QuantumPharm (2228 HK)

Advanced quantum physics-based, AI-powered and robotics-driven company to accelerate drug and material discovery

- **Accelerating the design and discovery of novel drugs and materials leveraging quantum physics, AI and robotic automation**. Founded by three MIT-trained physicists, QuantumPharm Inc. is a globally leading, quantum physics-based, AI-powered, and robotics-driven, innovative R&D platform in terms of technological advantages, aiming to accelerate the design and discovery of novel drugs and materials. The Company adopts a combination of quantum physics-based first-principles calculation, advanced AI, high-performance cloud computing, and scalable and standardized robotic automation to provide drug and material science R&D solutions and services to global conglomerates and innovative companies in the pharma and material science industries and beyond.
- **Well-formatted AI-enabled businesses components**. Leveraging its advanced technologies, the Company's business primarily comprises (i) drug discovery solutions providing modular solutions spanning the full spectrum of the drug discovery and research process, and (ii) intelligent automation solutions consisting of solid-state R&D services and automated chemical synthesis services. QuantumPharm expects to have diverse revenue streams, including (i) transaction-based upfront, milestone, contingent payments, and/or royalties from drug discovery collaborations, (ii) transaction-based service fees from drug discovery solutions and solid-state R&D services, and (iii) subscription-based service fees from automated chemical synthesis services.
- **Significant collaborations and investments as endorsements to the Company's solutions.** With significant value to customers and collaborators and synergies within the Company's ecosystem, QuantumPharm has a suite of elite customers and collaborators. As of 13 May 2024, the Company served more than 100 global biotechnology and pharmaceutical companies and research institutions, including 16 of the top 20 global biotechnology and pharmaceutical companies ranked by revenue in 2022. The Company's advanced technologies have attracted both private equity and strategic investors, many of which are globally leading investors, such as HongShan, Mirae Asset, Google, Tencent, China Life, and 5Y Capital.
- **Initiate at BUY with TP of HK$7.25.** We expect QuantumPharm's total revenue to reach RMB306mn/ 562mn/ 911mn with attributable net loss of RMB660/ 281mn/ 23mn in FY24E/ 25E/ 26E. We derive our target price of HK$7.25 based on a DCF model (WACC: 9.79%, terminal growth rate: 4.0%).
- **Risks:** Risks relating to 1) research and development, 2) commercialization of its solutions and services, and 3) operations.

Earnings Summary

(YE 31 Dec)	FY21A	FY22A	FY23A	FY24E	FY25E	FY26E
Revenue	**63**	**133**	**174**	**306**	**562**	**911**
YoY (%)	76%	112%	31%	75%	84%	62%
Net income (loss)	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**
R&D expenses	(213)	(359)	(481)	(420)	(370)	(410)
Administrative expenses	(137)	(204)	(296)	(350)	(250)	(228)
Contract fulfillment costs	(30)	(67)	(126)	(185)	(197)	(237)
Selling expenses	(27)	(40)	(62)	(73)	(89)	(117)

Source: Company data, Bloomberg, CMBIGM estimates

BUY

Target Price	**HK$7.25**
Up/Downside	**24.8%**
Current Price	**HK$5.81**

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Stock Data

Mkt Cap (HK$ mn)	19,836
Avg 3 mths t/o (HK$ mn)	-
52w High/Low (HK$)	6.60/4.28
Total Issued Shares (mn)	3,407

Source: FactSet

Shareholding Structure

Dr. Wen Shuhao	15.23%
Image Frame (Tecent)	12.88%

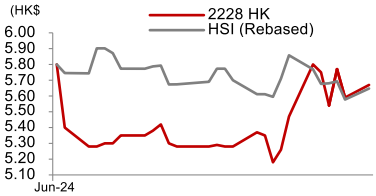
Source: Bloomberg

Share Performance

	Absolute	Relative
1-mth	6.0%	8.3%
3-mth	NM	NM
6-mth	NM	NM

Source: FactSet

12-mth Price Performance



Source: FactSet

Auditor: PwC

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Investment thesis

Founded in 2015 by three MIT-trained physicists, QuantumPharm is a globally leading, quantum physics-based, AI-powered, and robotics-driven, innovative R&D platform in terms of technological advantages. QuantumPharm aims to accelerate the design and discovery of novel drugs and materials by leveraging quantum physics, AI and robotic automation. The Company uses a combination of quantum physics-based first-principles calculations, advanced AI, high-performance cloud computing, and scalable and standardised robotic automation to provide drug and material science R&D solutions and services to global companies in the pharmaceutical and material science industries (including agritech, energy and new chemicals, and cosmetics) and beyond.

Well-established business components based on the integrated technology platform

QuantumPharm has established a proprietary integrated technology platform, which integrates cloud supercomputing-powered *in silico* tools, including quantum physics-based first-principles calculation and AI, for dry lab calculation and evaluation, and wet lab experimentation with robotic automation. The technology platform is designed to efficiently search chemical and material space for the rapid identification and analysis of lead molecules and materials with desired functional properties for applications in various areas (including drug and material R&D) as well as to provide insights and assistance to the Company's customers and collaborators in their drug and new materials discovery processes.

The Company's business primarily comprises (i) drug discovery solutions, providing modular solutions spanning the full spectrum of the drug discovery and research process, and (ii) intelligent automation solutions, consisting primarily of solid-state R&D services and automated chemical synthesis services. The Company has diverse revenue streams, including (i) transaction-based upfront payments, milestone payments, contingent payments, and/or royalties from drug discovery collaborations, (ii) transaction-based service fees from its drug discovery solutions and solid-state R&D services, and (iii) subscription-based service fees from its automated chemical synthesis services. Unlike its peers in the AI-powered drug discovery space, who primarily focus on the initial drug design stage, QuantumPharm has an integrated business model that combines early-stage drug design and chemical synthesis services. This gives the company a first-mover advantage in providing a comprehensive suite of discovery capabilities. Additionally, in contrast to many others in the industry, QuantumPharm employs a service-for-fee business approach. Rather than conducting intensive in-house clinical trials of drug candidates, the Company provides its design and synthesis expertise to clients, which helps reduce the uncertainty and high costs associated with advanced drug development stages. QuantumPharm's business model allows it to capitalize on the growing demand for AI-powered drug design expertise and chemical synthesis services, without taking on the financial burden and risks of late-stage clinical development.

As of 13 May 2024, the Company entered into approximately 159 agreements for its drug discovery solutions, some of which have progressed to the IND-enabling stage. These solutions and collaborations generate drug discovery revenue and generally have the potential to generate additional royalties, milestones or contingent payments. The Company is also expected to benefit from its equity positions in certain of its collaborators. Going forward, QuantumPharm intends to offer new solutions and forge new collaborations that offer scientific synergies and favourable commercial terms. In 2021, 2022 and 2023, the Company had approximately 18, 47 and 81 drug discovery solutions and collaboration programs which generated revenue, respectively, and approximately 17, 33 and 42 customers and collaborators, respectively.

The Company's intelligent automation solutions leverage AI and robotic automation to empower wet lab to provide stable and reliable data and results in a more efficient, accurate, and scalable way. The intelligent automation capability is a natural extension of the automation, digitization and AI capabilities. In 2021, 2022 and 2023, the Company had 168, 246 and 423 intelligent automation solution programs which generated revenue, respectively, and the number of customers increased to 145 in 2023 from 87 in 2022 (58 in 2021).

Significant collaborations and investments as endorsements to the Company's solutions

Since its founding, the Company has served and collaborated with a large number of global biotechnology and pharmaceutical conglomerates and has received investments and support from world-renowned private equity and strategic investors. We believe the Company's blue-chip shareholder base and prominent customer base is a testament to its capabilities and prospects.

QuantumPharm has well-established, long-term relationships with its customers and collaborators. It has been serving and collaborating with certain global biotech and pharmaceutical conglomerates, including Pfizer, Johnson & Johnson, CTTQ Pharma, Daewoong Pharma, and Merck KGaA, Darmstadt, Germany, since inception. Its customers and collaborators include 16 of the top 20 global biotechnology and pharmaceutical companies in terms of revenue in 2022 according to Frost & Sullivan. Due to its advanced R&D capabilities and distinct value proposition to customers and collaborators, many of them are the Company's repeat customers and collaborators. The customer retention rate was approximately 67.5%, 51.4% and 64.9%, respectively, in 2021, 2022 and 2023. The Company's advanced technologies have attracted both private equity and strategic investors, many of which are globally leading sophisticated investors with proven track records, such as HongShan, Mirae Asset, Google, Tencent, China Life, and 5Y Capital. The well-known customers and collaborators as well as reputable investors not only provide ample resources, capital or otherwise, to the Company's operations and growth, but also strengthen the brand name, reliability, and ability to acquire future opportunities through their strong global network and word-of-mouth referrals.

Significant market opportunities in the AI-powered R&D service industries

The R&D service markets QuantumPharm is targeting capture vast fast-growing opportunities, including drug R&D, solid-state R&D, automated R&D lab, and material science R&D markets. 1) For drug R&D, many biotechnology and pharmaceutical companies elect to collaborate with AI-powered service providers, especially those with both AI and wet lab capabilities that can act as a one-stop solution provider to accelerate their drug discovery process, reduce R&D costs, and optimize the molecules. The size of the global drug R&D outsourcing service market for drug discovery is expected to increase at a CAGR of 14.9% from US$12.3bn in 2023 to US$32.5bn in 2030, according to Frost & Sullivan. 2) For solid-state R&D, the global solid-state R&D service market mainly comprises pharmaceuticals and material science. Global pharmaceutical companies are increasingly choosing to use AI-based solid-state R&D services for a more systematic screening of potential crystal/salt forms to make more informed decisions. According to Frost&Sullivan, the size of the global solid-state R&D service market is expected to increase at a CAGR of 27.7% from US$3.8bn in 2023 to US$20.9bn in 2030. 3) For automated R&D lab, the global market size is expected to increase at a CAGR of 39.6% from US$5.9bn in 2023 to US$60.7bn in 2030. 4) For material science R&D, the global market is expected to increase at a CAGR of 12.8% from US$76.3bn in 2023 to US$177.9bn in 2030.

Initiate at BUY with TP of HK$7.25

We expect QuantumPharm's total revenue to reach RMB306mn/ 562mn/ 911mn with attributable net loss of RMB660/ 281mn/ 23mn in FY24E/ 25E/ 26E. We derive our target price of HK$7.25 based on a DCF model (WACC: 9.79%, terminal growth rate: 4.0%).

Investment risks

Risks relating to 1) research and development, 2) commercialization of its solutions and services, and 3) operations.

Accelerating the development of novel drugs and materials by leveraging quantum physics, AI and robotic automation

Overview of QuantumPharm

Founded in 2015 by three MIT-trained physicists, QuantumPharm is a globally leading, quantum physics-based, AI-powered, and robotics-driven, innovative R&D platform in terms of technological advantages. QuantumPharm aims to accelerate the design and discovery of novel drugs and materials by leveraging quantum physics, AI and robotic automation. The Company uses a combination of quantum physics-based first-principles calculations, AI, high-performance cloud computing, and scalable and standardised robotic automation to provide drug and material science R&D solutions and services to global and domestic conglomerates and innovative companies in the pharmaceutical and material science industries (including agritech, energy and new chemicals, and cosmetics) and beyond.

Figure 1: Key milestones of QuantumPharm

Time	Milestones
2015	The Company was founded with the establishment of Shenzhen Jingtai to provide crystal structure prediction and drug research development services
	QuantumPharm began to develop its research platform to study the solid-state form of drugs.
2016	The Company established a crystal structure prediction (CSP) platform for crystal form prediction, leveraging quantum physics applications and AIs.
	The CSP platform was proven accurate in a blind test held by Pfizer.
	QuantumPharm established an AI R&D center.
	The Company completed Series Pre-A Financing, Series A-1 Financing and Series A-2 Financing which had first launched since 2015.
2017	The Company launched AI-powered integrated technology platform “Atompai” and AI-powered drug discovery platform “Renova”
	The Company was incorporated in the Cayman Islands.
	It began the cooperation with Pfizer to provide polymorph screening and selection services.
	It completed its Series B Financing.
2018	The Company entered into a ten-year strategic Master Collaboration Research and License Agreement with Pfizer to develop force field platform.
	The Company developed the XFF high-precision force field in cooperation with Pfizer and XFEP for free energy perturbation calculations.
	The Company established wet lab facilities for solid-state R&D, synthesis and experimental research.
	It developed its drug discovery platform for small molecules.
	It completed its Series B+ Financing.
2019	The Company began to develop its drug discovery platform for antibody, peptide and protein therapeutics.
	The Company completed its Series B++ Financing.
2020	The Company started R&D of automation laboratory and completed development and concept certification on the prototype machine of the automation station.
	It completed its Series C Financing.
2021	QuantumPharm completed the development of its experimental and computing R&D center in Futian, Shenzhen.
	The Company completed the development of its pharmaceutical innovation R&D center in Pudong, Shanghai.
	It developed a proprietary AI-powered next-generation antibody discovery platform “XupremAb”.
	It completed its Series D Financing.
2022	It built-up its scalable and standardized intelligent robotic wet labs.
2023	The Company has developed its proprietary ProteinGPT, an AI-based biomedical generative tool, designed to predict and screen protein sequences and generate protein drugs that meet specific pre-set criteria by incorporating LLM into its algorithms.
	The Company entered into an AI small molecule drug discovery collaboration worth up to US$250mn with a global leading pharmaceutical company headquartered in Indianapolis, Indiana.
	It established an innovative demo lab in Boston, Massachusetts to showcase its R&D capability in the US market.
	The Company unveiled the brands “QuantumPharm Drug Discovery” and “QuantumPharm Intelligent Automation”.

Source: Company data, CMBIGM

In 2016, the Company participated in a global crystal structure prediction ("CSP") blind test held by Pfizer and achieved accurate prediction, which led to its long-term strategic master partnership in technology innovation and drug R&D with Pfizer. Since then, the Company has gradually become a global leader in providing computational solid-state R&D services. The Company's CSP capabilities and long-term collaboration with Pfizer ultimately enabled it to contribute to the development and production of Paxlovid, the world's first FDA-approved oral COVID-19 drug, in 2021, at a critical time in the global fight against coronaviruses.

As CSP and drug design and discovery share similar fundamental methodologies and problem-solving patterns, where target functions are used to search for solutions within a large number of possible outcomes, the Company naturally expanded into the drug R&D industry, driven by the evolving needs of its customers. To validate the compounds generated from its drug R&D activities, QuantumPharm built up its wet lab experimental capabilities. With the rapid growth of the business, the Company had an increasing customer demand for compound synthesis, which, according to Frost & Sullivan, is one of the most time-consuming and costly parts of the entire drug R&D process. To speed up the synthesis process, QuantumPharm developed robotic automation in its wet lab to enable scalable, flexible, multi-project, faster and more cost-effective experimental cycles. Acting as a molecular search engine, QuantumPharm has been able to explore the applicability of novel materials design and discovery at the molecular-level in a wide range of industries.

QuantumPharm has established a proprietary integrated technology platform that integrates cloud supercomputing-powered *in silico* tools, including quantum physics-based first-principles computation and AI, for dry lab computation and evaluation, and wet lab experimentation with robotic automation. The platform is designed to improve dry lab calculations with experimental data generated by the wet lab, and to improve the efficiency of the wet lab with insights derived from dry lab calculations.

The Company has well-established and long-standing relationships with many of the world's leading biotechnology and pharmaceutical companies, including Pfizer, Johnson & Johnson and Merck KGaA, Darmstadt, Germany, many of which are repeat customers. Since its inception, QuantumPharm has received significant investments and support from world-renowned private equity and strategic investors, including HongShan, Mirae Asset, Google, Tencent and China Life. Its blue-chip shareholder base and prominent customer base are testaments to its capabilities and prospects.

Business and revenue model

The Company's business consists primarily of (i) drug discovery solutions, which provide modular solutions spanning the entire spectrum of the drug discovery and research process, and (ii) intelligent automation solutions, which consist primarily of solid-state R&D services and automated chemical synthesis services.

The drug discovery solutions business focuses on the identification and development of molecules with pharmaceutically active functions against specific disease-related targets. Drug discovery solutions span the entire drug discovery and research process, from target validation, hit identification, lead generation and lead optimisation to preclinical candidate nomination, and cover various modalities, including small molecules, antibodies, peptides, ADC (antibody-drug conjugates) and PROTAC (proteolysis-targeting chimera). The Company also collaborates with certain drug developers on various therapeutic targets, from which it expects to receive royalty, milestone payments or contingent payments upon the achievement of milestones or events specified in the respective agreements, such as successful commercialisation in certain territories.

The intelligent automation solutions business focuses on AI- and automation-enabled discovery and research of novel drugs and materials. In particular, the Company's solid-state R&D services focus on analysing the physical and chemical properties of solid materials, which are the key to drug and materials science R&D. Solid-state R&D services include computational services, wet-lab experimental services and integrated solutions, which are a combination of both computational services and wet-lab experimental services. The computational services include CSP and morphology prediction, as well as screening of co-formers and carriers for crystallisation. The wet lab experimental services cover many aspects of solid-state R&D, including crystallisation process development and crystal structure determination. The automated chemical synthesis services launched in 2021, are designed to accelerate the chemical synthesis process, which is time-consuming and costly. The Company is also leveraging its robotic automation capabilities and expertise

to expand its intelligent automation solutions business by providing standard or customised automation solutions to customers in the pharmaceutical and materials science industries and beyond.

Figure 2: Business components of QuantumPharm

	Year ended December 31,					
	2021		2022		2023	
	(RMB'000, except for %)					
Drug discovery solutions	39,346	62.7	87,666	65.7	87,728	50.3
Intelligent automation solutions	23,453	37.3	45,687	34.3	86,692	49.7
Total	**62,799**	**100.0**	**133,353**	**100.0**	**174,420**	**100.0**

Source: Company data, CMBIGM

Well-established business components based on the integrated technology platform

The Company's business primarily comprises (i) drug discovery solutions, providing modular solutions spanning the full spectrum of the drug discovery and research process, and (ii) intelligent automation solutions, consisting primarily of solid-state R&D services and automated chemical synthesis services. The Company expects to have diverse revenue streams, including (i) transaction-based upfront payments, milestone payments, contingent payments, and/or royalties from drug discovery collaborations, (ii) transaction-based service fees from its drug discovery solutions and solid-state R&D services, and (iii) subscription-based service fees from its automated chemical synthesis services.

