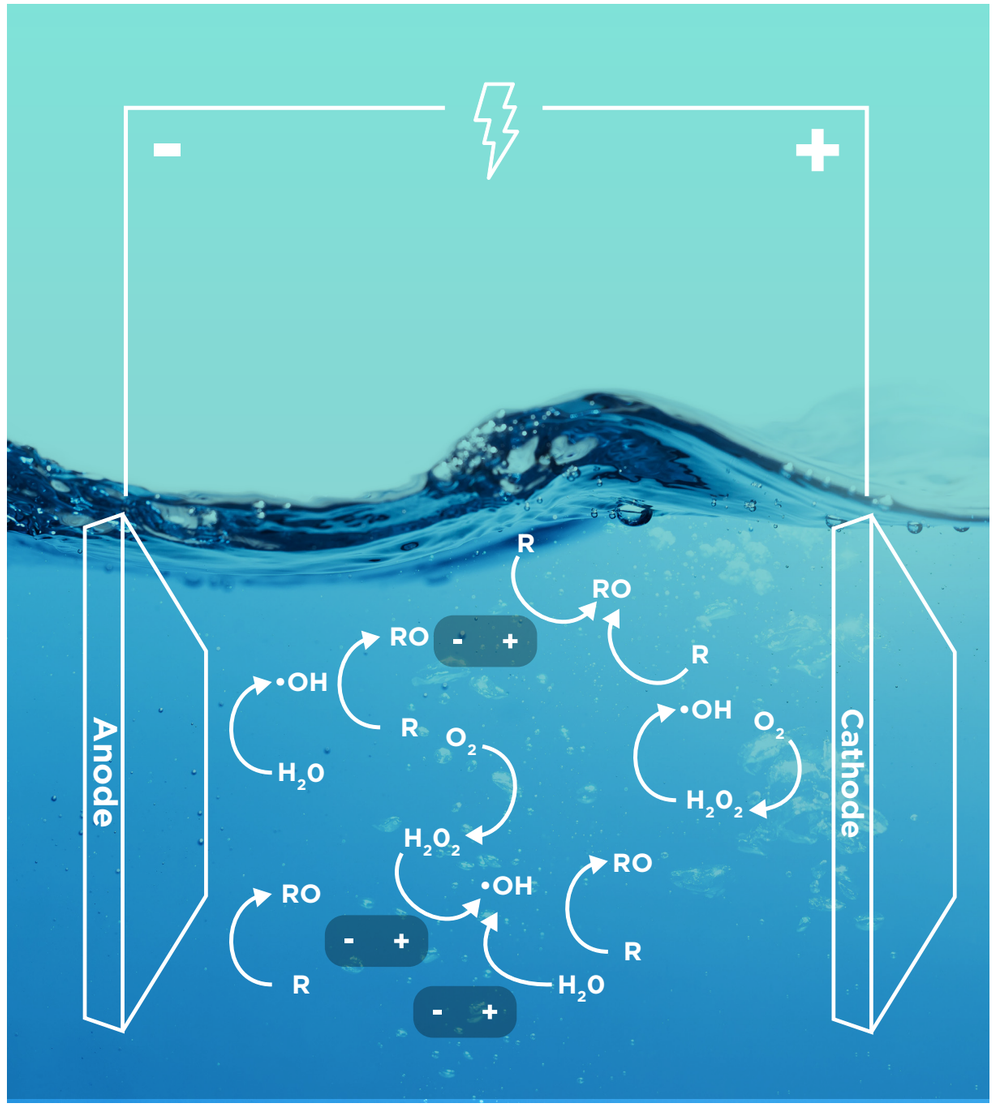
**Neil Ventura**
Special Advisor, DMCC





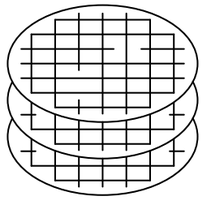
**FIGURE 2**

**Schematic of polycrystalline diamond used for water applications (Plasmability)**




**Source:** https://evoaeo.com

# EMERGING USE CASES



## Diamond-Based Semiconductors

**What**

LGDs could become the base material for next-generation semiconductors, surpassing today's industry standards.

**Context**

Currently, most semiconductors are made of silicon, with newer materials like silicon carbide (SiC) and gallium nitride (GaN) being adopted for higher-performance applications.

