

Global 4D Proton Therapy System Market Growth 2026-2032

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Abstracts

The global 4D Proton Therapy System market size is predicted to grow from US\$ 301 million in 2025 to US\$ 545 million in 2032; it is expected to grow at a CAGR of 8.2% from 2026 to 2032.

In 2025, the global production volume of 4D proton therapy systems is approximately 875 units, with an average global market price of around \$352,000 per unit. The total global production capacity for these systems is estimated to reach approximately 1,600 units in 2025. The average gross profit margin for the industry is approximately 49%. A 4D proton therapy system is an integrated treatment system that builds upon standard proton radiotherapy by incorporating positional changes of tumors and normal organs—caused by respiration, heartbeat, or other physiological movements—into the entire process of simulation, treatment planning, image guidance, dose calculation, and beam delivery. The term "4D" refers to three spatial dimensions plus the time dimension; it does not denote a new type of proton. Such systems typically comprise a cyclotron or synchrotron, energy selection and beam transport devices, a gantry, a pencil-beam scanning system, 4D CT or 4D cone-beam CT (CBCT), a treatment planning system, respiratory monitoring equipment, patient positioning systems, and software for gating, breath-holding, rescanning, or real-time tracking. Proton beams are characterized by a finite range and the Bragg peak, allowing for high-dose concentration at the target depth while minimizing the dose to distal normal tissues; however, their dose distribution is sensitive to variations in tissue density and motion, making 4D motion management particularly crucial for treating tumors in the lung, liver, pancreas, and the thoracic or abdominal regions. The IAEA identifies respiratory gating, 4D planning, verification imaging, and intra-treatment target visualization as key components of advanced radiotherapy capabilities.

The upstream supply chain primarily encompasses large-scale core equipment—such as cyclotrons, synchrotrons, superconducting magnets, RF systems, ion sources, vacuum equipment, beam transport magnets, energy selection systems, and gantries—as well as components like pencil-beam scanning magnets, dose-monitoring ionization chambers, position detectors, and rapid beam switches. 4D functionality also relies on CT detectors, flat-panel detectors, CBCT systems, respiratory pressure belts, optical surface monitoring equipment, infrared markers, implanted fiducials, and patient immobilization devices. Upstream software and algorithms include those for 4D image reconstruction, deformable image registration, proton range calculation, robust optimization, motion prediction, and dose accumulation. Because proton range is affected by changes in patient tissue density and anatomical positioning, upstream components must ensure precision in beam energy, position, and dosage while maintaining high temporal responsiveness to accurately synchronize respiratory signals, imaging, and proton beam switching. Proton therapy centers also typically require comprehensive dosimetry and quality assurance equipment to commission and periodically verify the accelerator, imaging, and beam delivery systems. The midstream of the industry chain comprises manufacturers of proton therapy systems, medical imaging companies, treatment planning software vendors, and hospital engineering integrators; they are primarily responsible for the integrated assembly of accelerators, rotating gantries, pencil beam scanning (PBS) systems, image guidance, patient positioning, treatment planning, and motion management systems. Typical workflows involve 4D CT simulation and localization, image reconstruction across respiratory phases, tumor motion assessment, robust treatment planning, pre-treatment image verification, and intra-treatment techniques such as respiratory gating, breath-holding, and volumetric (layer or voxel) rescanning. Compared to photon therapy, scanning proton beams can give rise to an "interplay effect"—where the beam scanning pattern interacts with tumor motion—potentially leading to localized dose overdoses or underdoses; consequently, midstream vendors must mitigate these risks through faster scanning speeds, multiple rescanning, respiratory synchronization, and 4D dose calculation. 4D-CBCT is being investigated for daily internal motion monitoring during PBS proton therapy, and existing commercial proton platforms are continuously upgrading their gantry-mounted CBCT and adaptive therapy capabilities. The downstream sector primarily includes large general hospitals, specialized cancer hospitals, regional proton therapy centers, pediatric oncology centers, and research institutions. 4D proton therapy is primarily utilized for lung, liver, pancreatic, and esophageal cancers, as well as thoracic and abdominal tumors and cases involving organs adjacent to critical structures like the heart, lungs, or gastrointestinal tract; it is also suitable for pediatric and young patients requiring reduced low-dose exposure to healthy tissue. When procuring these systems, hospitals