The drug discovery solutions

QuantumPharm's drug discovery solutions primarily revolve around hit identification, lead generation, lead identification and lead optimisation to produce high quality preclinical candidates. Leveraging its integrated technology platform, the Company is helping to transform the traditional manual methods of drug design and discovery and contributing to pharmaceutical innovation in China and around the world.

As of 13 May 2024, the Company entered into approximately 159 agreements for its drug discovery solutions, some of which have progressed to the IND-enabling stage. These solutions and collaborations generate drug discovery revenue and generally have the potential to generate additional royalties, milestones or contingent payments. The Company is also expected to benefit from its equity positions in certain of its collaborators. Going forward, QuantumPharm intends to offer new solutions and forge new collaborations that offer scientific synergies and favourable commercial terms. In 2021, 2022 and 2023, the Company had approximately 18, 47 and 81 drug discovery solutions and collaboration programs which generated revenue, respectively, and approximately 17, 33 and 42 customers and collaborators, respectively.

Small molecule discovery

QuantumPharm has a proprietary "three-in-one" AI-powered small molecule drug discovery platform, ID4Inno, designed to explore a wider chemical space with higher efficiency and lower costs. Through the ID4Inno platform, its intelligent computing designs the process for automated experimentation and analyses the results, providing data feedback to experts, and experts set specificity and metrics for intelligent computing to achieve a closed-loop AI drug R&D process.

ID4Inno consists of two sub-platforms, ID4Idea and ID4Gibbs, with different but complementary functionalities. ID4Idea can be customised to meet the diverse and specific needs of customers and collaborators. It is used to generate, select and evaluate small molecules with over 200 AI models covering molecular generation, molecular property evaluation and various other scenarios. ID4Gibbs is a high-precision quantum-physics computational platform based on physical modelling and first-principles calculations, enabling highly accurate prediction of drug-target interactions.

The overall workflow underlying small molecule drug design and discovery involves (1) broad-scope sampling of chemical structures, (2) prediction of potency, selectivity and drug-like properties, and (3) robotic wet lab validation.

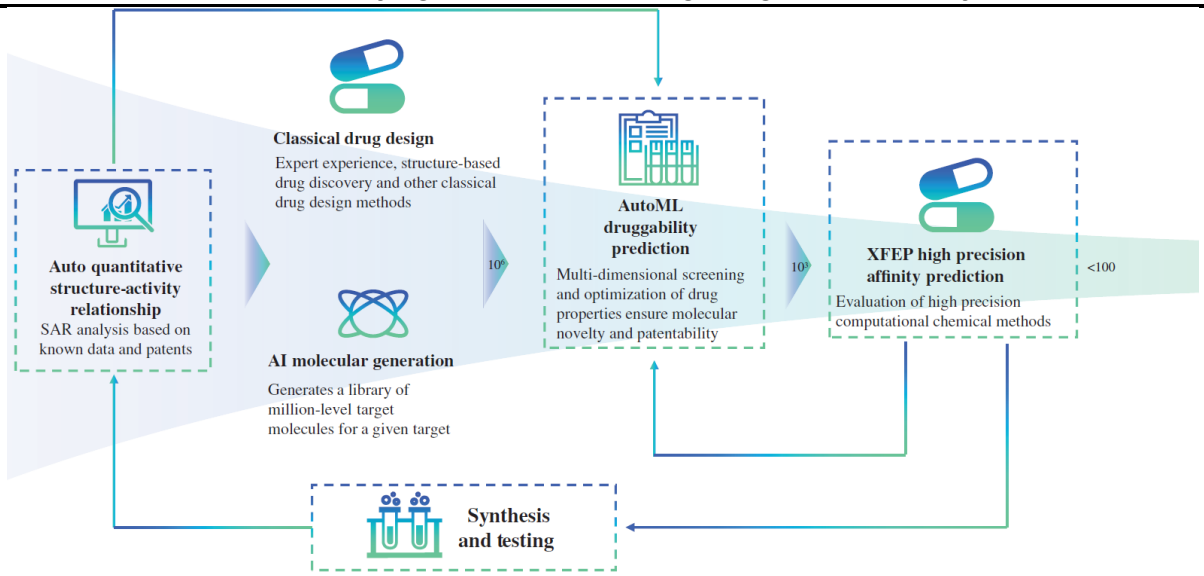
(1) Broad-scope sampling of chemical structures: QuantumPharm starts from using its AI models to explore the vast chemical space that is available to sample tens of millions of drug-like molecules as the starting pool that its AI models predict to be suitable for the subsequent screening for the particular target at issue. As a broader and deeper search of the chemical space is conducted for each target as compared to traditional methods, the Company's approach is more likely to yield quality candidate molecules for traditionally challenging targets.

(2) Prediction of potency, selectivity and drug-like properties: Next, the Company deploys a combination of its AI models and quantum physics to perform a multi-property optimization process where its AI models predict certain drug-like properties, such as solubility and ADMET (absorption, distribution, metabolism, excretion and toxicity) features, and the quantum physics-based platform predicts potency and selectivity, some of which could only be assessed at a later stage with traditional manual methods. The optimal profile of a drug candidate represents an acceptable balance of properties such as potency, selectivity, solubility, bioavailability, half-life, permeability, drug-drug interaction potential,

synthesizability, and toxicity, among others. Drug development is a multi-parameter optimization process because multiple properties are often inversely correlated, meaning that optimizing one property often de-optimizes others. The Company's predictions are able to yield a limited number of candidate molecules with a promising property profile. Its algorithms and prediction process are so designed that the resulting pool of molecules is small enough to be feasible for evaluation by the subsequent wet lab experimentation, while being large enough to reduce false negative results due to the limitation of the computational accuracy.

(3) Robotic wet lab validation: Finally, QuantumPharm performs wet lab experimentation to synthesize the pool of candidate molecules and conduct a variety of tests to assess their properties. QuantumPharm carries out a vast majority of the standard synthesis and tests by robotic automation, which can reduce costs, increase capacity and improve accuracy. The wet lab validations also generate data on molecules which are used to train the Company's *in silico* tools for better future insights.

Figure 3: The overall workflow underlying small molecule drug design and discovery



Source: Company data, CMBIGM. Note: SAR means structure-activity relationships. XFEP is a free energy perturbation (FEP) prediction platform.

Antibody discovery

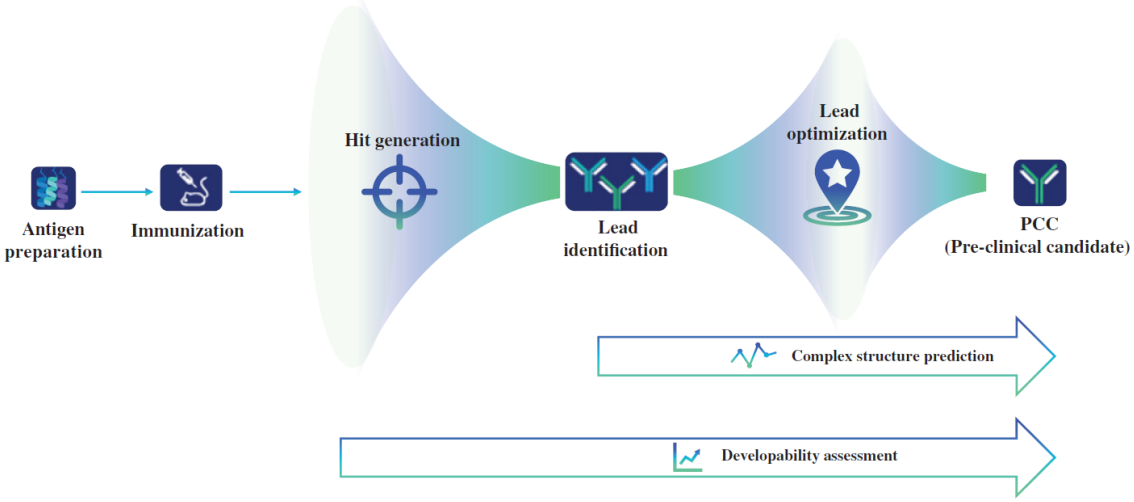
Driven by its customers' and collaborators' demand for antibody drug discovery and the great market potential of antibody drug discovery, QuantumPharm began to establish its antibody drug discovery capabilities since Mar 2021, leveraging its capabilities and expertise in small molecule drug discovery. The Company has developed a proprietary AI-powered next-generation antibody discovery platform, XupremAb, integrating various critical functions, including AI-powered hybridoma, AI-powered repertoire NGS discovery, AI-powered phage display, *de novo* design, super humanization, AI-powered affinity modulation, developability assessment and optimization, bispecific design, and ADC design.

Leveraging its integrated technology platform and similar underlying methodologies that are used for small-molecule drug discovery, QuantumPharm is exploring AI-powered solutions for the generation and prediction of other drug modalities, such as peptide, ADC, and PROTAC. Coupled with theoretical computation, empirical experimental data and its expert judgment, QuantumPharm's AI-powered function prediction model enables to screen and recommend candidate sequences to satisfy the specific needs and criteria of the research programs. With its AI-powered capabilities and practical experience, the Company is able to assist its customers and collaborators to tackle problems efficiently in drug design and discovery and to conduct discovery of novel therapeutics at a pace and scale beyond those with the traditional wet lab-based approaches.

The Company has made certain progress in its antibody discovery business, by entering into collaboration programs on antibody screening and antibody engineering, and plan to focus on antibody drug discovery collaborations with

biopharmaceutical companies in 2024, where the Company may receive upfront payment, development or commercial milestone payments, and/or royalties on a program-by-program basis.

Figure 4: The overall workflow of the Company's antibody discovery platform



Source: Company data, CMBIGM

To accelerate developing novel antibody drugs and reduce the cost and uncertainty, which are limiting factors of traditional antibody drug discovery methods, QuantumPharm adopts the following approaches:

(1) Cast a wider net. Its AI-powered repertoire discovery platform can unlock antibody sequence space to search for better and rarer candidates. With traditional methods involving hybridoma, only 0.01% to 0.1% of all B-cells can be explored, missing rare binders; while QuantumPharm's sequence-based AI models and NGS technologies can help search a much larger repertoire space, capturing nearly the entirety of the immune response, significantly improving hit diversity, and achieving a hit rate of over 50%.

(2) Design, not guess. The Company approach antibody engineering as design work rather than guesswork. It designs antibodies with direction by minimizing the random mutagenesis and trial-and-error method that drives traditional engineering. Its suite of predictive AI models analyze antibodies using sequences solely, reducing the number of sequences to be made and tested. As a result, its AI-powered precision engineering can quickly and accurately enable fine-tuning of candidates to targeted profiles.

(3) Excel in all dimensions. It searches for the optimal candidates, which are expected to excel across all properties, including function, developability, and immunogenicity. Its extensive predictive sequence-based AI models can predict developability with enhanced accuracy and speed and achieve multi-objective optimization, including on aggregation, thermostability, viscosity, and yield rate.

(4) Design superior antigens. It aims to design antigens beyond nature. As an example, GPCRs (G protein-coupled receptors) are difficult to express in their native forms, making GPCR antigen preparation a challenge. Mutations are usually required to thermostabilize GPCRs for expression. Human judgment and trial-and-error method are needed to identify mutations, which are tedious and time-consuming. Therefore, QuantumPharm utilizes its AI technologies on large-scale mutations to thermostabilize the GPCR antigen. The Company uses its generative AI models, primarily its ProteinGPT with proprietary LLM (large language machine learning model), to generate mutants, and narrow down the scope of mutants leveraging its predictive AI models of stability and electrogenerated chemiluminescence conformation. The Company's molecular dynamics modeling subsequently conducts fine-grained assessment of stability to select optimal mutants, which have been validated by benchmark antibodies and cleared stability tests. The unique approach can achieve rapid identification of mutations, maintain conformation of ECL, and enhance the level of stability and expression of GPCR antigens.

(5) Integrate and synergize. The Company combines various platforms with diversified functions end-to-end and integrate wet lab and dry lab capabilities to achieve optimal results. Specifically, it houses the computational and experimental capabilities under the same roof to achieve closed-loop synergies, integrate its internal data generation and immediate wet lab feedback to contribute to the superiority of its AI models, and routinely optimize and train ad hoc models for numerous specific programs to generate and accumulate new data.

Strategic collaborations

In addition to drug discovery solutions, the Company also collaborates with certain drug developers ("collaborators") to jointly work on various therapeutic targets ("collaboration programs") with huge unmet medical needs, from which the Company expects to receive royalties, milestone or contingent payments if such collaboration programs reach milestones or events specified in the respective contracts, such as successful commercialization in particular regions. QuantumPharm is responsible for the design, synthesis and assessment of candidate molecules against the pre-determined targets. Its collaborators conduct supplementary assays for the synthesized compounds and share the results with the Company. If the need arises, the Company will further optimize on the molecules and the collaborators will run further tests until a set of satisfactory compounds are generated.

QuantumPharm aspires to be a meaningful partner for innovative biotechnology and pharmaceutical and related companies, facilitating the quick translation of new biological discoveries into their promising new clinical candidates. QuantumPharm has entered into a number of collaborations with biotechnology and pharmaceutical companies and academic institutions under which the collaborators pursue research in a number of therapeutic areas, such as oncology, neurology, respirology, and inflammatory diseases. In some cases, it retains at least partial ownership in the pipeline programs, typically in the double-digit percentage range, of the programs pursued under these collaborations. The Company is not responsible for advancing their pre-clinical development beyond generation of pre-clinical candidates.

Through access to the Company's integrated technology platform and its practical experience in drug discovery, it can provide the collaborators with the following key benefits:

(1) Immediate utilization of the integrated technology platform. Ability to immediately and efficiently access the full benefits of the premier *in silico* tools, robotic wet lab facilities and its deep practical experience and expertise.

(2) Access to vast data assets. Ability to utilize the vast meaningful data assets accumulated from its calculations and experiments, reducing the time and costs for the design and discovery of drug candidates and evaluation of drug-like properties.

(3) Access to substantial computing power. Ability to access over hundreds of thousands of cores of computing power through the multi-cloud infrastructure for drug design and discovery, thereby avoiding the time and costs needed to build this infrastructure on their own and improve the capital and research efficiency.

(4) Target uniqueness. Under its collaboration agreements, it typically agrees to design drugs for a particular target or targets using its integrated technology platform and know-how only for the specific collaborator, and therefore enhancing the protection of intellectual property and reducing the likelihood of future conflicts of interest.

(5) Equity stakes. From time to time, it may either offer the solutions in exchange for equity interests in its collaborators or make equity investments in selected collaborators which develop complementary technologies to it and who it considers are compatible with the strategic position.

Figure 5: Equity stakes in the selected drug discovery collaborators as of 13 May 2024

Company	Shareholding %	Business Focus
Geode.	35.00	Oncology
META	15.34	Autoimmune disease and immunometabolism
Signet	9.11	Oncology
Hangzhou METiS Pharmaceutical Technology Co., Ltd. (杭州甾泰醫藥科技有限責任公司) ("**Metis**")	4.25	AI-driven drug delivery and drug development
PhoreMost Ltd.	6.67	Oncology and targeted protein degradation platform
CytoCan Inc	14.19	Multi-specific fusion protein drug development
ClickMab Biotech (Suzhou) Co. Ltd. (科邁生物科技(蘇州)有限公司)	30.0	*De novo* generation of antibodies
Leman	15.82	AI-driven tumor immunotherapy drug development and cell therapy
Xinshengtai (Hangzhou) Materials Technology Co. Ltd. (新生泰(杭州)材料科技有限公司)	30.0	AI-powered new materials discovery platform
Hangzhou Zentec Biotech Co., Ltd. (杭州箴泰生物科技有限公司)	30.23	AI- and automation-driven drug transdermal formulation R&D

Source: Company data, CMBIGM

As of 13 May 2024, all of its collaboration programs were still in the discovery and pre-clinical stages. Generally, the payments the Company is eligible to receive from a collaboration program increase as the program advances, while it may incur substantial upfront expenses at the early stage of the program. The Company will continue evaluating new collaboration programs that fit its selection criteria and where the collaborator's particular expertise has the potential to create synergies with it.

The intelligent automation solutions

The Company's intelligent automation solutions leverage AI and robotic automation to empower wet lab to provide stable and reliable data and results in a more efficient, accurate, and scalable way. The intelligent automation capability is a natural extension of the automation, digitization and AI capabilities. Automation can reduce human errors and experiment costs, thus enhancing experimental efficiency and quality; digitization can connect all the data and make the data processing and analysis more visible and accessible; and AI can transform its perception of data from a simple statistical analysis mode and experience-driven R&D mode to an AI model-driven innovative R&D mode, helping the Company to discover points of variation and the corresponding new rules and patterns in the R&D process more efficiently.

The Company's intelligent automation solutions primarily comprise solid-state R&D services and automated chemical synthesis services catered to its drug discovery customers and collaborators, and plan to strategically focus on providing standard or customized automation solutions to prospective customers in the pharmaceutical and material science industries. In 2021, 2022 and 2023, the Company had 168, 246 and 423 intelligent automation solution programs which generated revenue, respectively, and 58, 87 and 145 customers and collaborators, respectively.

Figure 6: Revenue from intelligent automation solution by business line

	Year ended December 31,		
	2021	2022	2023
		(RMB'000)	
Solid-state R&D services	23,296	27,756	42,184
Automated chemical synthesis	55	17,931	43,715
Others[1]	102	–	793
Total	23,453	45,687	86,692

Source: Company data, CMBIGM. Note: Others means income from other services pursuant to customers' requests, including lease income in 2021, and income primarily from the provision of automation solutions in 2023, such as the set-up of an automated wet lab for a biomaterials company. Automation solutions, as part of QuantumPharm's R&D Solutions, were launched in 2023.