**How it works**

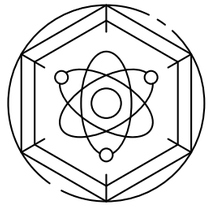
Diamonds are classified as wide bandgap materials — meaning they can operate at higher voltages, frequencies, and temperatures without breaking down. (The "bandgap" refers to the energy needed for electrons to move and conduct electricity; the wider it is, the more resilient the material is under stress.)

**Why it matters**

This could revolutionise power electronics in EVs, aerospace, and energy grids, enabling more efficient, compact, and durable devices. While chips are still at prototype stage and currently cost thousands of dollars each, the potential market for diamond semiconductors could be worth tens of billions by the 2030s.







## Quantum Technologies

Quantum computing is a new paradigm of computing that uses the principles of quantum mechanics. Unlike traditional computers, quantum computers use qubits that can exist in multiple states simultaneously. This allows them to process enormous amounts of information in parallel. The promise is transformative: faster drug discovery, unbreakable encryption, new materials design, and optimisation problems that classical computers can't solve.

**What**

Special defects inside LGDs, called Nitrogen-Vacancy (NV) centres, can function as qubits or ultra-sensitive sensors. semiconductors could be worth tens of billions by the 2030s.

**How it works**

These NV centres trap and manipulate electrons in ways that encode and process quantum information.

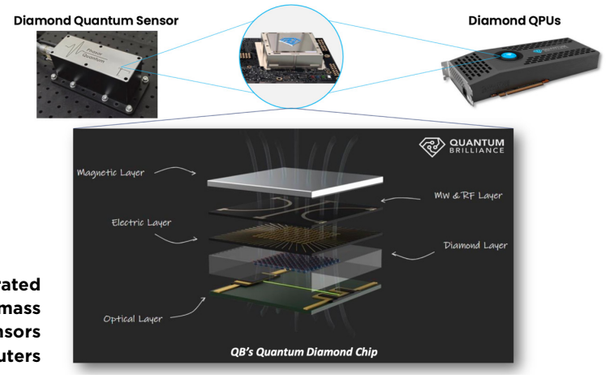
**Why it matters**

If scalable, LGDs could become the backbone of quantum computers, sensors, and secure communications. Market projections for quantum technologies overall exceed $100 billion by 2040[2]).

[2] McKinsey, The Quantum Technology Opportunity 2023

**“I think diamond is really the only route towards mass deployable Quantum computing.”**

**Andrew Dunn**
COO, Quantum Brilliance




**Vision for an integrated diamond quantum chip for mass deployable quantum sensors and computers**

**Installation of three diamond-based computers at Oak Ridge National Laboratory, Tennessee, U.S.**



SECTION 4: Technology Applications (B2B)

# Medical Technologies

**What**

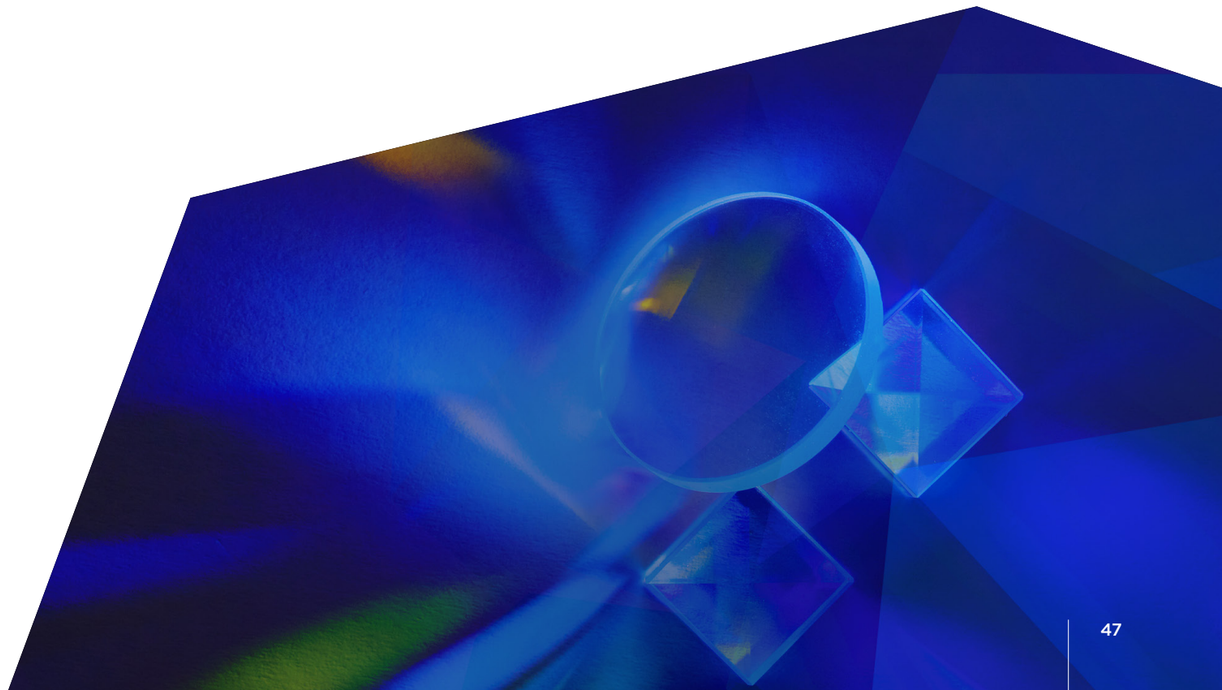
LGDs are being explored for biosensors, imaging, radiation detectors, and implants.

