

Business Plan

商业计划书

Colour engineering for photovoltaic surfaces — retaining 88–90% of power (TMM-simulated)

光伏表面的干涉色工程 — 仿真保留 88–90% 发电能力

Hong Kong BandGap Quantum Technology Limited 香港能带间隙量子科技有限公司

BR No. 80343212 · Incorporated in Hong Kong, 7 May 2026

Founder: Dr. DAI Jitao 戴继涛 (DBA, Lingnan University) · www.bandgap.hk · hi@bandgap.hk

Version 2.0 · August 2026 · Prepared for the HKSTP IDEATION Programme

This document supersedes all earlier business plans of the company. Every performance figure herein follows the company's three-tier data-labelling discipline (simulation result / design target / literature data). No unverified experimental, patent or publication claims appear in this document.

1. Executive Summary

Solar surfaces are everywhere, but they are all the same colour — because making them any other colour has meant giving up too much power. BandGap Quantum engineers colour for photovoltaic (PV) surfaces using multilayer thin-film interference: $\text{TiO}_2/\text{SiO}_2$ dielectric stacks that reflect a designed narrow band of visible light (the colour) while passing the rest of the spectrum to the cell. Our Transmission-Matrix-Method (TMM) simulations — AM1.5G-weighted, quantum-efficiency-corrected, Monte-Carlo stress-tested, and published with reproducible scripts — indicate 88–90% retained power capability for our best designs, versus ~78% typical of commercial coloured BIPV glass.

We commercialise this through three connected lines: BgFilm, a retrofit colour/functional film for the world's existing PV fleet (no reinstallation, applied on-site); coloured module co-manufacturing with OEM partners for new BIPV projects; and BgSuite software (defect-recognition and optical-design tools) that grows from our own engineering pipeline. The beachhead is infrastructure PV operations-and-maintenance retrofit — expressway, façade and public-realm installations in the Greater Bay Area — where aesthetics, glare control and asset value meet.

The company was incorporated in Hong Kong in May 2026, is founder-funded, fully compliant (corporate account, MPF payroll, live bilingual site), and enters the HKSTP IDEATION programme with theory and simulation complete, seeking to convert them into measured samples, filed patents and signed letters of intent within 12 months.

At a glance	
Stage	Pre-seed · simulation-validated · pre-revenue
Ask	HKSTP IDEATION (HK\$100,000 milestone grant + ecosystem); seed round planned for Year 2
12-month goals	≥3 measured samples (≥85% retention target) · ≥3 patent filings · ≥3 LOIs · Incubation application
Founder	Dr. DAI Jitao — DBA (Lingnan U, 2025); 20 yrs industrial-park & energy investment operations; full-time in HK

2. Problem & Opportunity

2.1 The colour-power trade-off

Architects, city authorities and asset owners want PV that does not look like PV: façades that match a building, expressway installations that carry wayfinding or branding, heritage and tourism zones where standard blue-black panels are unacceptable. Today's options force a hard trade: pigment/ceramic-print coloured glass typically sacrifices roughly one-fifth of output (literature values around ~78% retention are common), while premium interference glass exists mainly for new-build projects at high cost — and nothing serves the fleet already installed.

2.2 Why now, and why Hong Kong

- Installed base: global PV additions have run at hundreds of GW per year in the mid-2020s (IEA/industry data), creating an enormous existing fleet that can only be addressed by retrofit — our BgFilm wedge.

- Policy pull: Hong Kong’s green-building agenda (BEAM Plus, government decarbonisation plans) and mainland China’s building-integrated PV push are expanding demand for PV that satisfies planning and aesthetic review.
- New surfaces: expressway slopes, noise barriers and urban furniture are becoming PV real estate where colour, glare control and advertising value matter as much as raw efficiency.
- Hong Kong base: a trusted IP and standards jurisdiction, university optics/materials capacity, and the GBA manufacturing belt one hour away — the right place to engineer, certify and license.

Market-size figures vary widely across analyst houses; we treat all third-party sizing as literature data and anchor our plan on bottom-up segment economics (Section 5) rather than headline TAM claims.

3. Solution & Technology

3.1 The physics, honestly stated

A quarter-wave $\text{TiO}_2/\text{SiO}_2$ stack reflects a designed narrow visible band — that reflected band is the colour you see; everything else, including most of the 400–1100 nm band that crystalline silicon converts, passes through. Colour without dye, without pigment absorption, without covering the cell. Our recipe library spans deep-space blue (~89%), emerald (~90%), champagne/wine-red (~85%) and deep black (~86%) — all simulated retention values from TMM with $\text{AM1.5G} \times \text{c-Si}$ EQE weighting, each with Monte-Carlo tolerance bands ($\pm 3\%$ thickness, $\pm 2\%$ refractive index, $n=400$ runs). Scripts are published in our Engineering Whitepaper v2.0 appendix and rerunnable by any reviewer.