Figure 7: Number of intelligent automation solutions programs which generated revenue

	Year ended December 31,		
	2021	2022	2023
Solid-state R&D services	166	198	283
Automated chemical synthesis services	1	48	137
Others[1]	1	–	3
Total	168	246	423

Source: Company data, CMBIGM

Solid-state R&D Services

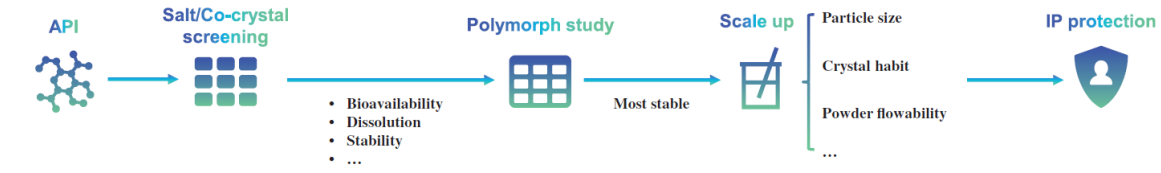
Solid-state R&D plays a critical role throughout the drug development cycle. Typically, solid-state studies are required in at least three stages of drug development: pre-clinical stage, post-Phase I clinical studies, and post-Phase II clinical studies, with the purpose of identifying suitable and thermodynamically stable crystal forms for *in vitro* studies, scale-up studies, and patent protection. The quality of solid-state studies directly affects various aspects of drug R&D. According to Frost & Sullivan, QuantumPharm is a global leader in providing computational solid-state R&D services, as assessed by its AI capabilities and the number of completed computational programs in 2022. It is one of the few companies globally that is able to simultaneously provide computational CSP (crystal structure prediction) services and experimental polymorph screening and selection services, according to the same source.

The flagship program of its solid-state R&D is the study of crystal forms. Many compounds crystallize into more than one distinct crystal form, a phenomenon known as polymorphism, which is particularly important for pharmaceutical molecules as the bioavailability and efficacy of drugs can be significantly affected by a particular crystal form. Thorough solid-state studies are crucial for obtaining patent protections for the critical crystal forms of a particular drug molecule.

Traditional solid-state R&D mainly relies on the practical experience of researchers and requires a large amount of experimental screening that does not guarantee full elucidation of all crystal forms, which in turn, leads to a potential risk to drug bioavailability and effectiveness, according to Frost & Sullivan. In contrast, the Company is dedicated to enhancing solid-state R&D workflow by combining theoretical computation and wet lab experimentation, which is designed to encompass major steps of solid-state R&D from full screening and characterization of crystal forms to crystallization process development. The solid-state R&D services can efficiently and effectively address challenges that traditional solid-state R&D methods face, such as API low solubility, poor *in vitro* stability, hygroscopicity, unclear API conformation, and polymorphic risk.

The Company has achieved favorable results that demonstrate the value of its solid-state R&D services. As an illustration of the quality of its services, the Company had achieved a 100% success rate in all of the CSP programs it conducted for small molecules as of May 2024.

Figure 8: The Company's approach to and advantages in solid-state R&D compared to traditional manual methods



Goal	Crystallinity, solubility, stability	Most stable form 3D crystal structure	Efficient and stable scale-up	Comprehensive IP protection
Traditional way	10-20 common counterions/co-formers	200+ screening experiments	Only focusing on the problems in the crystallization process	Doing more experiments blindly
XtalPi	**Virtual screening** of **70** co-formers + experiments	Screening experiments + **MicroED+ CSP**	**Morphology prediction** + process optimization	Experiments + **CSP**
Our advantage	**Larger** screening scale **Higher** success rate	**De-risk** Determination of crystal structure with **fast and high success rate**	**Solving problems** from properties of crystal	**Improving completeness** of study obtaining more IP rights

Source: Company data, CMBIGM

The Company's solid-state R&D services encompass computational services, wet lab experimental services, and integrated solutions which is a combination of computational services and web lab experimental services.

Computational services:

Leveraging the years of experience and expertise in enhancing *in silico* tools for solid-state studies, the Company is differentiated from its peers in the solid-state R&D industry by its core competence in conducting computational studies to predict the crystal structure and morphology of solid-state drugs. Such computational studies help better inform the subsequent wet lab experimentation and reduce the risk of failures in drug development and patent protection.

The components of computational services include (1) crystal structure prediction, (2) virtual coformer, salt, solvate and carrier screening, and (3) morphology prediction.

Wet lab experimental services:

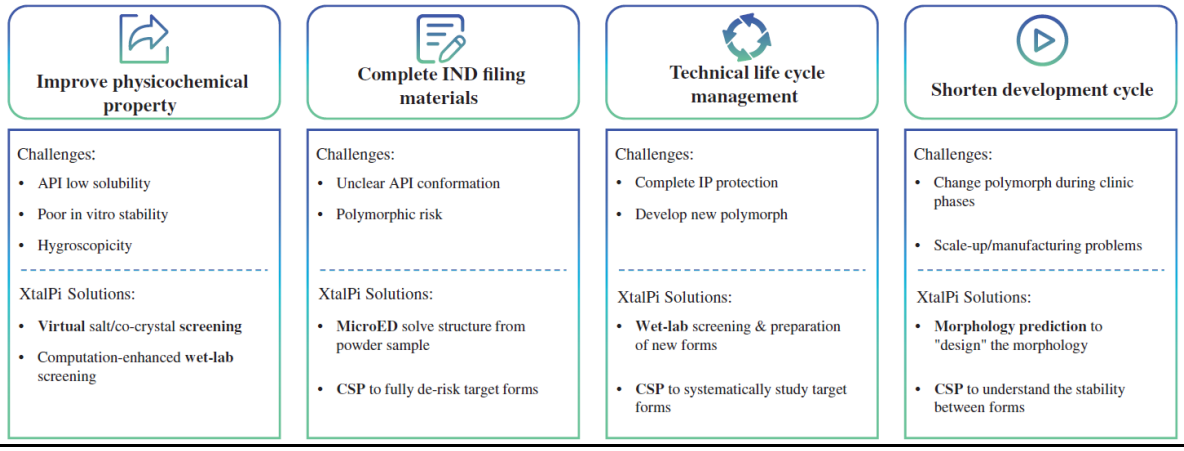
In addition to advancing its computational services, the Company conducts wet lab experimentation for solid-state R&D to support its internal research efforts and suit its customers' particular needs. The wet lab capability encompasses various stages of solid-state R&D from early solid form screening to process development for scaled-up production. Combining improved algorithms and experimental expertise, it can design and customize as well as effectively perform the solid-state screening process through proprietary automated crystallization workstations. The Company has also established technical capabilities with microcrystal electron diffraction ("MicroED") to facilitate structure determination and circumvent limitations of traditional methods, such as single X-ray diffraction that requires large size, single-phase crystal in regular shape and uniform orientations.

The components of web lab experimental services include polymorph screening and selection, salt screening and selection, crystal structure determination, and crystallization process development.

Integrated solutions:

Beyond individual computational or experimental services, the Company offers integrated solutions that combine expertise in both computation and experimentation to cater to the customers' needs and address multiple aspects of their solid-state R&D endeavors. As of May 2024, the Company offered a series of solutions that encompass solid-state property screening for lead molecules, solubility improvement studies, crystallization process development and crystal structure determination for challenging molecules, polymorph risk assessment for medicinal crystal form, and polymorph patent breakthrough studies for generic drugs.

Figure 9: "Experiment + Computation" integrated service platform, providing advanced, high-quality, and high-efficiency solid-state R&D services.



Source: Company data, CMBIGM

Automated chemical synthesis services

Chemical synthesis is the process where chemical reactions are performed to convert a reactant or starting material into compounds, which is time-consuming and costly. The Company began leveraging automation technology and capabilities to provide automated chemical synthesis services in Dec 2021, as an upgrade to its traditional non-automated chemical synthesis services. It has developed an in-house automation system, XtalDynamics, which is able to accelerate the chemical synthesis process, improve data quality, and generate a large scale of data 24 hours per day, while ensuring occupational safety with minimum human intervention. In addition, the automated robotic workstations can enable higher throughput of reaction conditions screening and optimization, accelerate the synthesis of intermediates, and significantly improve the efficiency of synthesis of compound libraries.

Future development in material science and intelligent automation

To unleash the potential of the integrated technology platform, R&D capacity, and accumulated expertise and experience, the Company has launched the QuantumPharm R&D Solutions program in late 2022 to expand its business in other sectors, such as material science and automation.

QuantumPharm has and will continue to engage in molecular design for industrial purposes. The QuantumPharm R&D Solutions business is expected to leverage similar well-established technologies as those for drug discovery customers, making the R&D of new materials a natural extension of its existing business. It believes the combination of its drug discovery expertise, solid-state R&D capability, AI-powered quantum physics-based computation, and high throughput standardized and automated wet lab facilities will enable the Company to offer R&D solutions beyond the pharmaceutical industry.

Material science: The quantum physics-based AI-powered integrated platform can also be applied to new problems of interest and new fields of study. Since the underlying physics that drives a biologic to bind to its target is no different than the physics that drives a small drug molecule to bind to a protein, the Company has been able to successfully apply these technologies to the discovery of biologics. Similarly, the physics underlying the properties of materials is no different than the physics underlying the properties of drug molecules. Therefore, the Company believes it is able to apply the integrated technology platform to material science applications, including in the fields of biomaterials, novel chemical compound for agritech applications, new chemical surfactant and catalyst, and cosmetics and healthcare products.

Intelligent automation: QuantumPharm launched the intelligent automation solutions with a goal of spearheading the design and production of next-generation lab automation platforms, with emphases on efficiency, flexibility, scalability, seamless integration with third-party hardware and software, and digital-twin applications. The aim is to create a robust, intelligent R&D infrastructure, curate tools tailored for optimal data flow, and lead the change in next-generation automated lab solutions. The intelligent automation solutions will strategically focus on providing standard or customized

automation solutions to empower customers to scale their business, enhance their product or service quality, and reduce their operational costs.

Integrated technology platform as the foundation of business growth

Quantum physics-based, AI-powered, and robotics-driven integrated technology platform

QuantumPharm has established a proprietary integrated technology platform, which integrates cloud supercomputing-powered *in silico* tools, including quantum physics-based first-principles calculation and AI, for dry lab calculation and evaluation, and wet lab experimentation with robotic automation.

Quantum physics-based computation methods form the core of the Company's technology platform. Quantum physics-based first-principles calculation enables the Company to model drug properties *ab initio*, which helps the company to discover and design promising drug candidates promptly without having to first accumulate empirical data. The data it generates from the quantum physics-based calculation in turn help it to train its AI models to predict critical properties at various levels of complexity, from atomic, molecular, crystal, biological target, to *in-vitro* and *in-vivo*. Such capabilities allow the Company to identify candidate compounds and crystal forms suitable for drug R&D. QuantumPharm considers that the fundamental approaches and technologies underlying its quantum physics-based computation capability can equally be applied in the field of material science R&D, naturally extending its services to cover material science R&D.

QuantumPharm integrates its AI capabilities into many of its core technologies, including automated chemical synthesis, crystal structure screening, and its multiple-modality drug discovery platforms covering small molecule, peptide, ADC, PROTAC, and antibody, to optimize the efficiency and performance of these technologies.

The wet lab with robotic automation can validate the predictions generated by its *in silico* tools, while the data produced at scale from the wet lab experimentation function as the feedback to further train its *in silico* tools, creating a mutually reinforcing cycle of learning. The improved in silico tools then produce better insights into the design and performance of wet lab experimentation. Therefore, the iteration of *in silico* and wet lab experimentation creates a virtuous cycle where data generation, learning and confirmation enhance each other and continually strengthen the integrated technology platform with real world experimental data on molecules and chemical synthesis.

The quantum physics-based computation

QuantumPharm is among the few scientific research companies that have first-principles calculation capabilities to predict the properties and behavior of potential drug candidates, including their binding affinity to target proteins, solubility, and stability, among others, at the molecular level *ab initio*, according to Frost & Sullivan. Unlike traditional R&D service providers and other market participants without first-principles calculation capabilities, which generally require sufficient experimental data to train their AI models, the quantum physics-based first-principles calculation can generate scalable data assets and drug properties *ab initio*, enabling the Company to overcome the problem of lack of data frequently seen in the early stages of applying AI. Thus, the quantum physics-based first-principles calculation capabilities enable the Company to identify promising candidates faster and more accurately by generating training data *ab initio* for scalable machine learning models of binding, ADMET, and solid state properties.

QuantumPharm believes that material science as an industry is a natural candidate for quantum physics-based computation. Quantum physics is well-known for predicting and simulating the structure, properties, and behavior (or reactivity) of atoms and molecules more effectively and accurately than conventional computing. As a result, the Company believes the capability in quantum physics-based computation naturally empowers the Company to tap into high value sectors in material science that involve the fundamental understanding of properties and behaviors of the very building blocks of materials, including biomaterials, novel chemical compounds for agritech applications, new chemical surfactants and catalysts, and cosmetics and healthcare products.

The quantum physics-based computation has a wide array of inherent capabilities:

(1) Faster Lead Discovery: the ability to rapidly identify potent molecules suitable to initiate hit-to-lead and lead optimization efforts via solutions for virtual screening of extremely large libraries of molecules, as well as molecular design with various algorithms, including fragment growth and linkage, R-group substitution, scaffold hopping, conformation constraint, and molecular hybrid, to identify novel, highly potent molecules unavailable in library collections;

(2) Accurate Property Prediction: the ability to assess critical properties of molecules using its quantum physics-based computation with accuracy comparable to that of experimental lab assays, to facilitate optimization of molecular properties, including potency, selectivity, and bioavailability;

(3) Large-scale Molecule Exploration: the ability to computationally conceptualize and explore novel, high-quality molecules for consideration by discovery program teams utilizing computational enumeration and generative machine learning techniques that are trained and constructed to yield molecules that are synthetically feasible; and

(4) Large-scale Molecule Evaluation: the ability to scale its calculations of key molecular properties to ultra-large idea sets of over a billion molecules to enable more rapid and successful identification of high-quality candidate molecules via integration of machine learning methods with the quantum physics-based techniques, as well as large-scale utilization of internal and cloud computing resources.

The advanced generative AI capability

The AI technology is one of core competencies that enables the Company to revolutionize the scientific fields of drug and material science R&D. The integrated technology platform utilizes AI to process information and generate predictions at scale. Built upon cloud computing resources, the company has constructed a set of over 200 AI models to conduct comprehensive evaluation of the critical properties of compounds. In addition, QuantumPharm has built and is continually upgrading the technical capabilities in therapeutic modalities with respect to large molecule drugs, including peptides, RNA, and antibodies. The Company embeds AI modules within the quantum physics-based computation algorithms to improve their calculation efficiency while maintaining accuracy. For particular targets and compounds, it is able to build customized AI models as necessary to improve the performance of its *in silico* predictions. The Company has developed an in-house AI modeling platform, which equips the Company with data feature extraction and data mining capabilities. The valuable data assets generated from quantum physics-based computation through the drug discovery collaborations with biotechnology and pharmaceutical companies will further guide and train the AI model algorithms to improve the speed, accuracy, efficiency and success rate of the R&D cycles.

The AI-powered intelligent robotic wet lab

QuantumPharm believes its automation technology and capability bring a competitive advantage over other AI-powered drug discovery companies. The Company has recently completed the construction of the intelligent robotic wet lab with the aim of replacing manual experiments, featuring its cross-discipline automation team, clusters of robot scientists, standardization and scalability, AI, intelligent control, digital twin, and Lab-as-a-Service.

The Company believes the AI-powered intelligent robotic wet lab can tremendously improve operational efficiency and reduce operating expenses. The Company believes the combination of *in silico* tools and robotic wet lab experimentation brings benefits over traditional methods, in terms of speed, scale, novelty, and success rate of drug and material science R&D. The two pillars of cloud supercomputing-powered *in silico* tools and robotic wet lab experimentation mutually inform and reinforce each other, and thus creating synergies among its technologies and achieve a full-stack closed-loop technology chain.

The cloud supercomputing infrastructure

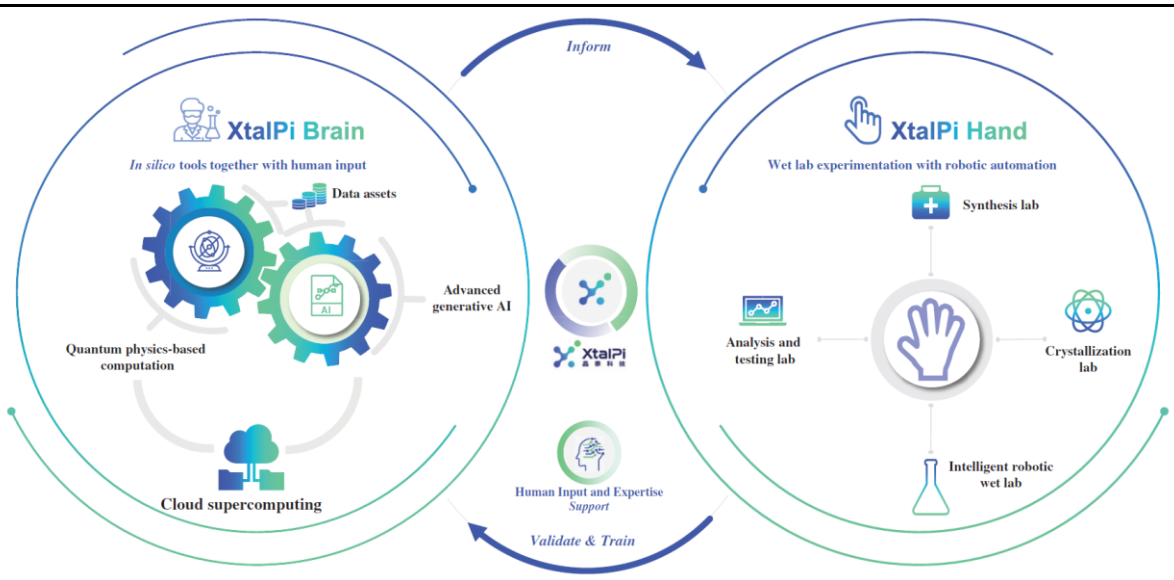
The Company's quantum physics-based computation and AI capabilities are optimized through its self-developed cloud architecture, allowing the Company to benefit from the security, scalability, flexibility, and efficiency of cloud computing. The cloud architecture is designed for multi-cloud capacity and is supported by leading, global public cloud service providers. The integrated technology platform is able to run on major cloud service providers simultaneously and leverage their combined computing capabilities. Combining the effects of GPUs and cloud computing with its integrated quantum physics and machine learning technologies enables the Company to shorten timelines, decrease costs, and increase the probability of success of its drug or new materials discovery efforts. The Company is able to adjust different cloud computing clusters across geographies, scaling its computing power to hundreds of thousands of cores in minutes to accelerate the computing process and quickly deliver results to its customers or collaborators. The powerful cloud supercomputing infrastructure enables the Company to deploy over a million cores in a few hours and run dozens of projects in parallel, and thus augmenting computing power to be more efficient and faster.