**How it works**

Diamonds are chemically stable and biocompatible, so they can interact safely with the human body while providing precise sensing.

**Why it matters**

They open pathways for safer implants, better imaging tools, and more accurate cancer treatments. This is a niche but high-value application area, potentially becoming a multibillion market by the 2030s.



# Photonics and Optoelectronics

Photonics is the science of generating, controlling, and detecting light (photons), while optoelectronics integrates light-based and electronic systems. Together, these technologies underpin fibre-optic internet, laser-based manufacturing, and optical computing.

**What**

LGDs are studied for photonic circuits, UV LEDs, and optical amplifiers.

**How it works**

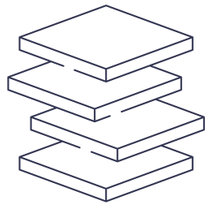
LGDs' optical clarity and ability to guide light at nanoscale levels make them ideal for manipulating photons instead of electrons. Using light instead of electrons to process and transmit data offers the promise of faster speeds and better energy efficiency.

**Why it matters**

This could lead to faster, cooler, and more energy-efficient chips — essential for AI data centres, next-generation telecom, and secure communications. Global photonics/ optoelectronics markets are already large and are poised to grow significantly in the years ahead.



SECTION 4: Technology Applications (B2B)



# Advanced Batteries and Energy Systems

**What**

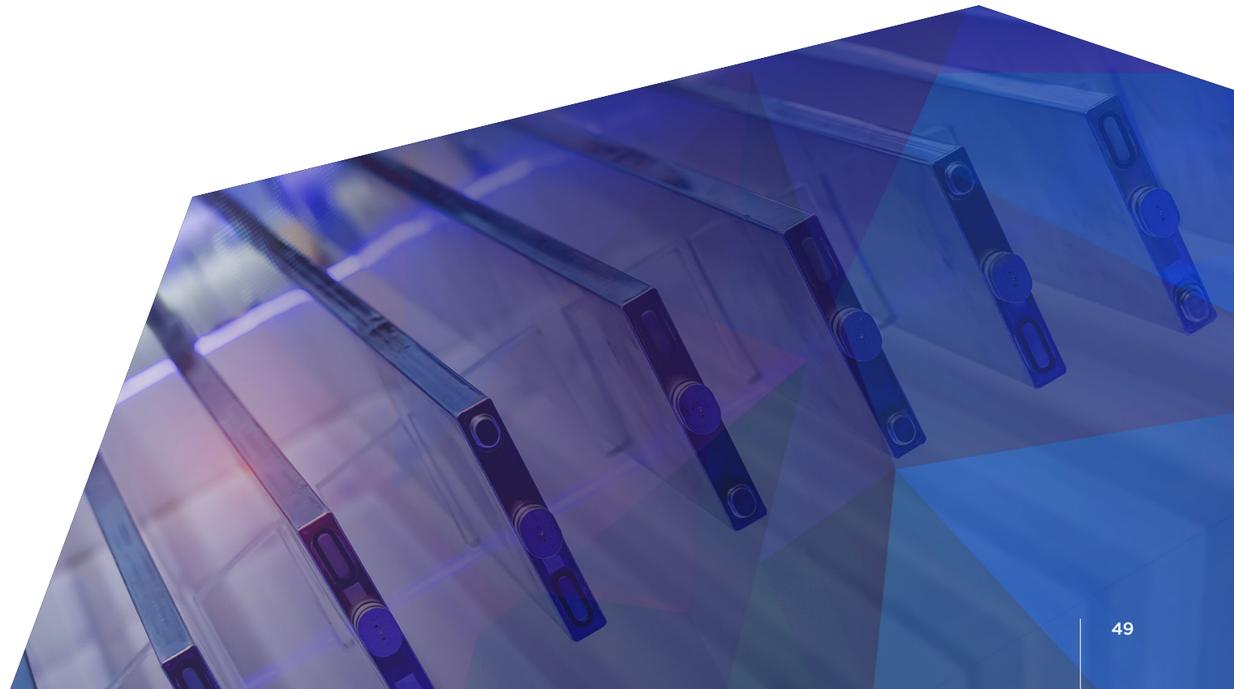
LGDs are being tested in next-gen batteries and nuclear-powered nano-diamond batteries (NDBs).