3.2 Product lines

Line	What it is	Status (Aug 2026)
BgFilm	Retrofit interference-colour / functional film applied to installed PV; variants for O&M branding, glare control, heritage zones	Recipes simulated; BOM & three-ledger cost model built; 15 patent disclosure drafts cover material, process & application families
Coloured modules	Co-manufactured coloured BIPV modules with OEM laminators (asset-light: we own recipes & QC, partners own capex)	Partner shortlist in GBA; demo module scheduled Month 5–8 of IDEATION plan
BgSuite software	BgClassNet EL-defect recognition (public-data baseline first), optical design & QC tools from our own pipeline	Baseline scheduled Month 5–8; grows into inspection/licensing revenue

3.3 Data integrity as a moat

Every number we publish is labelled simulation result, design target, or literature data; measured results join as a fourth tier from Milestone 1. In a field crowded with inflated efficiency claims, being the company whose numbers can be rerun by any engineer is a durable trust advantage with certifiers, universities and government buyers.

4. Market & Competition

4.1 Beachhead and expansion

Segment	Need	Our entry
Expressway / infrastructure PV O&M (GBA & Henan first)	Branding, wayfinding, glare control on existing installations; provincial operators manage GW-scale assets	BgFilm retrofit projects via established operator relationships; LOI target in Months 9–12
BIPV façades & heritage/tourism zones (HK & GBA)	Planning-compliant colour; BEAM Plus alignment	Coloured module co-manufacturing + architect partnerships
Media & advertising surfaces	PV surfaces that carry designed patterns/brand colour	Patterned interference film (patent family A4/A5 drafts)

4.2 Competition and differentiation

Player type	Examples	Limitation we exploit
Interference coloured glass (new-build)	Kromatix-type premium glass suppliers	New-build only, high cost; no retrofit path for the installed fleet
Pigment / ceramic print	Mainstream coloured BIPV glass	Absorption losses (literature ~78% typical retention); limited palette brightness
Coloured-PV manufacturers (mainland)	e.g. COLORFULEAD (新源劲吾)	Module-sales model; we are film-first, software-carrying, and open to co-manufacture rather than compete on capex

Our defensibility stacks: recipe library + tolerance engineering (hard to copy without our simulation discipline), patent families filed from Milestone 2, certification/standards track (we have drafted a technical-specification outline for interference-coloured PV), and the retrofit installation know-how that pure glass makers lack.

5. Business Model & Unit Economics

- Project revenue (BgFilm retrofit): design + material + certified installation, priced per m²; bottom-up BOM modelling supports healthy project margins at modest scale (three-ledger cost model available for due diligence).
- Licensing / co-manufacturing (coloured modules): recipe licence + QC fee per batch with OEM partners — asset-light, scales without our own fab.
- Software & services (BgSuite): EL-inspection and optical-design tools; entry pricing per site/report, growing into subscriptions for O&M operators.

Sequencing: Year 1 proves measured performance and signs LOIs (grant-funded milestones); Year 2 converts LOIs into 2–3 paid pilots and raises a seed round; Year 3 scales the co-manufacturing and software lines. Detailed cost models are maintained as internal working files and shared under NDA.

6. Go-to-Market

- Months 1–8: credibility assets — measured samples with a HK university lab, demo module, patent filings, all public materials on the measured tier.

- Months 9–12: ≥3 LOIs across expressway O&M and BIPV segments; Eco Expo Asia 2027 showcase; one paid pilot negotiation opened (target value ≥ HK\$100k).
- Year 2: pilots delivered with named reference sites; seed round; HKSTP Incubation for deep-tech scale-up; first software licences.
- Channels: direct founder-led BD into operator relationships (20-year network in park/energy investment), architect/consultant partnerships in HK, exhibition & standards-committee visibility.

7. Team

Dr. DAI Jitao 戴继涛 — Founder & Director (full-time, Hong Kong). Doctor of Business Administration, Lingnan University (2025), research field: global digital economy and governance; dissertation on digital transformation of traditional industrial parks (Lingnan University thesis repository). Bachelor of Electrical Power Engineering. 20 years in industrial-park investment and operations across mainland China; led parks serving hundreds of enterprises and cumulative financing programmes at the tens-of-RMB-billions scale. Author of the BandGap Engineering Whitepaper v2.0 and the company's TMM simulation pipeline.

Hiring plan: part-time research engineer (thin-film optics / data) from Month 3 of the programme; first full-time engineering hire at seed round. Advisory bench under construction via Lingnan and HK engineering faculties — we deliberately list no advisor names before agreements are signed.

8. Financial Plan (Targets, Founder-Funded Core)

Item (HK\$)	Y1 (to mid-2027)	Y2 (to mid-2028)	Y3 (to mid-2029)
Revenue (target)	0 – 300k (first pilot)	1.5M – 4M (2–3 pilots + licences)	8M – 15M (scale + software)
Operating cost	≈ 600k – 800k	≈ 1.8M – 2.5M	≈ 4M – 6M
Funding	Founder capital + IDEATION HK\$100k	Seed round HK\$3M – 5M (target)	Series A optional
Headcount	1 FT + 1 PT	4 – 6	10 – 15

All revenue figures are design targets, not forecasts of certainty; they are grounded in the bottom-up cost models and the LOI pipeline defined in the milestone plan. The company carries no debt; the founder funds operating costs from own capital and the IDEATION grant is applied exclusively to technical/commercial milestones.