Closed-loop integrated technology platform

The technology platform is designed to efficiently search chemical and material space for the rapid identification and analysis of lead molecules and materials with desired functional properties for applications in various areas, including drug and material science, as well as to provide insights and assistance to the Company's customers and collaborators in their drug and new materials discovery processes.

The technology platform integrates (i) cloud supercomputing-powered *in silico* tools, including quantum physics-based computation and AI, for dry lab calculation and evaluation, and (ii) wet lab experimentation with robotic automation, backed up by its domain expertise, to develop R&D solutions with the potential to accelerate the process, expand the scale, address challenging targets, and improve success rate over traditional alternatives. The Company believes the combination of *in silico* tools and robotic wet lab experimentation brings benefits over the traditional methods, where the two pillars are informed and reinforced by each other creating a full-stack, closed-loop technology platform. In addition to constantly improving its *in silico* tools by fine-tuning its algorithms and training the AI with accumulated data, the Company has recently enhanced the wet lab capabilities with the aim of replacing manual experiments with robotic automation, to the largest extent applicable, to improve the speed, scale and efficiency of the wet lab experimentation. Furthermore, the Company has successfully upgraded its proprietary AI-based ProteinGPT tool, designed to predict protein sequences and generate protein drugs that meet specific pre-set criteria, by incorporating LLM into its algorithms.

Figure 10: The structure of the Company's closed-loop integrated technology platform combining its dry lab and wet lab capabilities



Source: Company data, Frost & Sullivan Report, CMBIGM

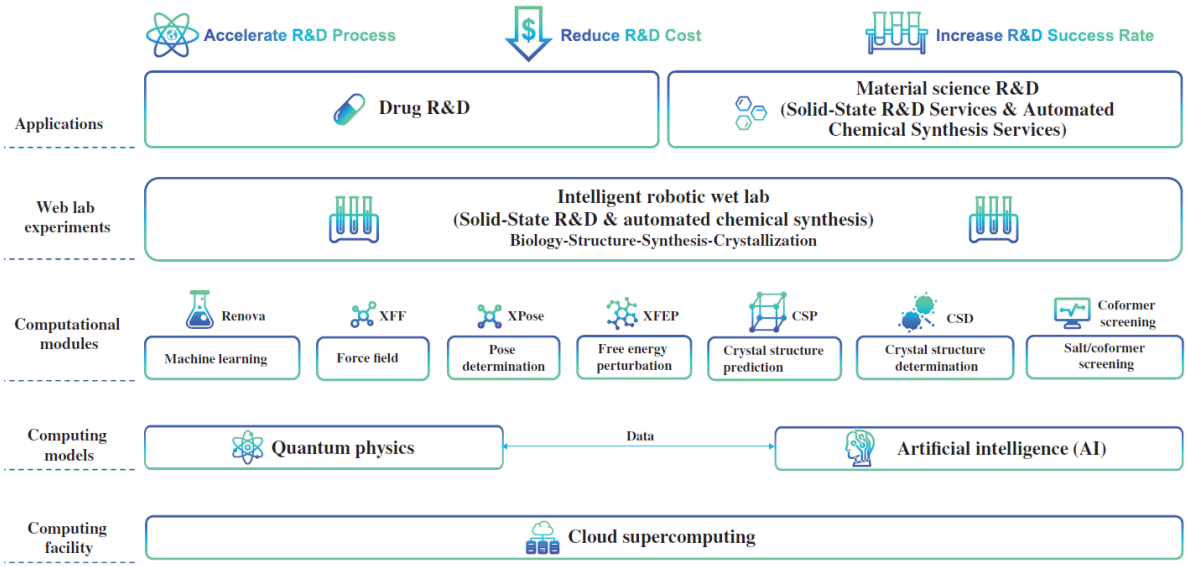
The components of the integrated technology platform integrate within the system and enable each other as follows:

(1) Within its *in silico* tools, the Company embeds AI models into quantum physics-based computation algorithms to expedite the calculation process by reducing the number of calculations otherwise required without the AI models, and the Company deploys quantum physics-based computation methods to extract features of molecules to facilitate construction of AI models for better predictions. The Company also uses the results at the molecular, crystal, or protein-ligand complex level generated from quantum physics-based computation, such as intra-molecular energy and inter-molecular energy, as training sets to enhance its AI models. The quantum physics-based computation algorithms and AI models are powered by cloud supercomputing architecture that allows the Company to benefit from high cloud computing power and adjust different cloud computing clusters to scale up the computing capacity to hundreds of thousands of cores in order to accelerate the calculation process and timely deliver results to its customers and collaborators.

(2) In integrating its *in silico* tools and wet lab experimentation, the predictions generated by *in silico* tools are assessed in its own wet lab, which create a mutually reinforcing cycle of learning. The data produced at scale from the wet lab experimentation, such as biological activity, target selectivity, metabolic stability, hERG liability, and crystallization propensity, function as the feedback to further train its *in silico* tools. Predictions that are confirmed through experiments reinforce understanding and algorithms. Predictions that are identified as incorrect through experiments generate valuable data to refine the algorithms to improve future predictions. The improved *in silico* tools then produce better insights into the design and performance of wet lab experimentation.

Therefore, the iteration of *in silico* and wet lab experimentation creates a virtuous cycle where data generation, learning and confirmation enhance each other and continually strengthen the integrated technology platform with real world experimental data on molecules and chemical synthesis. In addition, as the Company further expands the wet lab and enhance automation with the aim of replacing manual operations with robotics, the Company expects to generate abundant wet lab data at a faster pace compared to that of manual operations, which would further enable the company to enhance its *in silico* tools.

Figure 11: The workflows of the integrated technology platform



Source: Company data, CMBIGM

Significant cooperation and collaborations as endorsements to the Company's solutions

The Company has well-established, long-term, mutually beneficial relationships with its customers and collaborators. It has been serving and collaborating with certain global biotechnology and pharmaceutical conglomerates, including Pfizer, Johnson & Johnson, CTTQ Pharma, Daewoong Pharma, and Merck KGaA, Darmstadt, Germany, since inception. Its customers and collaborators include 16 of the top 20 global biotechnology and pharmaceutical companies in terms of revenue in 2022 according to Frost & Sullivan. Due to its advanced R&D capabilities and distinct value proposition to customers and collaborators, many of them are the Company's repeat customers and collaborators. The customer retention rate was approximately 67.5%, 51.4% and 64.9%, respectively, in 2021, 2022 and 2023.

Strategic long-term cooperation with Pfizer to accelerate drug R&D

In 2016, QuantumPharm participated in a global crystal structure prediction ("CSP") blind test held by Pfizer and achieved accurate prediction, which led to its long-term strategic master partnership in technological innovation and drug R&D with Pfizer. Since then, the company gradually became a global leader in providing computational solid-state R&D services.

In April 2018, QuantumPharm entered into a ten-year strategic collaborative research and license agreement with Pfizer, pursuant to which Pfizer and the Company have engaged in strategic research collaborations to develop hybrid physics- and AI-powered technologies to accelerate drug R&D.

Building upon the existing relationship with Pfizer for CSP, this research collaboration aims to help the Company and Pfizer further advance its capability in computation-based rational drug design and solid-form selection. For example, its quantum physics-based computation has enabled Pfizer's scientists to perform CSP calculations in a matter of days, while traditional methods may take up to four months. The Company believes that this collaboration is already changing the way Pfizer performs its screening work and has the potential to disrupt the industry as a whole.

To date, QuantumPharm has collaborated with Pfizer to carry out multiple research plans, including the development of optimized force field parameters. Force field parameters provide a description of intramolecular and intermolecular interactions and are an essential component for the structure-based drug design predictions and CSP studies. The Company believes that its strategic cooperation with Pfizer evidences industry recognition of its capabilities in quantum physics-based computation and AI-powered solid-state R&D and presents a valuable opportunity to upgrade the technologies.

Cooperation with CK Life Sciences to develop a AI-powered tumor vaccine R&D platform and diagnostic models

QuantumPharm entered into a three-year collaborative research agreement (the "CK Life Sciences Agreement") with CK Life Sciences in Nov 2022, to jointly develop a novel AI-powered tumor vaccine R&D platform to improve the discovery and design capabilities of tumor vaccines and accelerate the development of more vaccine types. The Company's goal of this collaboration is to realize precision treatment for patients worldwide.

According to Frost & Sullivan, the size of the global cancer immunotherapy market was approximately US$50.2bn in 2022 and is expected to increase to approximately US$219.7bn in 2030, with a CAGR of 20.3% from 2022 to 2030. The existing design and pre-clinical development process for tumor vaccines is complex and lengthy, hindering the efficiency and success rate of tumor vaccine R&D. To address these unmet medical needs, QuantumPharm collaborated with CK Life Sciences, leveraging its advanced technologies and industry expertise in quantum physics-based computation, AI, and robotic automation, to build an AI-powered tumor vaccine R&D platform that applies advanced AI algorithms and high-precision molecular modeling to predict and design a variety of tumor vaccines that can activate specific immune responses to kill tumors. Tumor vaccines will be screened and verified through intelligent robotic wet lab experiments. By integrating algorithmic feedback to optimize activity and efficacy, the Company expects the platform to generate pre-clinical tumor vaccine candidate compounds with robust immune activity.

Expanding upon its existing partnership, QuantumPharm entered into a three-year agreement with CK Life Sciences in Oct 2023 to explore and develop clinically usable, high-precision mRNA-based molecular diagnostic models for prognostic risk prediction which may enhance the ability of physicians to assess the risk of cancer recurrence and implement better-tailored postoperative treatment plans to improve the survival rate and quality of life of patients. Leveraging its AI capabilities and machine learning models, the Company expects that this program will lead to the development of advanced intelligent solutions for the processing and modeling of holistic multidimensional biomedical data, biomarker discovery, and postoperative recurrence risk prediction. Furthermore, QuantumPharm intends to utilize the crucial biomarkers to be identified in this program to further enhance the computational modeling capabilities in clinical diagnosis, disease management, and the screening of novel therapeutics, and to lay the foundation for its future programs involving larger and more complex datasets.

Collaboration with a global leading pharmaceutical company to develop drug candidates

The Company entered into an AI small molecule drug discovery collaboration worth up to US$250mn with a global leading pharmaceutical company headquartered in Indianapolis, Indiana, in Apr 2023. The collaboration aims to develop the drug candidates which target a disease that currently has huge unmet medical needs. The Company will leverage its AI capabilities and automated robotics platform for the *de novo* design and delivery of a novel compound, which will be advanced by this collaborator through clinical and commercial development. In particular, the small molecule drug discovery platform will help to create and explore a target-specific mega chemical space, as well as identify a promising lead series. The Company will conduct tests on each synthesized molecules group using the internal biochemical, pharmacodynamic, cellular and pharmacokinetic assay capabilities. The program-specific R&D data will be fed into generative AI models through iterative cycles of design, making, testing and analysis. By using multiple autonomous robotic workstations, the Company is able to perform precise and energy-efficient parallel chemical synthesis and assays 24 hours per day. With its closed-loop of AI and quantum physics algorithms working in sync with the data factory of large-scale robotics experiments, the Company is uniquely equipped to tackle challenging novel targets for this collaborator.

Well-structured business operations to secure future revenue growth

A diverse R&D team backed by increasing financial support

QuantumPharm's team, led by the Company's three MIT-trained scientists and Co-founders (Wen Shuhao, Ma Jian, Lai Lipeng), consisted of more than 500 scientists and technologists as of Dec 2023. They possess multi-disciplinary expertise in algorithm design, physics, biology, chemistry, pharmaceutical R&D, and automation and robotics that collectively bring insights and experience to its R&D. The Company's R&D staff have exceptional backgrounds, with many holding advanced degrees and having gained valuable experience from leading global academic institutions and well-recognized industry participants.

The Company continues to increase its R&D expenses to support business growth. The R&D expenditure increased from RMB214.4mn in 2021 to RMB359.0mn in 2022, and further to RMB480.3mn in 2023, accounting for approximately 52.4%, 53.5% and 49.8% of its total operating expenditure in the same years, respectively.

QuantumPharm's also has a dedicated innovation team, the XIC team, in Beijing, China, which focuses on fundamental innovation through AI, scientific computing and advanced experimental technologies to continue developing the application of AI and automated experimental technologies in life sciences and other high value sectors such as material science (including agritech, energy, cosmetics, and healthcare). The XIC team, led by the Company's Co-founder Dr. Lai, possesses robust expertise in AI, such as deep learning, data mining and multi-method integration to define and address key issues in both the R&D process and the computational algorithms. The Company's XIC team consisted 22 cross-disciplinary researchers, 64% having a master's degree or above, with diverse expertise in, among others, computer science, chemistry, and biochemistry and molecular biology.

Business development and marketing team integrated with product development

QuantumPharm's business development and marketing team consisted of approximately 45 members with relevant qualifications and experience in the pharmaceutical and material science industries as of end-2023. The marketing team works in collaboration with its scientists and technologists to better understand existing and prospective customers' needs, and to better offer tailored solutions.

Integration of dry lab and wet lab expertise to bring competitive advantages

For its drug discovery solutions, QuantumPharm faces competitions from many sources, including major pharmaceutical companies, specialist biotechnology and pharmaceutical companies, technology companies, academic institutions and government agencies, and public and private research institutions. In particular, it faces competition from competitors engaged in AI-powered early-stage drug R&D. Some of its competitors possess well-established capabilities in drug R&D and have long-standing relationships with many of its existing and potential collaborators and customers, including large biotechnology and pharmaceutical companies and academic institutions. The Company also faces competitions from pharmaceutical companies that develop AI-powered drug R&D solutions internally, smaller companies that offer drug discovery solutions and services directed at more specific markets than it targets, as well as a large number of companies focused on applying AI and quantum physics-based computation technologies to drug discovery. However, only a few competitors possess both dry lab and wet lab capabilities, like QuantumPharm, who is more capable of further accelerating the drug discovery process.

For its solid-state R&D, QuantumPharm faces competition from companies providing computational and/or experimental solid-state R&D services. This includes specialized solid-state CROs, other large CROs, and AI-focused CROs. It also faces competition from pharmaceutical companies that develop solid-state R&D internally. However, only a few competitors incorporate both *in silico* prediction and wet lab experiment, like QuantumPharm, which is capable of offering more efficient solid state R&D services. Although the current market is still dominant by the traditional manual method providers, like specialized solid-state CROs and other large CROs, the market share of AI-focused service providers is expected to grow due to the advantages of AI-based solid-state R&D services in terms of higher R&D efficiency and better quality.

High-quality customers and investors to drive business growth

Since its founding, QuantumPharm has served and collaborated with a large number of global biotechnology and pharmaceutical conglomerates and has received investments and support from world-renowned private equity and strategic investors. The Company believes its blue-chip shareholder base and prominent customer base is a testament to its capabilities and prospects.

QuantumPharm has well-established, long-term, mutually beneficial relationships with its customers and collaborators. The Company has been serving and collaborating with certain global biotechnology and pharmaceutical conglomerates, including Pfizer, Johnson & Johnson, CTTQ Pharma, Daewoong Pharma, and Merck KGaA, Darmstadt, Germany, since its inception. The customers and collaborators include 16 of the top 20 global biotechnology and pharmaceutical companies in terms of revenue in 2022, according to Frost & Sullivan. The Company had 75, 120 and 187 customers in 2021, 2022 and 2023, respectively. Due to its advanced R&D capabilities and distinct value proposition to its customers and collaborators, many of them are its repeat customers and collaborators and engage the Company for either bundled transactions or long-term collaborations. The customer retention rate was approximately 67.5%, 51.4% and 64.9%, respectively, in 2021, 2022 and 2023.

The Company's advanced technologies have attracted both private equity and strategic investors, many of which are globally leading sophisticated investors with proven track records, such as HongShan, Mirae Asset, Google, Tencent, China Life, and 5Y Capital. The elite customers and collaborators as well as reputable investors not only provide ample resources, capital or otherwise, to the Company's operations and growth, but also strengthen the brand name, reliability, and ability to acquire future opportunities through their global, strong network and word-of-mouth referrals.

Significant market opportunities in the AI-powered R&D service industries

The R&D service markets that QuantumPharm is targeting capture fast-growing vast opportunities, including drug R&D, solid-state R&D, automated R&D lab, and material science R&D markets.

Figure 12: Market opportunities for QuantumPharm

	Features	Market size
Drug R&D	Many biotechnology and pharmaceutical companies elect to collaborate with AI-powered service providers, especially those with both AI and wet lab capabilities that can act as a one-stop solution provider to accelerate their drug discovery process, reduce R&D costs, and optimize the molecules.	The size of the global drug R&D outsourcing service market for drug discovery is expected to increase at a CAGR of 14.9% from US$12.3bn in 2023 to US$32.5bn in 2030. The size of the drug R&D outsourcing service market for drug discovery in China is expected to increase at a CAGR of 19.6% from US$3.5bn in 2023 to US$12.2bn in 2030.
Solid-state R&D	The global solid-state R&D service market mainly comprises pharmaceuticals and material science. Global pharmaceutical companies are increasingly choosing to use AI-based solid-state R&D services for a more systematic screening of potential crystal/salt forms to make more informed decisions.	The size of the global solid-state R&D service market is expected to increase at a CAGR of 27.7% from US$3.8bn in 2023 to US$20.9bn in 2030.
Automated R&D lab	Automation is the prevailing trend for industrial upgrade and reform, and is expected to bring significant benefits, such as higher quality and efficiency in R&D. Automated R&D lab can be involved in three aspects of the R&D process, including (i) synthesis, (ii) crystallization and (iii) process control by providing screening, condition control, quality assurance, *in situ* reaction analysis and real-time monitoring and data collection services.	The size of the global automated R&D lab market is expected to increase at a CAGR of 39.6% from US$5.9bn in 2023 to US$60.7bn in 2030.
Material science R&D	The development of new materials drives innovation in both research and technology in crucial areas, such as sustainable energy and microelectronics. With the technological advancements and the growing adoption of big data, computational material science and engineering has emerged as a prominent subfield in material science R&D. It is expected to revolutionize the discovery of new materials, reduce the time and costs of R&D cycles, and accelerate the rapid evolution of new materials into products.	Global material science R&D expenditure is expected to increase at a CAGR of 12.8% from US$76.3bn in 2023 to US$177.9bn in 2030, and material science R&D expenditure in China is expected to increase at a CAGR of 18.5% from US$17.8bn in 2023 to US$58.5bn in 2030.