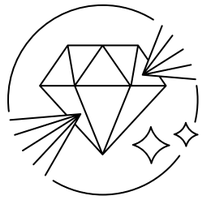
**How it works**

Diamonds act as stable electrodes or encapsulate radioactive materials to generate ultra-long-life power.

**Why it matters**

This could deliver EV batteries with improved safety and performance — or even "eternal" batteries for aerospace and defence, lasting decades without recharge.





# Laser Technologies

**What**

LGDs may be used as active laser media for industrial and defence applications.

**How it works**

Their purity and optical properties allow them to amplify light into powerful, stable beams.

**Why it matters**

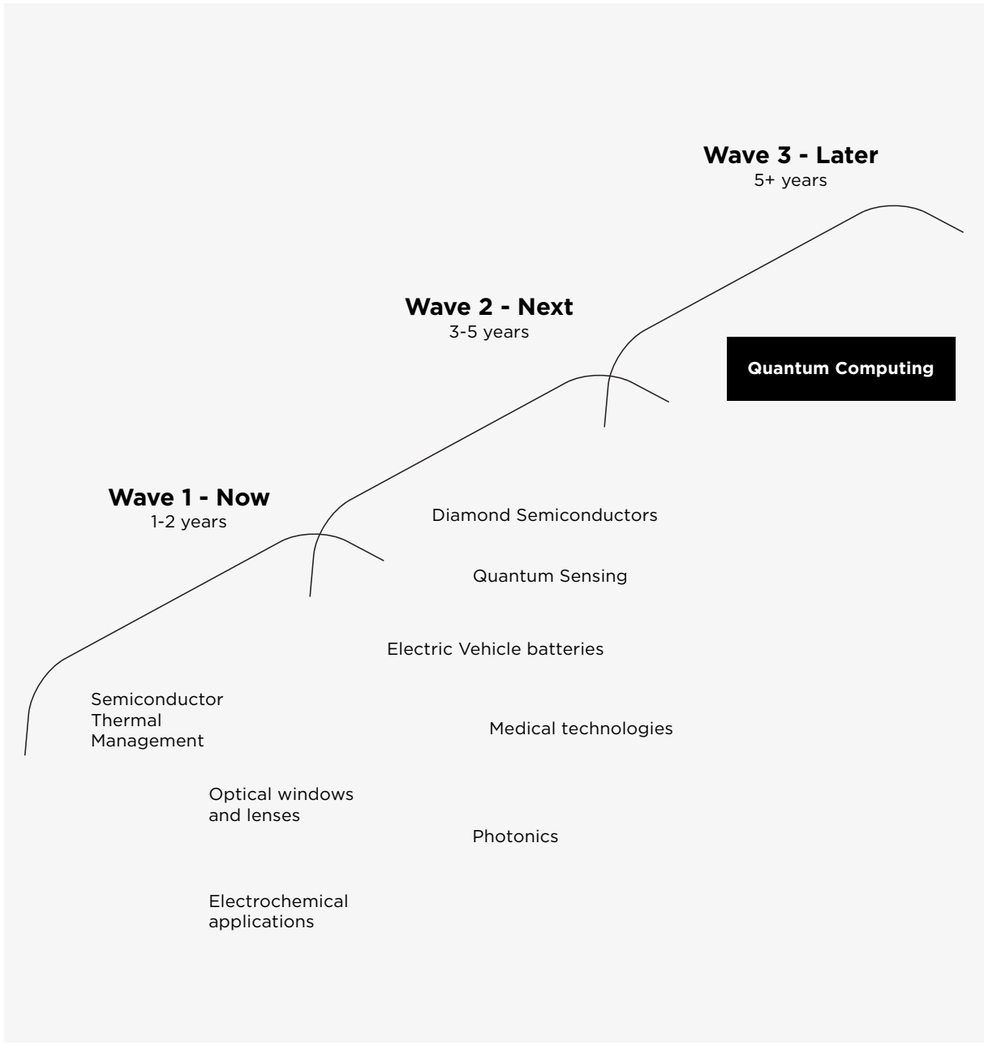
Diamond-based lasers could offer higher power, longer lifespan, and better efficiency — essential for precision manufacturing and national security systems. While still at research stage, this could become a multi-billion-dollar market by the 2030s with defence systems, radar and detection tech at the fore.