9. Contribution to Hong Kong

- I&T substance: real engineering R&D (optics simulation → university-lab measurement → patents) headquartered in Hong Kong, not a trading shell.
- Jobs: HK-based engineering hires from Year 1 (part-time) and Year 2 (full-time), MPF-enrolled from day one.
- Green building & decarbonisation: makes PV acceptable on surfaces where aesthetics currently block deployment, supporting HK's climate plan and GBA green-infrastructure demand.
- Standards & IP: technical-specification drafting for interference-coloured PV anchored in HK; patent families filed from a HK company.

10. 12-Month Milestones (Summary)

The full milestone plan (separate document, v1.0) defines three tranches: M1 (Months 1–4) university-lab measurement of ≥ 3 samples and Whitepaper v2.1 — HK\$40k; M2 (Months 5–8) BgClassNet public baseline, full-size demo module, ≥ 3 patent filings — HK\$30k; M3 (Months 9–12) ≥ 3 LOIs, Eco Expo Asia showcase, Whitepaper v3.0 and Incubation application — HK\$30k. Every KPI is stated as a verifiable deliverable.

附录·中文对照（要点版）

1. 摘要

光伏无处不在，却只有一种颜色——因为换颜色的代价一直是发电量。能带间隙量子科技用多层介电薄膜干涉（ $\text{TiO}_2/\text{SiO}_2$ 叠层）为光伏表面做「设计色」：反射一条设计好的窄带可见光（即颜色），其余光谱透过给电池。TMM 仿真（AM1.5G × 晶硅 EQE 加权、蒙特卡洛容差）显示最优设计保留约 88-90% 发电能力，商用彩色 BIPV 玻璃典型值约 78%。三条产品线：BgFilm 后装贴膜（面向全球已装机存量）、彩色组件代工合作（轻资产）、BgSuite 软件（EL 缺陷识别与光学设计工具）。滩头市场：大湾区/河南高速公路等基础设施光伏运维改造。公司 2026 年 5 月在港注册，创始人全资、合规齐备，带着已完成的理论与仿真进入 IDEATION，12 个月内转化为实测样品、专利申请与客户意向书。

2. 问题与机会

建筑师与业主要「不像光伏的光伏」：颜料/陶瓷印刷彩色玻璃牺牲约五分之一发电（文献典型 ~78%），高端干涉玻璃只服务新建项目且昂贵，存量电站无人服务。时机：全球年新增装机数百 GW 造就巨大存量市场（后装是唯一入口）；香港绿建（BEAM Plus）与内地 BIPV 政策拉动；高速边坡、声屏障、城市家具成为新光伏表面。香港优势：IP 与标准公信力 + 高校光学能力 + 一小时大湾区制造带。

3. 方案与技术

四分之一波长叠层反射设计窄带 = 显色，其余（含晶硅主吸收 400-1100nm）透过。配方库：深空蓝 ~89%、翠绿 ~90%、香槟金/酒红 ~85%、深空黑 ~86%（均为仿真值，附蒙特卡洛容差区间，脚本随白皮书 v2.0 附录公开可复跑）。数据纪律即护城河：所有数字三级定性标注，里程碑一后新增「实测结果」层级。

4-6. 市场·模式·打法

竞争：新建彩色玻璃（无后装能力）、颜料印刷（吸收损失）、内地彩色组件厂（重资产卖组件；我们贴膜优先+软件加持+愿意与其代工合作而非拼产能）。收入：贴膜项目（按 m^2 ）、配方授权+批次 QC 费、软件订阅。节奏：Y1 实测+意向书（拨款里程碑），Y2 付费试点 2-3 个 + 种子轮 300-500 万港元，Y3 规模化。渠道：创始人 20 年园区/能源人脉直销 + 建筑师伙伴 + 展会与标准委员会。

7-8. 团队与财务

创始人戴继涛：岭南大学工商管理博士（DBA，2025，方向为全球数字经济与治理，论文研究传统园区数字化转型）、电力工程学士，20 年园区投资运营经验，白皮书 v2.0 与仿真管线作者。第 3 个月增聘兼职研究工程师，种子轮后首位全职工程师。财务（目标口径）：Y1 收入 0-30 万/成本 60-80 万（创始人自筹+拨款 10 万），Y2 收入 150-400 万/种子轮 300-500 万，Y3 收入 800-1500 万。无负债。

9-10. 对香港的贡献与里程碑

真研发实体（仿真→港校实测→专利）、本地雇佣（MPF 全程合规）、支持香港减碳与绿建、以港为锚的标准与 IP。12 个月里程碑：M1 实测（4 万）→ M2 数据资产+首批专利（3 万）→ M3 意向书+参展+升级申请（3 万），详见《12 个月里程碑计划 v1.0》。