Source: Frost & Sullivan Report, CMBIGM

The new technology markets

New technologies, such as artificial intelligence (AI), quantum physics and automation, are transforming businesses and are believed to contribute to economic growth by enhancing productivity.

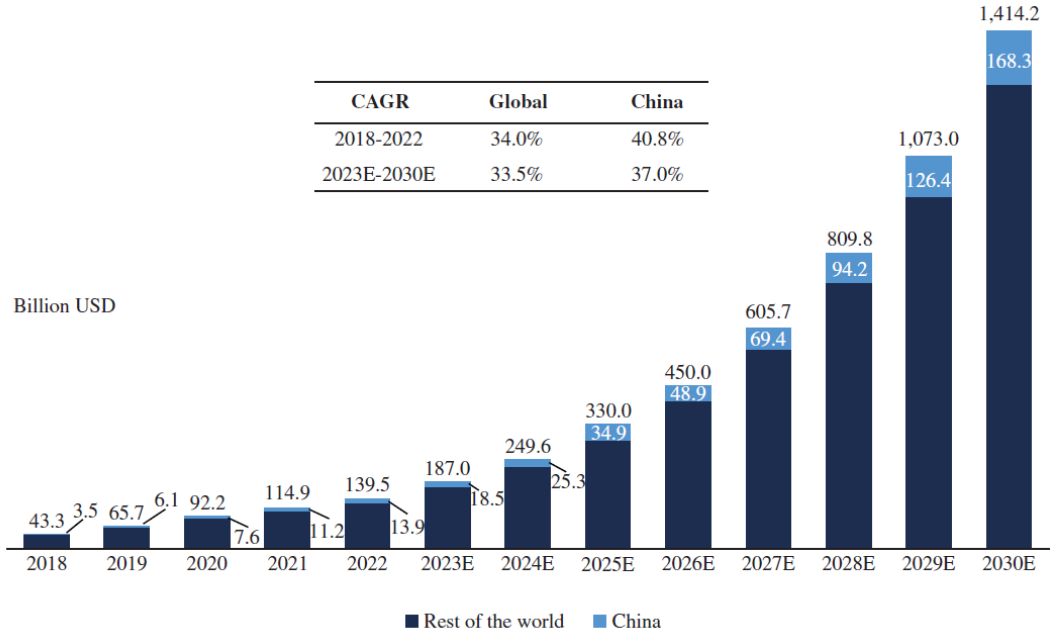
AI solution market

AI solutions show great potential in various application scenarios, as it can break through the huge bottleneck of data quality, processing efficiency, complete in-depth analysis, and standardization of large-scale, multi-source heterogeneous data, thereby significantly increasing the demand for AI technology.

According to Frost & Sullivan, the global AI solution market is experiencing rapid growth, driven by technological advancements, favorable government policies, and increased demand across various industries. The size of the global

AI solution market increased at a CAGR of 34.0% from US$43.3bn in 2018 to US$139.5bn in 2022, and is expected to further increase at a CAGR of 33.5% from US$187.0bn in 2023 to US$1,414.2bn in 2030. The size of the AI solution market in China increased at a CAGR of 40.8% from US$3.5bn in 2018 to US$13.9bn in 2022, and is expected to further increase at a CAGR of 37.0% from US$18.5bn in 2023 to US$168.3bn in 2030.

Figure 13: Global and China AI solution market, 2018-2030E



Source: Frost & Sullivan Report, CMBIGM

Among the various sectors in the AI solutions market, the application of AI solutions in healthcare and material science (including agriculture, beauty and cosmetics, petrochemical, battery, and display sectors) is expected to grow significantly.

According to Frost & Sullivan, the size of the global market for AI solutions in the healthcare sector is expected to increase at a CAGR of 35.5% from US$13.7bn in 2022 to US$155.3bn in 2030; the size of the global market for AI solutions in the agriculture sector is expected to increase at a CAGR of 34.0% from US$5.4bn in 2022 to US$56.0bn in 2030; the size of the global market for AI solutions in the beauty and cosmetics sector is expected to increase at a CAGR of 34.0% from US$2.7bn in 2022 to US$28.1bn in 2030; the size of the global market for AI solutions in the petrochemical sector is expected to increase at a CAGR of 39.8% from US$1.4bn in 2022 to US$20.6bn in 2030; the size of the global market for AI solutions in the battery sector is expected to increase at a CAGR of 33.8% from US$3.8bn in 2022 to US$39.5bn in 2030; and the size of the global market for AI solutions in the display sector is expected to increase at a CAGR of 39.1% from US$0.1bn in 2022 to US$1.3bn in 2030.

Automation market

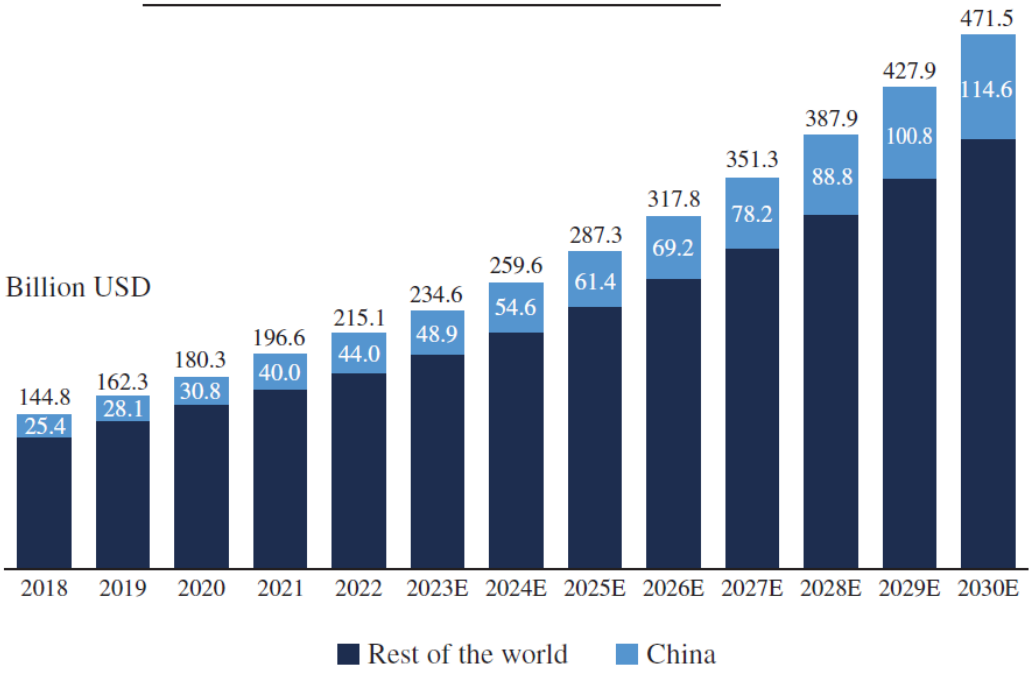
The global automation market is experiencing significant growth as industries increasingly embrace technology to streamline processes and improve efficiency. The automation market can be divided into the markets for industrial automation and lab automation. Industrial automation primarily refers to the incorporation of automation into end-to-end manufacturing processes, while lab automation primarily refers to the application of technology and services to automate various lab processes and tasks. The global penetration rate of lab automation is expected to increase from 3.7% in 2022 to 23.2% in 2030, according to Frost & Sullivan.

According to Frost & Sullivan, the size of the global automation market increased at a CAGR of 10.4% from US$144.8bn in 2018 to US$215.1bn in 2022. Driven by the advancements in robotic and AI technologies, the size of the global

automation market is expected to further increase at a CAGR of 10.5% from US$234.6bn in 2023 to US$471.5bn in 2030. The size of the automation market in China increased at a CAGR of 14.7% from US$25.4bn in 2018 to US$44.0bn in 2022, and is expected to further increase at a CAGR of 13.0% from US$48.9bn in 2023 to US$114.6bn in 2030.

Figure 14: Global and China automation market, 2018-2030E

CAGR	Global	China
2018-2022	10.4%	14.7%
2023E-2030E	10.5%	13.0%



Source: Frost & Sullivan Report, CMBIGM

Among the various sectors in the automation market, the application of automation in healthcare and material science (including, petrochemical, battery, and display sectors) is expected to grow significantly.

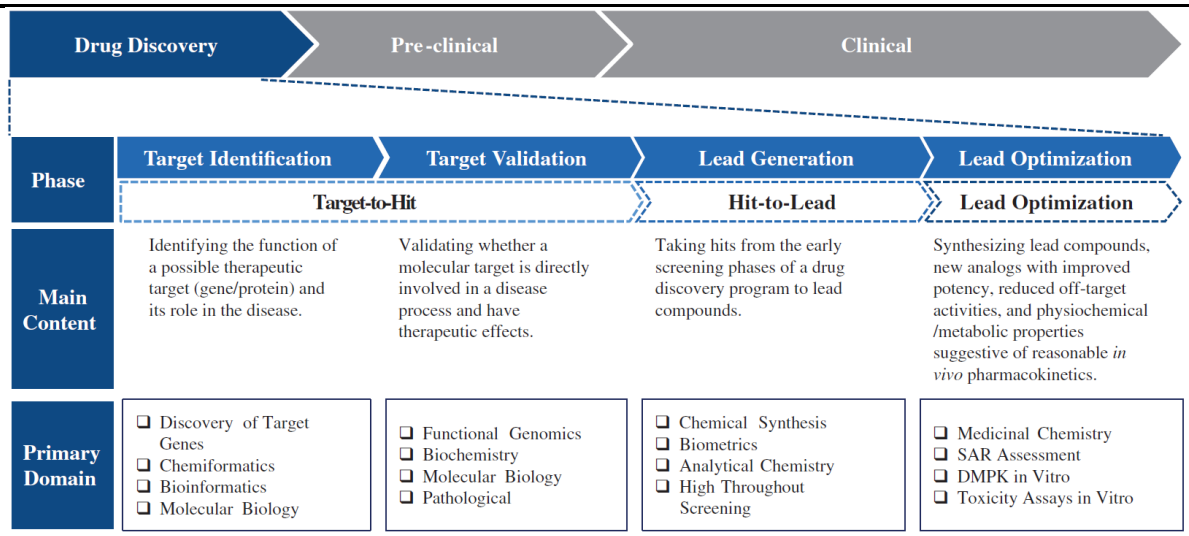
According to Frost & Sullivan, the size of the global market for automation in the healthcare sector is expected to increase at a CAGR of 19.2% from US$15.5bn in 2022 to US$63.2bn in 2030; the size of the global market for automation in the petrochemical sector is expected to increase at a CAGR of 11.0% from US$6.7bn in 2022 to US$15.3bn in 2030; the size of the global market for automation in the battery sector is expected to increase at a CAGR of 9.5% from US$10.4bn in 2022 to US$21.4bn in 2030; and the size of the global market for automation in the display sector is expected to increase at a CAGR of 9.9% from US$0.9bn in 2022 to US$2.0bn in 2030.

The drug R&D market

Drug R&D is a systematic process that requires interdisciplinary efforts to design safe, effective and commercially feasible drugs, which can be divided into three main stages: early drug discovery, pre-clinical studies, and clinical studies. Among all the stages, early drug discovery is the first step and is considered as fundamental to drug R&D.

There are four phases in drug discovery, from the initial phases of target identification and target validation ("target-to-hit"), to the later phases of lead generation ("hit-to-lead"), and lead optimization. Target identification is the process of identifying the direct molecular target, and target validation is the process of verifying the predicted molecular target. Lead generation is the process of evaluating target molecules and performing limited optimization to identify promising compounds, and lead optimization is the process of designing drug candidates after the initial target compounds have been identified.

Figure 15: Four phases of drug discovery



Source: Frost & Sullivan Report, CMBIGM. Note: (1) SAR: structure-activity relationship. (2) DMPK: drug metabolism and pharmacokinetics.

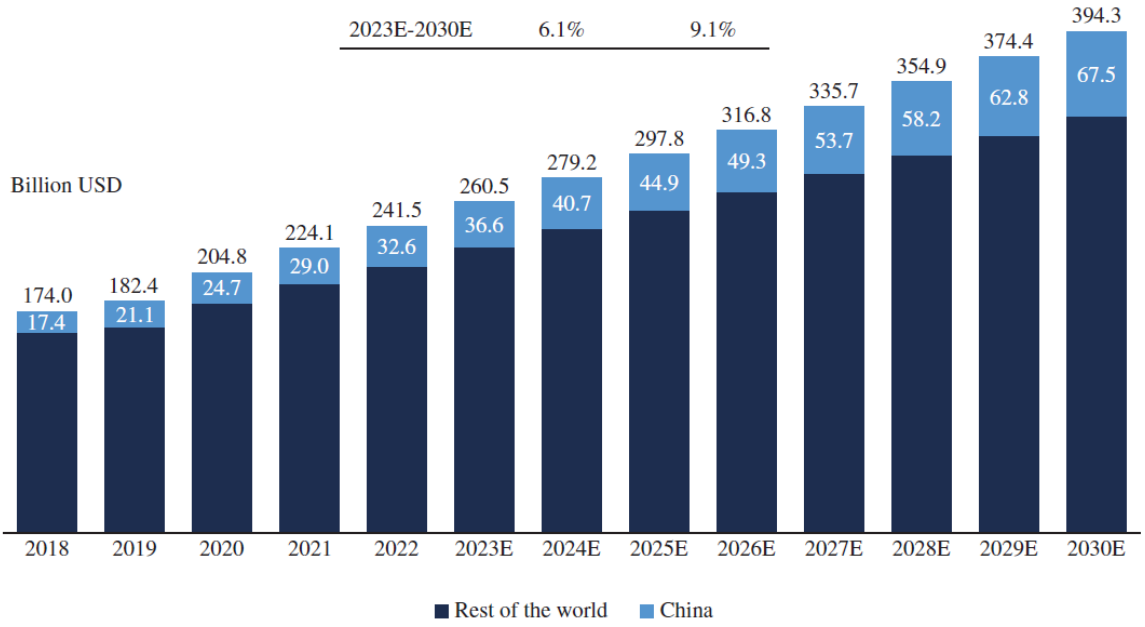
Global and China drug R&D expenditure

According to Frost & Sullivan, the global drug R&D expenditure has experienced rapid growth in recent years and is expected to continue increasing. It increased at a CAGR of 8.5% from US$174.0bn in 2018 to US$241.5bn in 2022, and is expected to further increase at a CAGR of 6.1% from US$260.5bn in 2023 to US$394.3bn in 2030.

Driven by increasing domestic technological advancements, robust government support, and a strategic emphasis on fostering innovation, drug R&D expenditure in China increased at a CAGR of 17.0% from US$17.4bn in 2018 to US$32.6bn in 2022, and is expected to further increase at a CAGR of 9.1% from US$36.6bn in 2023 to US$67.5bn in 2030, according to Frost & Sullivan.

Figure 16: Global and China drug R&D expenditure, 2018-2030E

CAGR	Global	China
2018-2022	8.5%	17.0%
2023E-2030E	6.1%	9.1%



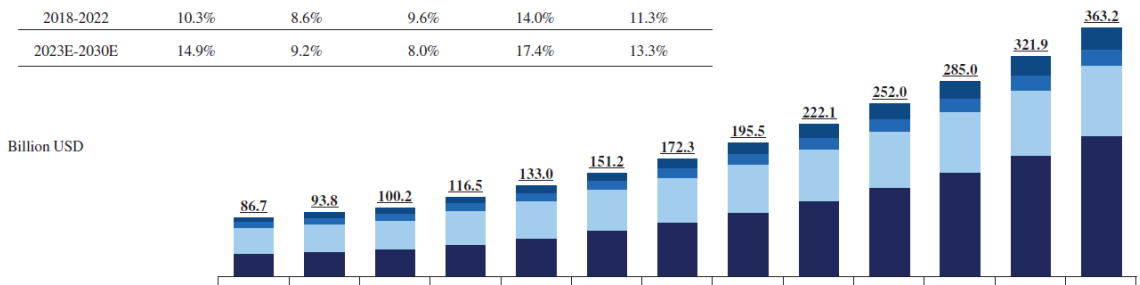
Source: Frost & Sullivan Report, CMBIGM

Global and China drug R&D outsourcing service markets

According to Frost & Sullivan, drug R&D outsourcing services includes CRO services for drug discovery, preclinical, clinical studies, and CMO/CDMO services for small molecular drugs and biologics. The size of the global drug R&D outsourcing service market increased at a CAGR of 11.3% from US$86.7bn in 2018 to US$133.0bn in 2022, and is expected to further increase at a CAGR of 13.3% from US$151.2bn in 2023 to US$363.2bn in 2030. In particular, the size of the global drug R&D outsourcing service market for drug discovery increased at a CAGR of 10.3% from US$7.6bn in 2018 to US$11.2bn in 2022, and is expected to further increase at a CAGR of 14.9% from US$12.3bn in 2023 to US$32.5bn in 2030.

Figure 17: Global drug R&D outsourcing service market, 2018-2030E

Period	Discovery	Preclinical	Clinical	CDMO	Total
2018-2022	10.3%	8.6%	9.6%	14.0%	11.3%
2023E-2030E	14.9%	9.2%	8.0%	17.4%	13.3%



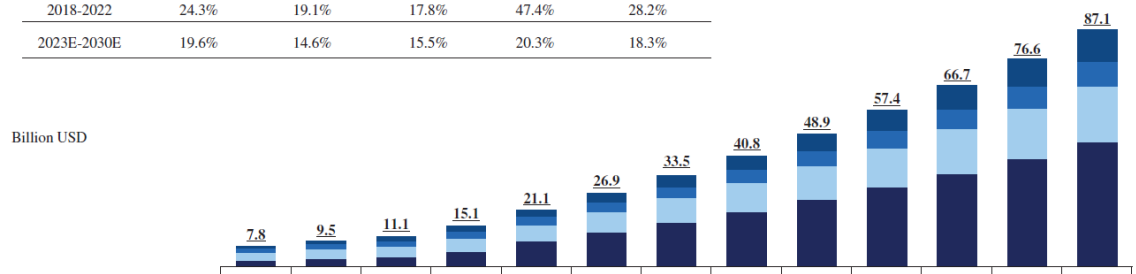
	2018	2019	2020	2021	2022	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Total	86.7	93.8	100.2	116.5	133.0	151.2	172.3	195.5	222.1	252.0	285.0	321.9	363.2
Discovery outsourcing services	7.6	8.5	9.2	10.2	11.2	12.3	14.7	17.1	19.8	22.7	25.8	29.1	32.5
Preclinical outsourcing services	8.4	9.1	9.5	10.6	11.7	12.9	14.2	15.5	17.0	18.5	20.2	22.0	23.9
Clinical outsourcing services	37.9	40.6	41.8	50.2	54.7	59.5	64.6	70.0	75.8	81.8	88.2	94.9	101.9
CMO/CDMO outsourcing services	32.8	35.6	39.7	45.5	55.4	66.5	78.9	92.9	109.6	128.9	150.8	175.9	204.9

Source: Frost & Sullivan Report, CMBIGM

According to Frost & Sullivan, the size of China's drug R&D outsourcing service market increased at a CAGR of 28.2% from US$7.8bn in 2018 to US$21.1bn in 2022, and is expected to further increase at a CAGR of 18.3% from US$26.9bn in 2023 to US$87.1bn in 2030. In particular, the size of drug R&D outsourcing service market for drug discovery in China increased at a CAGR of 24.3% from US$1.1bn in 2018 to US$1.4bn in 2022, and is expected to further increase at a CAGR of 19.6% from US$3.5bn in 2023 to US$12.2bn in 2030.