**CHART 3**

**Probable time to impact for LGDs in high tech applications (DMCC)**




**Source:** Neil Ventura, DMCC

SECTION 5

# SUSTAINABILITY

The LGD industry as a whole is still uneven — with some producers only beginning to announce sustainability targets, while others are demonstrating and proving great progress.





Alongside technology breakthroughs and cost curve improvements, ESG performance is emerging as a decisive enabler of LGD adoption — both in consumer and technology markets. However, much like the broader diamond sector (and many other industries), LGD players are at different stages of their ESG journeys.

## Saying (Commitments)

In the early phase, companies issue public statements about sustainability intentions — net-zero pledges, renewable energy targets, commitments to carbon neutrality or simply assertions of being ecofriendly. These are important signals but without evidence of delivery they remain aspirational and can be misleading.

## Doing (Demonstrating Action)

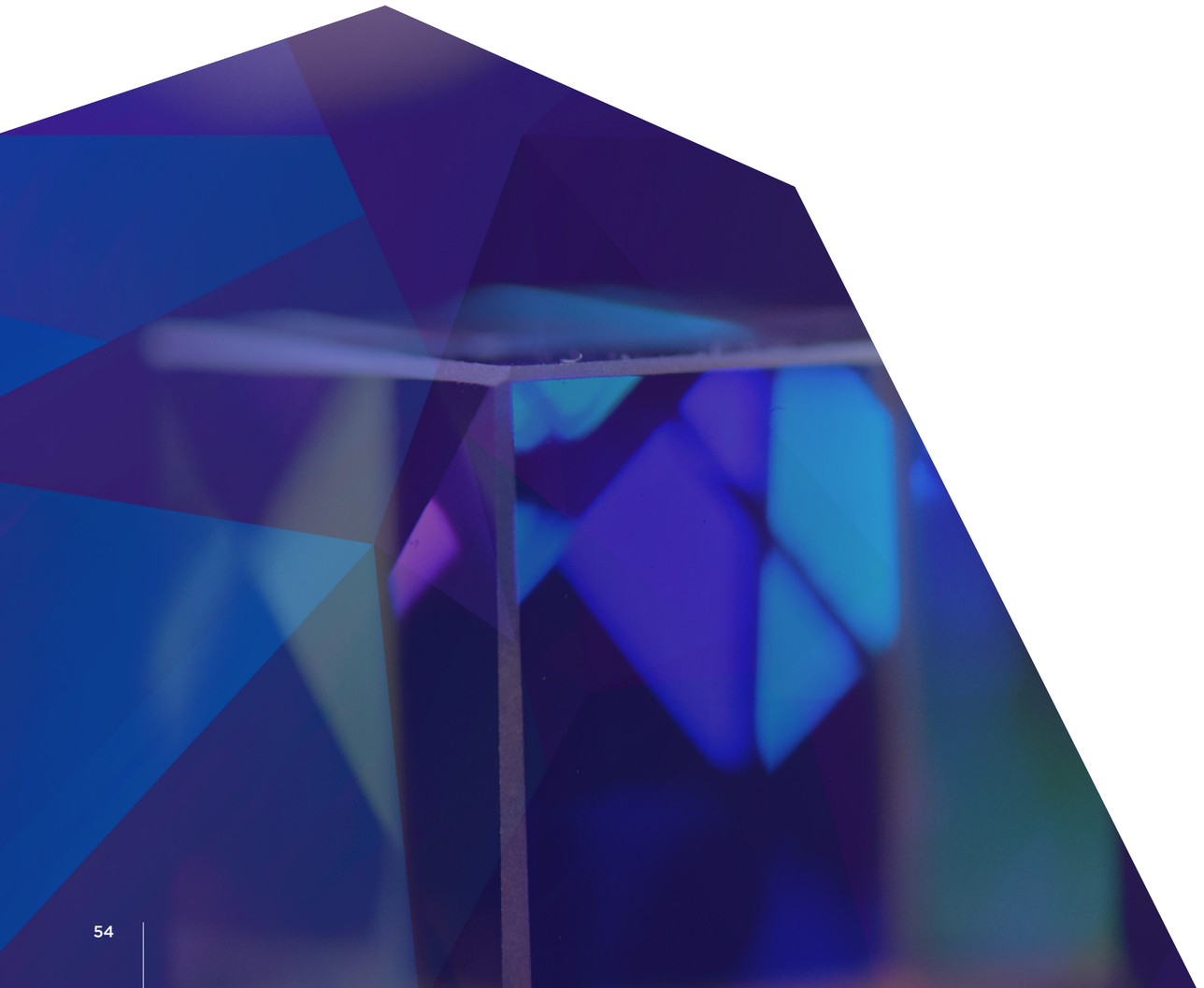
The next stage involves taking concrete actions, such as sourcing renewable power for CVD reactors, investing in hydrogen efficiency, or joining industry-wide frameworks like the Responsible Jewellery Council (RJC) Laboratory-Grown Materials Standard (LGMS, 2025). Here, firms begin to show operational changes aligned with their claims, and a steady cadence of progress.