Figure 18: China's drug R&D outsourcing service market, 2018-2030E

Period	Discovery	Preclinical	Clinical	CDMO	Total
2018-2022	24.3%	19.1%	17.8%	47.4%	28.2%
2023E-2030E	19.6%	14.6%	15.5%	20.3%	18.3%



	2018	2019	2020	2021	2022	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
Total	7.8	9.5	11.1	15.1	21.1	26.9	33.5	40.8	48.9	57.4	66.7	76.6	87.1
Discovery outsourcing services	1.1	1.4	1.8	2.5	2.7	3.5	4.3	5.3	6.5	7.7	9.1	10.6	12.2
Preclinical outsourcing services	1.5	1.8	1.9	2.4	3.1	3.5	4.1	4.8	5.5	6.4	7.2	8.1	9.1
Clinical outsourcing services	3.2	3.7	3.8	5.1	6.1	7.4	9.1	10.8	12.5	14.5	16.5	18.5	20.3
CMO/CDMO outsourcing services[1]	1.9	2.6	3.5	5.2	9.1	12.5	15.9	19.9	24.4	28.9	33.8	39.4	45.6

Source: Frost & Sullivan Report, CMBIGM. Note: For CMO/CDMO outsourcing services, it only includes services for small molecular drugs and cell and gene therapies.

Application of AI in drug R&D

According to Frost & Sullivan, the traditional drug R&D process is costly and time-consuming, and generally takes at least approximately 10 years and over US$1bn of investments. In particular, it generally takes approximately one to two years and around US$400mn to US$450mn for the discovery of a single drug. Furthermore, one commercially viable drug is typically selected from thousands of compounds at drug discovery. The total cost of R&D activities for a new drug can reach US$2.6 bn.

However, the application of new technologies, such as AI, in drug R&D can significantly reduce the time and costs required, and improve the success rate. AI has been successfully applied in each step of the drug R&D process, and the feedback from drug R&D helps to refine the functionality of the AI-powered drug R&D platform and enrich AI database. In the process of learning and validation, algorithm, computing power and data, which are the three core elements of AI, can enhance each other and continually strengthen the AI-powered drug R&D platform. With the increasing adoption of AI across all stages of drug R&D, pharmaceutical companies worldwide have either built their own AI platforms or have formed collaborations with AI companies for drug R&D.

Application of quantum physics in AI-based drug R&D

According to Frost & Sullivan, along with the significant advancements in AI technology, big data and computing power, quantum physics-based computation, a physics-based method to pharmaceutical computation has gradually emerged. This method is originated from the first-principles of quantum physics, and can be used to calculate the interaction forces between drug molecules and target protein molecules at the microscopic particle level, such as molecules and atoms. Quantum physics-based computation is recognized as the next technological breakthrough, and is expected to make a great impact on the R&D of pharmaceutical interventions and therapeutics.

Unlike typical AI-based methods that require sufficient experimental data to train their AI models, quantum physics-based first-principles calculation can generate its own scalable data, overcoming the lack of data in early stages of AI-based drug R&D. Quantum physics-based methods can also substantially increase the accuracy of predictions and provide more relevant models of chemical and biological objects and their interactions.

Furthermore, quantum physics-based computation is able to compute properties of molecules beyond existing industry knowledge and data without any training sets, significantly improving early drug discovery. Quantum physics-based algorithms can also guide generative AI to efficiently discover innovative drug candidates on a larger scale in a more rapid and accurate manner.

Entry barriers of the AI-based drug R&D market

New entrants into the AI-based drug R&D market face the following entry barriers:

(1) Limited resources. The scarcity of experts in both AI algorithms and biomedical research is a significant challenge for new entrants seeking to design AI-based algorithms for drug R&D. Moreover, the expenses and lengthy validation cycles associated with the development and testing of AI-based algorithms further exacerbate difficulties in funding technological acquisitions.

(2) Lack of algorithms and models. Algorithms are critical for AI-based drug R&D, as excellent drug R&D models can significantly improve prediction accuracy. However, drug R&D models are usually complex, containing a large number of complex parameters and algorithms. Furthermore, a large amount of real-world data is crucial to further fine-tune the drug R&D models. As new entrants lack advanced AI capabilities and high quality data, they are unable to take advantage of the benefits brought by algorithms and AI model to outperform current market players in drug R&D.

(3) Competition with current market players. The AI-based drug R&D market is competitive, presenting formidable obstacles for new entrants to compete with established market players. Major players combine AI-powered dry lab with robotic wet lab to form an iterative feedback loop for one-stop drug R&D services, making it difficult for new entrants to introduce innovations and distinguish themselves from existing major players.

(4) Commercialization difficulties. The drug R&D process is complex and time-consuming, making it difficult for small companies to commercialize their R&D services. Furthermore, with customers' evolving requirements and needs as well as stringent data requirements, start-ups may find it challenging to meet customer expectations.

Growth drivers and future trends of the AI-based drug R&D market

The AI-based drug R&D market is expected to be driven and influenced by the following factors or trends according to Frost & Sullivan:

(1) Rise in demand to accelerate drug R&D. The world's aging population and rising incidence of diseases, such as cardiovascular, metabolic, cancer, and neurodegenerative conditions, are stimulating demand for novel therapeutics and more efficient drug discovery. Traditional drug R&D programs are not efficient, characterized by lengthy R&D cycles, high failure rates, and exorbitant costs. This marks a significant opportunity for AI-based drug R&D to revolutionize current approaches.

(2) Technological advancements in AI. The discovery of new drug candidates aided by AI is particularly critical for diseases that lack effective treatment options and have significant unmet needs. Recent developments in deep learning, neural networks, generative adversarial networks ("GANs"), and generative AIs have enabled AI to analyze vast quantities of data with greater complexity and higher speed. By simulating and predicting potential outcomes, AI is helping researchers to reduce the experimental labor required in drug R&D, while increasing the efficiency in identifying suitable drug targets. Ultimately, AI has the potential to significantly shorten the drug R&D process and lower costs by screening for molecules that are more likely to succeed.

(3) Increasing investments in AI-based drug R&D and collaboration with AI companies. Utilizing AI capabilities can significantly reduce both time and costs required in the drug R&D process, making it a highly advantageous strategy for multinational corporations ("MNCs"). Biotechnology and pharmaceutical multinational corporations have showed great interest in investing in or collaborating with AI-based drug R&D companies. With the increased realization of the benefits of AI integration, the demand for AI-based solutions is predicted to rise continuously, leading to further investment and collaboration in this field.

(4) Supportive regulatory framework. Favorable policies have been implemented to promote innovative solutions in healthcare industry, such as the "2017 Digital Health Innovation Action Plan" in the US. This plan encourages risk-based approaches to regulate digital health technology to foster innovation. Likewise, China has enacted several reform policies that aim to expedite the drug approval process.

(5) Data privacy and protection. AI start-ups and biotechnology and pharmaceutical companies are leveraging cloud-based platforms to share data. To ensure the compliance with regulations and to prevent data breaches, players will need to use advanced technologies, such as blockchain.

(6) Pipeline diversification. The advancement of AI-powered prediction tools has and will continue to enhance the accuracy and efficiency of drug R&D and pre-clinical testing, enabling new research directions and more strategic R&D approaches. As the volume of high-quality data and algorithms continues to grow, AI-based method will further minimize failures in drug R&D while enhance pipeline diversification, thereby generating a higher return on investments in drug R&D.

The solid-state R&D service market

Solid-state R&D is critical for the evaluation of the physical and chemical properties of solid materials. For instance, properties such as bioavailability, solubility, dissolution rate, and stability, are important for the success of a drug candidate, as they affect how well the drug will be absorbed by the human body and stored under required conditions.

It is necessary to have a comprehensive solid form screening to identify and characterize the most optimal salt/co-crystal and polymorph to select the most pharmacologically/physically viable crystal form, while protecting the drug from generic

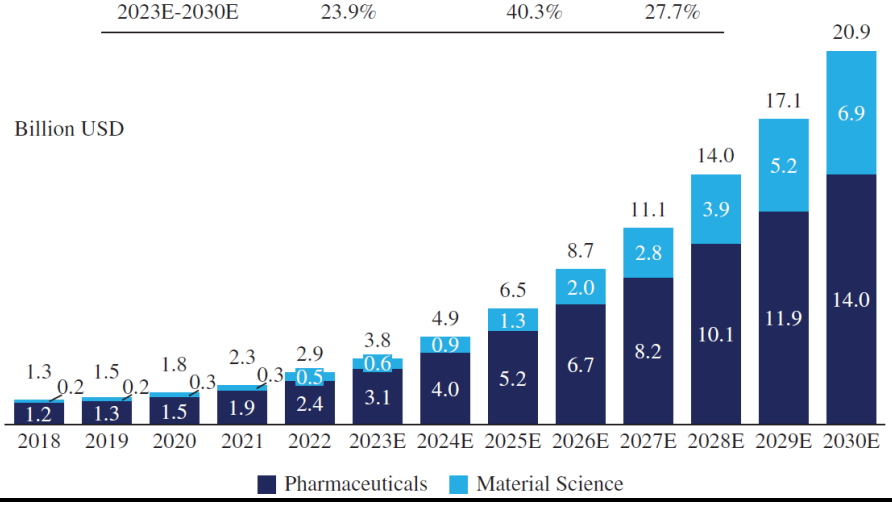
competition. A thorough solid-state R&D effort can help maximize the success rate of viable drug candidates and reduce the risk of excessive investments on less competent candidates.

Market size of the solid-state R&D service market

According to Frost & Sullivan, the global solid-state R&D service market consists of two segments: pharmaceuticals and material science. The size of the global solid-state R&D service market increased at a CAGR of 21.4% from US$1.3bn in 2018 to US$2.9bn in 2022, and is expected to further increase at a CAGR of 27.7% from US$3.8bn in 2023 to US$20.9bn in 2030.

Figure 19: Global solid-state R&D service market, 2018-2030E

CAGR	Pharmaceuticals	Material Science	Total
2018-2022	20.2%	28.7%	21.4%
2023E-2030E	23.9%	40.3%	27.7%



Source: Frost & Sullivan Report, CMBIGM

Application of new technologies in solid-state R&D services

According to Frost & Sullivan, traditional solid-state R&D methods are unable to effectively predict potentially correct crystal structures that will form a specific molecule with past data and publication. They can only screen and evaluate assays with a limited number of ligands, making it difficult to identify optimal salt or co-crystal and polymorph forms. Traditional solid-state R&D methods are also unable to determine a crystal structure accurately by manual analysis, and can only use experimental analysis to perform solid-state testing and analysis, which is insufficient for obtaining the detailed characteristics of a specific crystal form. Furthermore, traditional solid-state R&D methods can only address issues in the crystallization process by the “trial-and-error” method, requiring a large amount of time and costs.

Solid-state R&D involves five key aspects, which are (i) crystal structure prediction, (ii) solid-state screening and evaluation, (iii) crystal structure determination, (iv) solid-state testing and analysis and (v) crystallization process. Compared to traditional, experiment-only methods, the new technology-powered approach, in particular, the AI- and automation-powered approach, can establish a feedback loop between computational predictions and experimental validations, thus offering much higher efficacy and precision within a shorter period of time.

Figure 20: Advantages of the new technology-powered method over the traditional method in solid-state R&D

	Purpose	Traditional Method	New Technology Method
Crystal Structure Prediction	• To predict the potential correct crystal structures that will form from a given molecule based on first principles	• Cannot be effectively predicted by using past data and publications	• AI-powered CSP platform has the capability of computing all possible crystal forms and determine the stabilities with accuracy and efficiency at a faster speed
Solid-state Screening and Evaluation	• To identify the optimal salt / co-crystal and polymorph out of all possibilities	• Assay with only a limited number of ligands	• Computational screening expands the exploration of chemical space • AI-powered tool evaluate viability only on the most promising candidates
Crystal Structure Determination	• To determine the 3D structure of the single crystal	• Cannot be accurately determined with manual analysis using X-ray powder diffraction ("**XRPD**")	• 3D structure can be obtained with AI-powered analysis on an XRPD spectrum
Solid-state Testing and Analysis	• To test and analyze the detailed characteristics of a specific crystal form	• Experimental analysis, such as X-ray diffraction analysis, dynamic vapor sorption, and hot stage microscopy	• High-throughput properties screening driven by quantum physics-based simulations and ML • More thorough data analysis with AI-powered tools
Crystallization Process Development	• To identify the optimal crystallization conditions and process to scale up production	• Address issues by trial and error	• Predict and solve potential scale up issues based on the crystal's chemical / physical properties beforehand, reducing the number of trials needed, and involve auto lab to improve the experiment efficiency

Source: Frost & Sullivan Report, CMBIGM

Entry barriers of the solid-state R&D service market

According to Frost & Sullivan, new entrants into the solid-state R&D service market face the following entry barriers:

(1) Technical barrier. The development of drugs and new materials is a challenging, costly, and time-consuming process, particularly with regard to solid-state R&D. This is due to the technical difficulties involved in utilizing advanced crystal screening techniques to identify as many solid forms as possible while using minimal materials and time. Additionally, a deep understanding of solid-state R&D is necessary to accurately assess the market viability of crystal forms, by employing various characterization methods and research approaches to select the most advantageous forms for innovative pharmaceutical and new material enterprises. Furthermore, developing crystallization processes and conducting feasibility assessments of crystal forms in formulation development also involve techniques that would be challenging for new entrants.

(2) Lack of technical expertise. The solid-state R&D service industry demands a high level of technical expertise, which can only be accumulated from real-world work experience over an extended period, and hence the lack of experienced professionals in the industry. Solid-state R&D companies continually engage in numerous crystallization programs involving various compounds, enabling them to accumulate invaluable expertise and experience. This facilitates the continual enhancement of their technical proficiency in crystal form development, and the quality and efficiency of their services.

(3) Commercialization difficulties. The high risk and uncertainty in solid-state R&D services can prevent investments in new entrants. In addition, solid-state R&D, especially in regulated industries, such as the healthcare or energy industries, must comply with stringent regulatory requirements. Compliance with safety, quality, and environmental regulations can be complex and time-consuming, delaying the commercialization process for those new entrants unfamiliar with the regulatory framework.

Growth drivers and future trends of the solid-state R&D service market

According to Frost & Sullivan, the growth of the solid-state R&D service market is expected to be driven and influenced by the following factors or trends:

(1) Technological advancements. The development of new technologies, such as quantum physics and AI, has enabled faster and more cost-efficient solid-state R&D. AI-enabled solid-state R&D can speedily and exhaustively predict crystal forms and their characteristics, and provide critical insights for scientists to conduct targeted lab work to identify the most meaningful crystal structures. Consequently, AI-enabled solid-state R&D can increase the success rate, support critical R&D decision making, and significantly reduce the cycle of crystal structure research from at least several months or years to a mere few months or weeks.

(2) Increased outsourcing. Solid-state R&D services come in the early stage of drug R&D programs, including the profiling of crystallinity, stability, and solubility of novel molecules, thereby providing a developability assessment to support candidate nomination and ease the transition into pre-clinical development. Biotechnology and pharmaceutical companies are increasingly outsourcing R&D activities to third-party providers with the expertise and resources required for solid-state characterization, formulation optimization, and other related services. This trend is driven by the growing complexity of drug R&D and manufacturing, the need for specialized knowledge, and the capabilities to bring complex drugs to market.

(3) Expansion of application field. Solid-state R&D services, including crystal form screening and crystallization process development, play a vital role in many industries that require precise control over the properties of crystalline materials, in addition to the pharmaceutical industry. In the agrochemical industry, for example, solid-state R&D can help to optimize the active ingredients in pesticides, herbicides, and fertilizers. This can improve the efficacy, safety, and shelf life of these products. Furthermore, solid-state R&D services can contribute to the development of new materials with specific properties, such as high strength, durability or conductivity. These materials have been applied in industries, such as electronics and construction.

Competitive landscape of the solid-state R&D service market

Three types of companies are providing solid-state R&D services, namely (i) specialized solid-state CROs, (ii) large CROs, and (iii) AI-focused technology companies, like QuantumPharm. Due to the complexity and the amount of advanced equipment required for solid-state research, biotechnology and pharmaceutical companies often choose to outsource solid-state R&D.

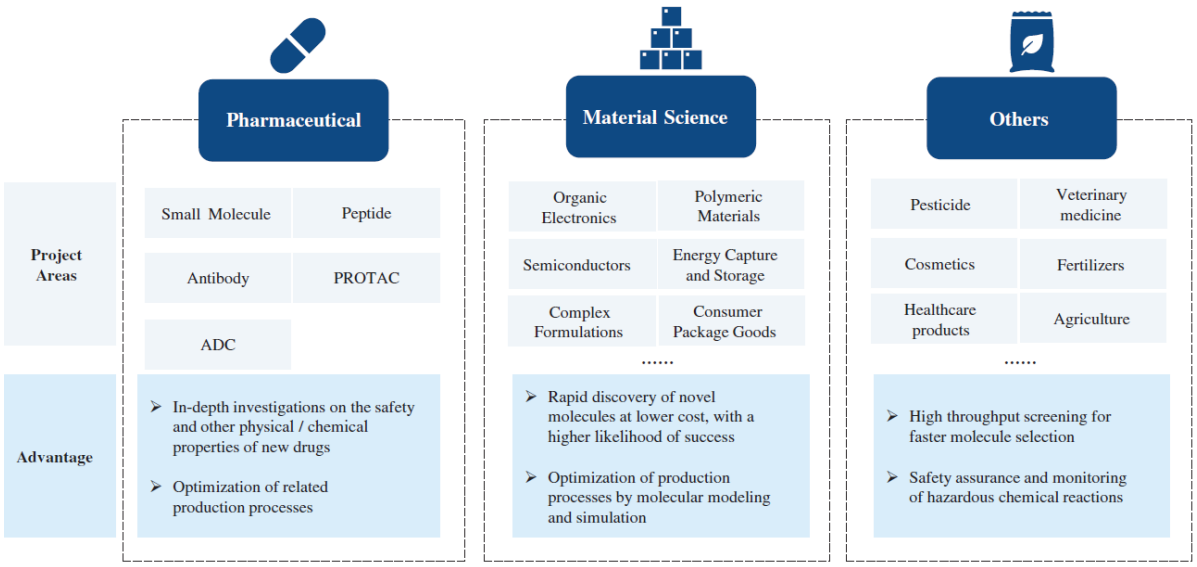
The automated R&D lab market

Automated R&D solutions apply automation technology to enable accelerated, higher throughput and more accurate wet lab processes, such as automated liquid handling, sample preparation, synthesis, and crystallization in a wide array of industries, including biopharmaceutical, chemical, and material industries. They can be used to analyze and optimize a large scale of data running 24 hours per day while ensuring occupational safety, enabling higher quality and efficiency in R&D.

Although automated reaction machinery is predominantly used in the pharmaceutical industry currently, the use of automated machinery is expected to increase across a wide range of other fields, including material science and agriculture. This cutting-edge technology has the potential to revolutionize the R&D process, shortening the time required to synthesize new molecules, and providing better reaction insights to optimize large-scale production.

The diagram below shows the addressable industries and the advantages of the application of automation in such industries.

Figure 21: Advantages of the application of automation in the addressable industries

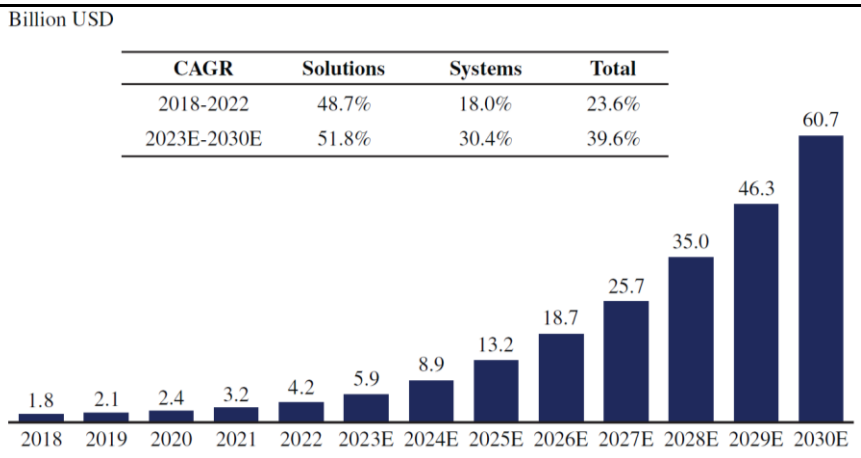


Source: Frost & Sullivan Report, CMBIGM

Market size of the automated R&D lab market

According to Frost & Sullivan, automated R&D labs can be used in three aspects of the R&D process, including (i) synthesis, (ii) crystallization and (iii) process control, by providing screening, condition control, quality assurance, in situ reaction analysis, real-time monitoring and data collection services. They can improve efficiency and precision in the R&D processes across various industries. The size of the global automated R&D lab market increased at a CAGR of 23.6% from US$1.8bn in 2018 to US$4.2bn in 2022, and is expected to further increase at a CAGR of 39.6% from US$5.9bn in 2023 to US$60.7bn in 2030.

Figure 22: Global automated R&D lab market, 2018-2030E



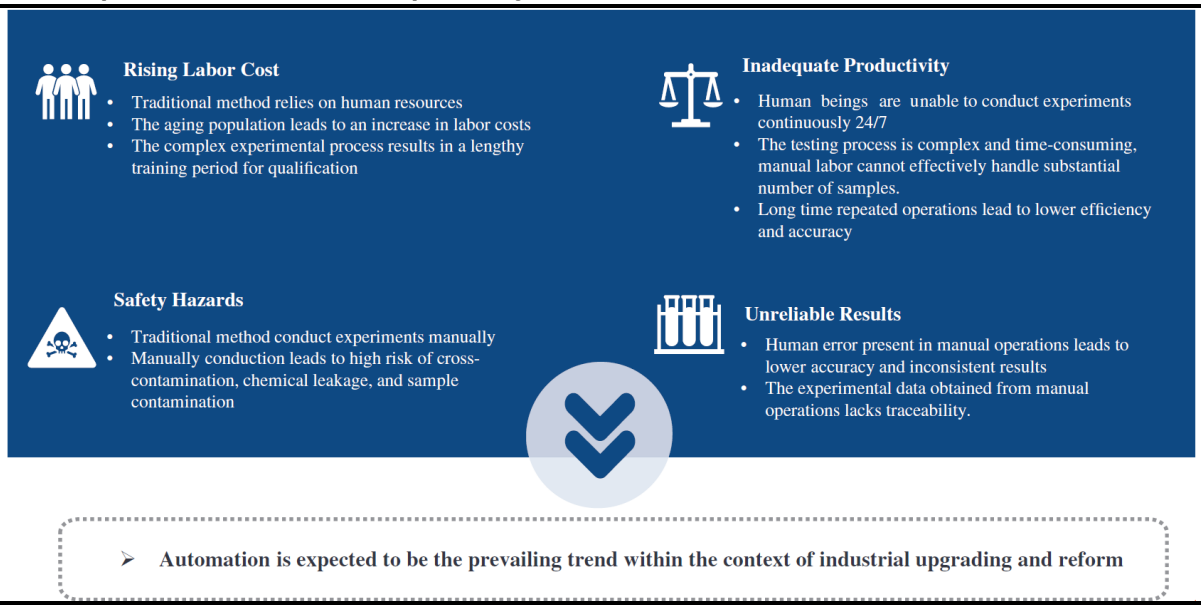
Source: Frost & Sullivan Report, CMBIGM

According to Frost & Sullivan, the pharmaceutical industry currently dominates the use of automated R&D labs and accounted for the largest market share, approximately 86.4% of the overall market in 2022. The global market for automated R&D labs is expected to experience rapid growth from 2022 to 2030, as the demand for automated R&D labs increases in various industries other than pharmaceutical, such as chemical and material science industries which manufacture pesticides, veterinary drugs, fertilizers, and cosmetics, among others. Apart from the pharmaceutical industry, other industries are expected to capture 44.5% of the global automated R&D lab market in 2030.

Application of automation in R&D

In traditional methods, 95% of the experimental operations rely heavily on manual testing, resulting in numerous drawbacks, such as increased labor costs, inadequate productivity, the risk of worker infections, among others, according to Frost & Sullivan. Automation is expected to be the prevailing trend in industrial upgrade and reform.

Figure 23: Pain points of traditional compound synthesis and research



Source: Frost & Sullivan Report, CMBIGM

With a confluence of technological breakthroughs and increasing integration and compatibility of technologies, automation has been widely employed across various industries, including pharmaceuticals and material science, among others, to achieve a more efficient, predictable, and high-throughput R&D process. Automation in R&D is applied in a wide array of areas, including, among others, drug and material science discovery, chemical synthesis, quality control, equipment and material handling, and data collection.

Advanced automation technologies can be used in the identification of new therapeutic compounds, optimization of chemical properties, and high throughout material screening, to streamline and accelerate the drug and new materials discovery process. By integrating robotic platforms, advanced instrumentation, and smart software, automation technologies can also be used to perform chemical reactions and synthesize compounds to streamline and enhance the efficiency of such process. Moreover, automation technologies can be used to capture and analyze real-time experimental data from various sources and platforms, and accelerate the analysis process by linking to shared analytical systems and combining with advanced analytics and ML. In addition, automation technologies can be applied to continuously monitor and assess safety parameters and potential risks in various lab environments and be employed in sensor-based monitoring, warning and alert systems, environmental conditions, and equipment and process monitoring.

Entry barriers of entering into the automated R&D lab market

According to Frost & Sullivan, new entrants into the automated R&D lab market face the following entry barriers:

(1) High investment. Establishing an automated R&D lab requires significant investment in infrastructure, equipment, and technology. This will require substantial upfront costs for acquiring advanced robotic systems, lab automation software, and analytical instruments, and future maintenance and upgrade costs, making it challenging for new entrants with limited financial resources to enter the market.

(2) Lack of technical expertise. The automated R&D lab market relies on sophisticated technologies, such as robotics, AI, and data analytics. New entrants need to possess the necessary technical knowledge and expertise to design,

develop and maintain these systems, where a large portion of the healthcare companies face difficulties in hiring competent R&D staff due to the shortage of relevant talents in the market.

(3) Competition with current market players. In the automated R&D lab market, there are already a number of established market players with well-known brands, extensive service offerings, and a strong market presence, creating a huge hurdle for new entrants to gain market share and compete with the established players. Pioneers have already automated their “wet labs” to improve R&D efficiency and prepare for large-scale production.

(4) Compatibility challenges with existing lab infrastructure. The process of integrating automated R&D lab with existing lab workflows, information systems, and data management platforms is complex. Costly and time-consuming training is required for lab staff who are unfamiliar with automation to use automated solutions. Compatibility issues, data transfer challenges, staff training, and the need for seamless integration will create obstacles for new entrants to establish smooth operation in an existing lab environment.

Growth drivers and future trends of the automated R&D lab market

The growth of the automated R&D lab market is expected to be driven and influenced by the following factors or trends:

(1) Industrial upgrade. Automation is the key to industrial upgrade and reform. Automated R&D lab offers significant advantages over traditional non-automated R&D labs, such as increased productivity, improved accuracy, scalability, and standardization, and lower costs, among others. These benefits help revolutionize lab workflows, enable researchers to optimize their operations and generate reliable data, and accelerate the pace of scientific discovery and innovation.

(2) Technological advancements. Technological advancements are one of the driving forces behind the rapid growth of lab automation. The continuous evolution of technologies, such as robotics, AI/ML, and cloud computing has revolutionized lab process. R&D automation lab equipped with robotics enable precise and efficient handling of experiments; AI and ML algorithms analyze complex datasets, providing valuable insights and supporting data-driven decision-making; and cloud computing empowers labs to interpret large volumes of data effectively. These technological advancements can optimize lab workflows, and enable scalability, increase efficiency and improve accuracy in laboratories.

(3) Integration of technologies. The integration of different technologies in the automated R&D lab is revolutionizing the way labs operate and improving efficiency, accuracy and productivity. Major market players offer a comprehensive and sophisticated solution for lab automation. The integration of AI, robotics, quantum physics-based first-principles computation, and cloud computing can enable researchers to optimize workflows, accelerate R&D processes, and produce exceeding outputs.

(4) Emphasis on data security. As the reliance on data for automated R&D lab increases, there is a growing focus on data security, privacy protection, and regulatory compliance. Market players are implementing comprehensive data management practices, encryption technologies, and compliance frameworks to ensure data integrity and meet regulatory requirements.

Competitive landscape of the automated R&D lab market

The global automated R&D lab market features several prominent players, all of whom offer specialized solutions and cutting-edge technologies. QuantumPharm is renowned for robust AI-powered automated solutions to analyze extensive datasets and monitor real-time experiment progress via digital LIMS systems. Other major market players can provide various diversified automation solutions, but have limited AI capabilities. As the industry continues to evolve, innovation, seamless integration of AI technologies, and customization will affect industry competition and market dynamics.

Major companies in the automated R&D lab market primarily offer automated equipment and/or high-throughput screening services but most of them are still using traditional automated robotic systems due to the lack of AI capabilities. Companies that are using traditional automated robotic systems have no or limited capabilities for intelligent data processing, and thus companies with AI-powered real-time experimental progress monitoring and data processing

capabilities, advanced AI-powered automated systems and digital LIMS are expected to outperform traditional automated R&D lab.

The material science R&D market

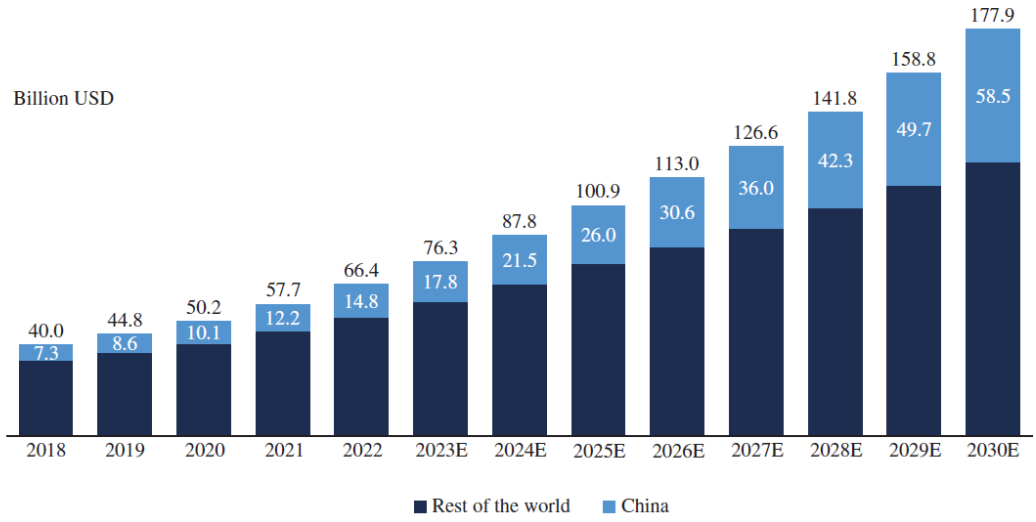
Material science is a multidisciplinary field that explores the properties, structure, performance, and processing of materials. Material science R&D aims to discover novel materials with enhanced and tailored properties, such as strength, conductivity, and flexibility. The development of new materials drives innovation in both research and technology in crucial areas, such as cosmetics, consumer packaged goods, petroleum, sustainable energy, microelectronics, and mobile electronics.

Market size of the material science R&D market

According to Frost & Sullivan, driven by the increasing demand for novel materials with enhanced properties and performance, global material science R&D expenditure increased at a CAGR of 13.5% from US$40.0bn in 2018 to US$66.4bn in 2022, and is expected to further increase at a CAGR of 12.8% from US$76.3bn in 2023 to US$177.9bn in 2030. Material science R&D expenditure in China increased at a CAGR of 19.3% from US$7.3bn in 2018 to US$14.8bn in 2022, and is expected to further increase at a CAGR of 18.5% from US$17.8bn in 2023 to US$58.5bn in 2030.

Figure 24: Global and China material science R&D expenditure, 2018-2030E

CAGR	Global	China
2018-2022	13.5%	19.3%
2023E-2030E	12.8%	18.5%



Source: Frost & Sullivan Report, CMBIGM

Application of new technologies in material science R&D

The traditional material science R&D process is a systematic approach covering scientific exploration, experimentation, assessment, and manufacturing. Currently, most material science R&D programs follow this established process, requiring a lengthy period before a concept attains market viability. Empowered by the advancements in cutting-edge technologies and the increasing adoption of big data analytics, computational material science and engineering has emerged as a prominent subfield in material science R&D, which is expected to revolutionize the discovery of new materials, reduce R&D time and costs, and accelerate the application of new materials into commercial products.

Growth drivers and future trends of the material science R&D market

The growth of the material science R&D market is expected to be driven and influenced by the following factors or trends:

(1) Advanced materials for sustainable applications. Increasing emphasis on sustainability is driving the development of advanced materials with reduced environmental impact, such as bio-based materials. Consequently, the current material science R&D is likely to shift its emphasis from petroleum-based materials to bio-based materials.

(2) Data-driven approaches and AI-driven methods. Material science R&D is inherently time-consuming, as it relies on the traditional “trial-and-error” method of experimentation to implement R&D activities. The use of data analytics and ML techniques will accelerate the process of discovery, optimization, and characterization of materials.

(3) Collaboration and interdisciplinary R&D. Collaboration and interdisciplinary R&D as well as academia-industry partnerships will drive innovation in material science R&D by exchanging knowledge, ideas, and methodologies across disciplines, fostering a comprehensive understanding of materials, and enabling the development of novel functionalities.

Financial Analysis

We expect QuantumPharm's total revenue to reach RMB306mn/ 562mn/ 911mn in FY24E/ 25E/ 26E, with the increase driven by small molecule drug discovery and automated chemical synthesis businesses.

Figure 25: Revenue forecasts

(YE 31 Dec) RMB mn	2023A	2024E	2025E	2026E
Drug Discovery Solutions	**88**	**148**	**300**	**481**
Intelligent Automation Solutions	**87**	**158**	**262**	**430**
Solid-stage R&D services	42	60	85	123
Automated chemical synthesis	44	84	154	269
Others	1	14	24	39
Total Revenue	**174**	**306**	**562**	**911**
YoY	*31%*	*75%*	*84%*	*62%*

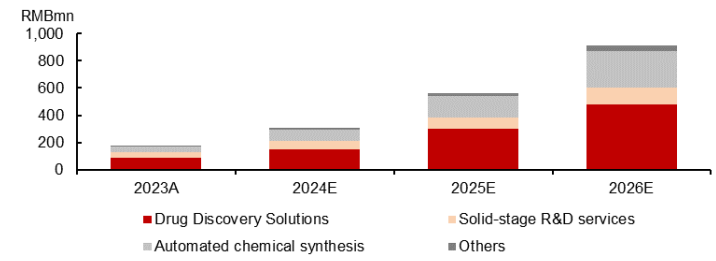
Source: Company data, CMBIGM estimates.