## Proving (Evidencing Impact)

The most advanced companies go further — providing auditable evidence of progress through lifecycle assessments, third-party verification, and transparent disclosure of carbon intensity metrics.

**“In each and every segment, sustainability is at par or is the most important element. ESG scores or carbon footprints now matter more, or are equal to, sales and finances.”**

**Kinjal Shah**
Head of Asian Development,
Responsible Jewellery Council







The direction of travel is clear: as jewellery buyers in the United States and Europe and technology buyers in semiconductors/ quantum increasingly demand verified ESG compliance, the competitive advantage will rest with those who have moved furthest along the sustainability maturity curve.

## CASE EXAMPLE
## DIAMOND FOUNDRY (US)

One of the first LGD producers to achieve carbon neutrality certification in 2017 and to commit to running production on 100% hydropower.

Its work on solar-powered growth facilities and independent verification of its carbon footprint demonstrates leadership in moving from *saying → doing → proving*.

By proving its ESG credentials, Diamond Foundry not only appeals to ethically-minded consumers but also strengthens credibility in tech supply chains, where procurement increasingly prioritises verified green inputs.

SECTION 6

# THE FUTURE OF LGD TRADE

## READING THE FUTURE THROUGH SIGNALS, PATTERNS, AND TRENDS



SECTION 6: The Future of LGD Trade

The future of the lab-grown diamond industry will not be shaped by chance but by signals that emerge today, patterns that form as these signals cluster, and trends that crystallise when momentum tips into mainstream reality.

By closely monitoring these dynamics across growth tracks, industry players can anticipate probable developments, position themselves accordingly, and maximise opportunities across both consumer and technology growth tracks. Strategic foresight in this context is less about ***prediction*** and more about ***preparedness***.

# GENERAL OBSERVATIONS

While short-term factors such as tariffs or trade frictions can create turbulence, they are unlikely to shape the industry's long-term trajectory. The enduring drivers of competitiveness will come from innovation — both in pushing down the cost of synthesis and in sophisticating outputs for different market applications. For jewellery, innovation is focused on cost efficiencies in production, supporting affordability and enabling expansion into new categories.
For technology, innovation means engineering diamonds with the purity, size, or doping characteristics required for advanced applications such as semiconductors, photonics, or quantum computing. Players able to balance both demands will capture disproportionate value.

**The enduring drivers of competitiveness will come from innovation — both in pushing down the cost of synthesis and in sophisticating outputs for different market applications.**





# CONSUMER MARKETS

The consumer market has been the most visible engine of LGD growth and provides some of the clearest patterns of the LGD sector's trajectory. Patterns include omnichannel integration, clustering of quality at the upper end, non-negotiable ESG verification norms (LGMS 2025, CIBJO guidelines), harmonisation of certification standards to avoid consumer confusion, and brand-led segmentation. The emergence of some form of LGD Council or similar body to promote the virtues of LGDs is likely.

The trajectory points toward continued mainstream presence in bridal, rapid expansion in fashion-led segments, and multi-tiered portfolios. Brands such as Signet, Pandora, and Swarovski show how LGDs are normalising in both bridal and fashion. As LGDs move into new markets, retailers will look to the experience of early adopters in the United States. Those firms, now market leaders, offer a roadmap of what worked—and what did not—as others weigh the "if, when and how" of adding lab-grown jewellery to their shelves.

**The trajectory points toward continued mainstream presence in bridal, rapid expansion in fashion-led segments, and multi-tiered portfolios.**

# TECHNOLOGY MARKETS

On the technology side, the signals are equally striking. Patent filings in semiconductors, quantum sensing, and photonics have accelerated, supported by government and defence funding. Producers are ring-fencing portions of capacity for high-purity CVD diamonds. These signals are coalescing into patterns: thermal management as a profitable mainstream application, collaborative consortia in photonics and quantum, and medical applications advancing from lab to pilots. By the early 2030s, diamond semiconductors and quantum sensing could enter commercial reality, enabling AI hardware, aerospace, and next-gen energy.

# SUPPLY DYNAMICS

Expansion of synthesis capacity has slowed due in large part to longer payback periods. In parallel a portion of capacity has been carved off to cater to the opportunities for growth on the tech track. As this happens though, and as jewellery demand continues to rise rising there is a potential future pattern developing where demand from all growth tracks starts to outpace supply capabilities. This may create the conditions for price stabilisation and even make locking in supply contracts and strategic partnerships a strategic imperative.



SECTION 6: The Future of LGD Trade

# DUBAI AS A HUB

Dubai is uniquely positioned to emerge as a central hub. The city already hosts a growing ecosystem of producers, traders, graders, investors, and technology players. Leading and diversified trade hubs such as DMCC provide not just a growing marketplace, but also a supportive regulatory framework and world-class infrastructure. Dubai could act as a convergence point for jewellery, tech, and finance, creating a hotbed of LGD innovation.

# INDUSTRY RECOMMENDATIONS

## Jewellery

The following recommendations can support the evolution of LGDs from a fast-growing alternative to mined diamonds to becoming a mainstream, design-driven and culturally resonant category that widens consumer access and reshapes global jewellery markets.

**Emotional Storytelling Beyond Price and Ethics**

LGDs must continue evolving from a narrative of affordability and verifiable sustainability into one anchored in aspiration, individuality, and cultural relevance. Success will depend on brand-led storytelling that positions LGDs as desirable in their own right, rather than as substitutes for mined stones.

**Consistency in Standards and Certification**

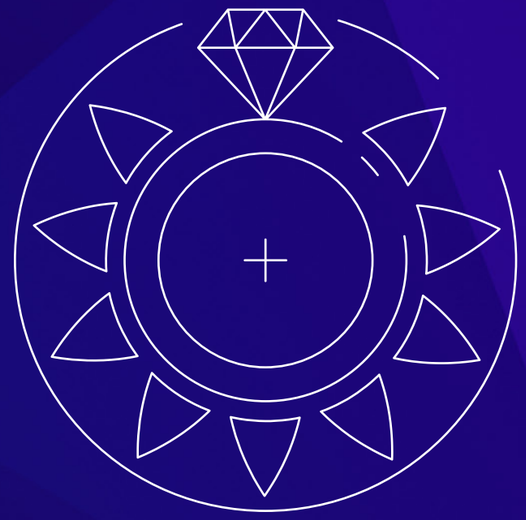
As grading norms evolve (IGI's 4C reports vs. GIA's simplified descriptors), industry-wide clarity will be required to avoid consumer confusion. Harmonised standards will be essential to sustain trust and premium positioning. The LGD community should lead this.

**Retailer Commitment and Portfolio Segmentation**

Major retailers will need to deepen integration of LGDs into both bridal and fashion-led segments. Clear value tiering and disciplined pricing strategies (avoiding over-discounting) will be critical to prevent commoditisation.







**Global Market Penetration**

The category's mainstreaming in the U.S. must be replicated in Europe, India, China, and the Middle East. Localised strategies tailored to cultural preferences, income levels, and retail landscapes will be essential to achieve scale.

**Supply Chain Resilience and Cost Curve Management**

Sustained reductions in production costs — coupled with reliable, high-quality supply — will be needed to preserve affordability while protecting retailer margins. Producers must balance jewellery output with growing allocations to technology markets, making adjustments to their tech stacks to be able to play in both markets if they are to unlock the full growth potential available.

**ESG Proof, Not Just Promise**

Verified ESG performance — from low-carbon production to transparent disclosure — will become non-negotiable. As buyers and regulators demand evidence rather than claims, companies will need to demonstrate leadership along the "saying -> doing -> proving" maturity curve.

# Fashion and Lifestyle

The following recommendations can support LGDs expand from jewellery into fashion and lifestyle, unlocking new creative markets and embedding diamonds into broader cultural and consumer experiences by meeting the following conditions:

**Design-Led Innovation**

LGDs must be further harnessed as a creative material, enabling new forms, colours, and applications that resonate with fashion and lifestyle aesthetics. Success will depend on brands positioning LGDs as design-forward rather than derivative.