Figure 26: Revenue breakdown

(YE 31 Dec) RMB mn	2023A	2024E	2025E	2026E
Drug Discovery Solutions	**50%**	**48%**	**53%**	**53%**
Intelligent Automation Solutions	**50%**	**52%**	**47%**	**47%**
Solid-stage R&D services	24%	20%	15%	13%
Automated chemical synthesis	25%	27%	27%	29%
Others	0%	5%	4%	4%
Total Revenue	**100%**	**100%**	**100%**	**100%**

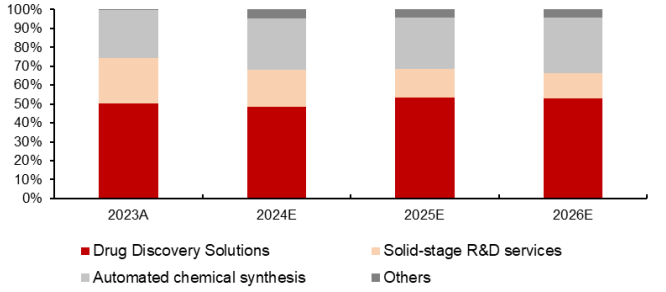
Source: Company data, CMBIGM estimates.

Figure 27: Revenue forecast



Source: Company data, CMBIGM estimates

Figure 28: Revenue breakdown



Source: Company data, CMBIGM estimates

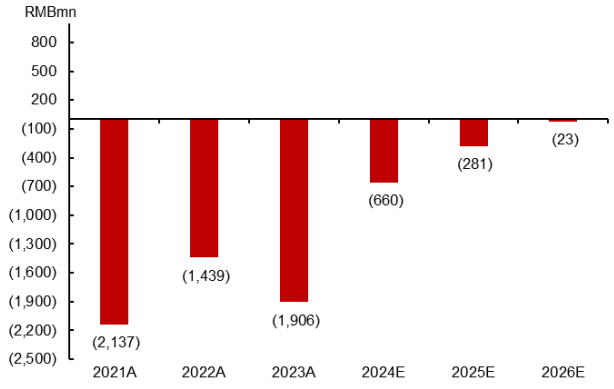
QuantumPharm recorded net losses of RMB1,439mn and RMB1,906mn in FY22A/ 23A, respectively. We expect the Company to book attributable net losses of RMB660/ 281mn/ 23mn in FY24E/ 25E /26E.

Figure 29: P&L forecasts

(YE 31 Dec) RMB mn	2021A	2022A	2023A	2024E	2025E	2026E
Revenue	**63**	**133**	**174**	**306**	**562**	**911**
YoY	*76%*	*112%*	*31%*	*75%*	*84%*	*62%*
Research and development expenses	(213)	(359)	(481)	(420)	(370)	(410)
% of revenue	*339%*	*269%*	*276%*	*137%*	*66%*	*45%*
General and administrative expenses	(137)	(204)	(296)	(350)	(250)	(228)
% of revenue	*218%*	*153%*	*170%*	*114%*	*44%*	*25%*
Contract fulfillment costs	(30)	(67)	(126)	(185)	(197)	(237)
% of revenue	*48%*	*50%*	*72%*	*60%*	*35%*	*26%*
Selling and marketing expenses	(27)	(40)	(62)	(73)	(89)	(117)
% of revenue	*44%*	*30%*	*36%*	*24%*	*16%*	*13%*
Profit/(loss) before tax	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**
Income tax benefit (expense)	0	0	0	0	0	0
Profit/(loss) for the year	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**
Attributable net profit/(loss)	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**

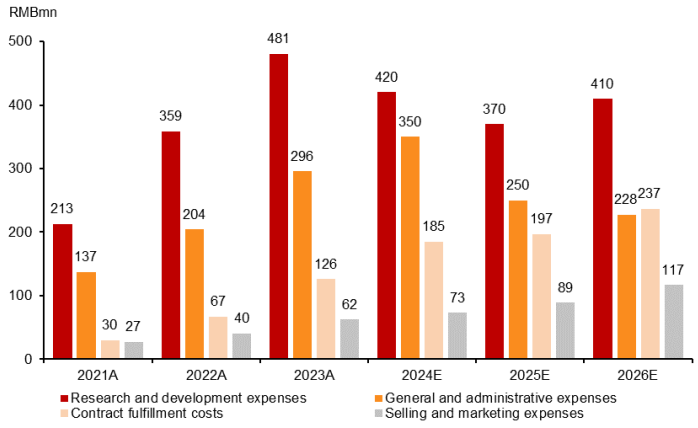
Source: Company data, CMBIGM estimates

Figure 30: Net profit (loss) forecasts



Source: Company data, CMBIGM estimates

Figure 31: SG&A expenses forecasts



Source: Company data, CMBIGM estimates

Financial Summary

INCOME STATEMENT	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec (RMB mn)						
Revenue	**63**	**133**	**174**	**306**	**562**	**911**
Selling expense	(27)	(40)	(62)	(73)	(89)	(117)
Admin expense	(137)	(204)	(296)	(350)	(250)	(228)
R&D expense	(213)	(359)	(481)	(420)	(370)	(410)
Others	(30)	(67)	(126)	(185)	(197)	(237)
Operating profit	**(299)**	**(525)**	**(722)**	**(692)**	**(313)**	**(50)**
Other income	9	21	28	15	15	15
Other gains/(losses)	37	(8)	41	15	15	15
Interest income	14	50	103	43	43	39
Interest expense	(4)	(6)	(10)	(12)	(12)	(12)
Others	(1,848)	(958)	(1,277)	0	0	0
Pre-tax profit	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**
Income tax	0	0	0	0	0	0
Minority interest	(0)	(0)	0	0	0	0
Adjusted net profit	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**

BALANCE SHEET	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec (RMB mn)						
Current assets	**3,920**	**3,597**	**2,945**	**3,349**	**3,065**	**3,054**
Cash & equivalents	3,524	574	711	1,588	1,952	1,874
Restricted cash	13	5	2	2	2	2
Account receivables	31	38	39	65	117	185
Prepayment	30	52	41	41	41	41
ST bank deposits	305	2,538	1,251	751	51	51
Financial assets at FVTPL	0	356	863	863	863	863
Other current assets	17	33	38	38	38	38
Non-current assets	**462**	**719**	**1,060**	**1,056**	**1,060**	**1,055**
PP&E	177	318	370	365	370	365
Right-of-use assets	94	78	189	189	189	189
Intangibles	5	7	8	8	8	8
Financial assets at FVTPL	170	285	424	424	424	424
Other non-current assets	16	33	69	69	69	69
Total assets	**4,382**	**4,316**	**4,006**	**4,405**	**4,126**	**4,110**
Current liabilities	**161**	**198**	**297**	**314**	**316**	**323**
Short-term borrowings	22	36	60	60	60	60
Account payables	11	14	14	30	32	39
Other current liabilities	101	108	139	139	139	139
Lease liabilities	17	24	59	59	59	59
Contract liabilities	10	16	26	26	26	26
Non-current liabilities	**7,825**	**9,428**	**10,950**	**169**	**169**	**169**
Long-term borrowings	11	0	0	0	0	0
Convertible bonds	7,701	9,321	10,780	0	0	0
Other non-current liabilities	113	107	169	169	169	169
Total liabilities	**7,986**	**9,626**	**11,247**	**483**	**485**	**492**
Share capital	0	0	0	0	0	0
Retained earnings	(3,684)	(5,126)	(7,040)	(7,700)	(7,982)	(8,004)
Other reserves	75	(202)	(227)	11,596	11,596	11,596
Total shareholders equity	**(3,609)**	**(5,328)**	**(7,267)**	**3,896**	**3,614**	**3,592**
Minority interest	5	18	26	26	26	26
Total equity and liabilities	**(3,604)**	**(5,310)**	**(7,241)**	**3,922**	**3,640**	**3,618**

CASH FLOW	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec (RMB mn)						
Operating						
Profit before taxation	**(2,137)**	**(1,439)**	**(1,906)**	**(660)**	**(281)**	**(23)**
Depreciation & amortization	23	69	122	55	55	55
Tax paid	0	0	0	0	0	0
Change in working capital	20	(22)	(13)	(10)	(50)	(61)
Others	1,841	963	1,231	(32)	(32)	(28)
Net cash from operations	**(254)**	**(429)**	**(568)**	**(647)**	**(308)**	**(57)**
Investing						
Capital expenditure	(161)	(193)	(124)	(50)	(60)	(50)
Net proceeds from disposal of short-term investments	166	(207)	3,601	500	700	0
Others	(76)	(2,357)	(2,742)	43	43	39
Net cash from investing	**(70)**	**(2,758)**	**736**	**493**	**683**	**(11)**
Financing						
Dividend paid	0	0	0	0	0	0
Net borrowings	20	25	60	0	0	0
Proceeds from share issues	2,480	0	0	1,043	0	0
Others	(24)	33	(86)	(12)	(12)	(12)
Net cash from financing	**2,476**	**58**	**(26)**	**1,031**	**(12)**	**(12)**
Net change in cash						
Cash at the beginning of the year	1,431	3,524	574	711	1,588	1,952
Exchange difference	(59)	179	(6)	0	0	0
Cash at the end of the year	**3,524**	**574**	**711**	**1,588**	**1,952**	**1,874**

GROWTH	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec						
Revenue	76.2%	112.3%	30.8%	75.5%	83.8%	62.0%

PROFITABILITY	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec						
Operating margin	(476.8%)	(393.9%)	(414.1%)	(225.9%)	(55.7%)	(5.5%)
Adj. net profit margin	(3,403.4%)	(1,078.7%)	(1,092.9%)	(215.6%)	(50.0%)	(2.5%)

GEARING/LIQUIDITY/ACTIVITIES	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec						
Current ratio (x)	24.4	18.2	9.9	10.7	9.7	9.5

VALUATION	2021A	2022A	2023A	2024E	2025E	2026E
YE 31 Dec						

Source: Company data, CMBIGM estimates. Note: The calculation of net cash includes financial assets.

Valuation

Base case DCF model derives target price of HK$7.25

We see DCF as appropriate in valuing the Company. We derived our target price of HK$7.25 based on a DCF model (WACC: 9.79%, terminal growth rate: 4.0%).

Figure 32: Base case risk-adjusted DCF valuation

DCF Valuation (RMB mn)	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E	2035E
EBIT	**-692**	**-313**	**-50**	**132**	**513**	**955**	**1,372**	**1,853**	**2,244**	**2,596**	**2,980**	**3,371**
Tax rate	*0%*	*0%*	*0%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
EBIT*(1-tax rate)	-692	-313	-50	112	436	812	1,166	1,575	1,907	2,206	2,533	2,865
+ D&A	55	55	55	54	54	53	53	52	52	52	52	51
- Change in working capital	-10	-50	-61	-78	-108	-124	-117	-108	-104	-77	-76	-65
- Capex	-50	-60	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
FCFF	**-697**	**-368**	**-107**	**38**	**332**	**691**	**1,052**	**1,470**	**1,805**	**2,131**	**2,459**	**2,801**
Terminal value												**50,324**

Total PV (RMB mn)	20,671
Net debt	-2,086
Minority interest (RMB mn)	26
Equity value (RMB mn)	**22,730**
Equity value (HK$ mn)	**24,707**
Equity value (US$ mn)	**3,168**
No. of shares (mn)	**3,407**
DCF per share (HK$)	**7.25**
Terminal growth rate	**4.0%**
WACC	**9.79%**
Cost of equity	13.0%
Cost of debt	4.5%
Equity beta	1.0
Risk free rate	2.5%
Market risk premium	10.5%
Target debt to asset ratio	35.0%
Effective corporate tax rate	15.0%

Source: CMBIGM estimates

Figure 33: Sensitivity analysis (HK$)

		WACC				
		8.79%	**9.29%**	**9.79%**	**10.29%**	**10.79%**
	5.0%	11.18	9.62	**8.41**	7.43	6.63
	4.5%	10.09	8.80	7.77	6.93	6.23
Terminal growth rate	**4.0%**	9.23	8.14	**7.25**	6.51	5.89
	3.5%	8.53	7.59	6.81	6.16	5.60
	3.0%	7.95	7.13	**6.44**	5.85	5.34

Source: Company data, CMBIGM estimates

Investment Risks

Risks related to research and development

The Company's commercial success depends on its closed-loop integrated technology platform and technological capabilities, and their acceptance by its customers and collaborators. Failure to maintain its technological advantages or gain market acceptance of the platform or technology may have a material and adverse impact on the Company's commercial success. The Company intends to continue investing significantly in R&D, which may adversely impact its profitability and operating cash flow in the short term and may not generate the results the Company expects to achieve.

Risks related to the commercialization of its solutions and services

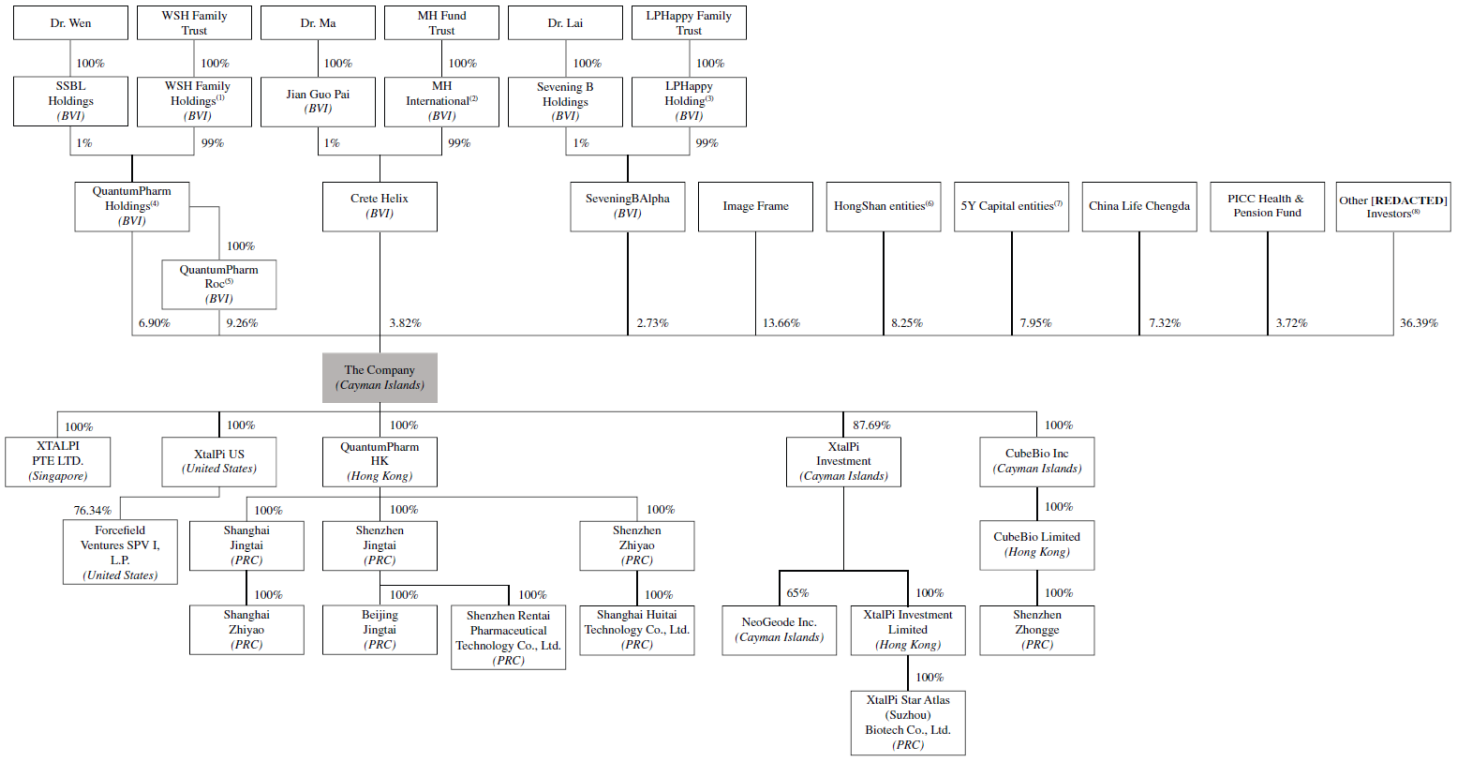
QuantumPharm has a limited operating history, which may make it difficult to evaluate its current business and predict the future performance. The size of the addressable markets and the demand for the Company's solutions and services may not increase as rapidly as anticipated due to a variety of factors, which could materially and adversely affect business, results of operations, financial condition and prospects. QuantumPharm has limited experience in the commercialization of its solutions and services. If its customers or collaborators are unable to successfully complete clinical development, obtain regulatory approval for, or commercialize any product candidates, or experience delays in doing so, its business may be materially harmed.

Risks related to operations

If the Company fails to manage its technology infrastructure, customers and collaborators may experience service outages and delays in the deployment of its solutions and services. Data corruption, cyber-based attacks or network security breaches may materially and adversely affect its reputation, business, financial condition, results of operations and prospects.

Appendix: Company Profile

Figure 34: Shareholding structure



Source: Company data, CMBIGM. Note: For detailed shareholding structure after completion of IPO, please refer to Company's announcement on 12 Jun 2024 (link1, link2).

Figure 35: Directors and management profile

Name	Age	Position	Roles and responsibilities
Dr. Wen Shuhao	42	Executive Director and Chairman of Board	Overseeing overall global business management and strategies in the capital markets
Dr. Ma Jian	39	Executive Director and Chief Executive Officer	Overseeing overall operation and management
Dr. Lai Lipeng	40	Executive Director and Chief Innovation Officer	Overseeing artificial intelligence development
Dr. Jiang Yide	59	Executive Director and Chief Strategic Officer	Overseeing strategic development including identification of growth opportunities, strategic planning and execution
Dr. Zhang Peiyu	40	Chief Scientific Officer	Overseeing scientific research operations
Mr. Tam Man Hong	46	Chief Financial Officer	Overseeing fundraising and corporate finance transactions, investor relations, financial reporting, legal and compliance, intellectual properties, strategic formulation and business development

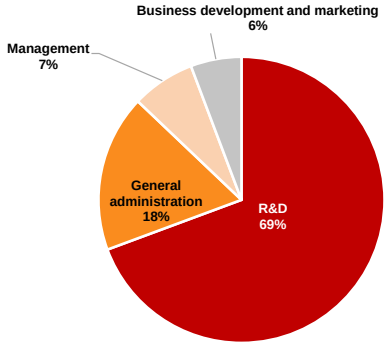
Source: Company data

Figure 36: Employee structure

Function	# of staff	% of total staff
R&D	543	69%
General administration	139	18%
Management	56	7%
Business development and marketing	45	6%
Total	**783**	**100%**

Source: Company data (as of 31 Dec 2023)

Figure 37: Employee number breakdown



Source: Company data (as of 31 Dec 2023)

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