**Collaboration Between Sectors**

Deeper partnerships between LGD producers and fashion/lifestyle companies will be required to translate material potential into commercially viable products. Co-development will accelerate innovation cycles and market entry.

**Material Access at Scale**

Fashion and lifestyle designers will need reliable access to LGDs in a range of qualities and formats. Supply must be adaptable for diverse product lines, from couture to mass-market accessories and this will require significant technological advancements in both generating suitable material and post processing to ensure suitability for different applications, and to match the different cadence of markets like fashion.





**Consumer Reframing of Diamonds**

Consumers must embrace diamonds as not only heirloom or bridal symbols but also as versatile, expressive accents in everyday and seasonal products. This cultural shift is essential to broaden adoption beyond jewellery and widen the overall consumer base.

**ESG Proof, Not Just Promise**

As with jewellery, credible sustainability will be critical. Verified low-carbon production, transparent supply chains, and auditable ESG performance will underpin consumer trust in categories where values-driven purchasing is pronounced.

# High-tech applications

The following recommendations can support the evolution of LGDs from niche materials into mainstream enablers of the digital, clean energy, and quantum revolutions of the 2030s and beyond:

**Scalable Production of Large, High-Purity Crystals**
Current growth techniques must advance to deliver larger wafers and crystals at lower cost while maintaining defect-free quality.

**Breakthroughs in Doping and Integration**
Reliable and cost-effective methods for doping diamonds (e.g., boron, nitrogen control) and integrating them into semiconductor and photonic systems are essential.

**Cost Curve Reductions**
CVD and HPHT production costs must decline significantly — from thousands of dollars per wafer or chip to levels competitive with silicon carbide and gallium nitride.

**Standardisation and Supply Chain Readiness**
Industry-wide standards and scalable supply chains are required to reassure buyers in semiconductors, medical devices, and defence industries.





**Demonstrated ESG Credentials**
Verified low-carbon production and transparent ESG reporting will be crucial for adoption in tech supply chains increasingly driven by sustainability metrics.

**Collaboration**
To deliver the innovation breakthroughs necessary to unlock the growth potential ecosystem participants from academia, industry, and providers of finance need to come together and collaborate in new ways.

**APPENDICES**

# Evolution of the LGD sector

**Phase 1: Discovery and Industrial Use (1950s–1990s)**
- 1954 – GE produces first synthetic diamond via HPHT for industrial use.
- 1950s – First CVD patents; De Beers forms Element 6.
- 1963 – China produces first LGD.
- 1971 – GE produces first gem-quality LGD.
- 1980s – CVD methods refined for larger crystals.
- 1990 – CVD gains traction as an alternative to HPHT.
- Applications: cutting, grinding, drilling across aerospace, automotive, electronics.

**Phase 2: Entry into Jewellery and Consumer Markets (1990s–2010s)**
- 1992 – Gem-quality LGDs achieved.
- 2007 – Apollo Diamond produces CVD gems; Gemesis begins retail sales.
- 2007 – GIA introduces LGD grading ranges.
- 2008 – First LGDs sold retail at small scale.
- 2010s – LGDs reach 2–3% of U.S. engagement rings.
- 2012 – Brilliant Earth begins selling LGDs.
- 2014 – De Beers softens stance, explores research into synthetics.

**Phase 3: Mass Market Adoption and Vertical Integration (2015–2020)**
- 2015 – Diamond Foundry gains celebrity backing (Leonardo DiCaprio).
- 2017 – Swarovski launches LGDs.
- 2018 – FTC recognises "diamond" to include LGD, with disclosure.
- 2018 – De Beers launches Lightbox Jewellery (~$800/ct).
- 2019 – Signet begins offering LGDs in bridal; Pandora and James Allen follow.
- 2019 – GIA issues full LGD grading reports.
- 2020 – All U.S. majors onboard.

**Phase 4: Maturity, Diversification and Tech Integration (2020–2025)**
- 2021 – Pandora exits mined diamonds, adopts LGDs fully.
- 2022 – Fashion brands (Balenciaga, Gucci, Tag Heuer) adopt LGDs.
- 2022 – Global LGD sales reach $12bn; IGI leads certification.
- 2023 – LGDs enter semiconductor applications.
- 2024 – Lightbox pivots away from Jewellery into tech.
- 2025 – Carbon-negative LGDs from $CO_2$ capture enter market.
- 2025 – RJC introduces Laboratory-Grown Materials Standard (LGMS).

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