must comprehensively evaluate factors such as the number of treatment rooms, proton energy range, PBS speed, image guidance configurations, motion management capabilities, treatment planning software, quality control systems, and long-term maintenance services. These systems are not merely standalone pieces of equipment but comprehensive clinical solutions encompassing simulation, planning, treatment delivery, imaging, and quality control; compact single-room systems coexist with multi-room proton centers. Future downstream demand will drive system evolution toward real-time imaging, online adaptive proton therapy, markerless motion tracking, faster scanning, and AI-assisted planning; however, widespread adoption remains constrained by high capital investment, specialized facility construction, the need for skilled clinical teams, and rigorous quality assurance requirements. IBA's current single-room system integrates PBS and CBCT, positioning itself for image-guided intensity-modulated proton therapy.

Proton beams offer the advantages of a finite range and the Bragg peak, allowing for reduced radiation doses to normal tissues distal to the target; however, their dose distribution is also more susceptible to the effects of respiration, organ deformation, and tissue density variations. For tumors exhibiting significant motion—such as those in the lung, liver, pancreas, and esophagus—relying solely on static 3D planning may result in range shifts or target dose under-coverage. Consequently, clinical facilities must incorporate the temporal dimension into treatment planning and dose verification through methods such as 4D CT, breath-holding, respiratory gating, and motion-robust optimization. Clinical consensus from PTCOG also emphasizes the use of 4D CT to assess thoracic tumor motion and the implementation of motion mitigation strategies and 4D robustness evaluations as needed.

Pencil beam scanning allows for precise control over the position, depth, and intensity of proton beam spots; however, under free-breathing conditions, an "interplay effect" between the scanning beam and tumor motion can occur, leading to localized dose hotspots or cold spots. As proton therapy centers increasingly adopt scanning beams to replace traditional passive scattering, techniques such as respiratory gating, deep-inspiration breath-hold (DIBH), layered rescanning, and volumetric rescanning are becoming standard features. Existing commercial systems already support various motion management strategies—including breath-hold, free-breathing, gating, and layered rescanning—indicating that 4D capabilities are shifting from optional add-ons to integral components of scanning proton therapy.

Currently, most 4D proton therapy relies on pre-treatment 4D CT, motion envelopes, robust planning, and pre-treatment image verification. Future systems will enhance

capabilities such as gantry-mounted CBCT, respiratory phase imaging, real-time tumor tracking, rapid beam switching, and online plan re-optimization, enabling dynamic adjustment of proton beam delivery based on the patient's daily anatomy and respiratory status. Technological competition will focus on faster energy layer switching, higher scanning speeds, low-latency gating, 4D dose accumulation, and online range verification. PTCOG has identified 4D plan optimization, motion modeling, image guidance, and real-time adaptive radiotherapy as key frontiers in scanning proton therapy.

Report Scope

LP Information, Inc. (LPI) ' newest research report, the "4D Proton Therapy System Industry Forecast" looks at past sales and reviews total world 4D Proton Therapy System sales in 2025, providing a comprehensive analysis by region and market sector of projected 4D Proton Therapy System sales for 2026 through 2032. With 4D Proton Therapy System sales broken down by region, market sector and sub-sector, this report provides a detailed analysis in US\$ millions of the world 4D Proton Therapy System industry.

This Insight Report provides a comprehensive analysis of the global 4D Proton Therapy System landscape and highlights key trends related to product segmentation, company formation, revenue, and market share, latest development, and M&A activity. This report also analyzes the strategies of leading global companies with a focus on 4D Proton Therapy System portfolios and capabilities, market entry strategies, market positions, and geographic footprints, to better understand these firms' unique position in an accelerating global 4D Proton Therapy System market.

This Insight Report evaluates the key market trends, drivers, and affecting factors shaping the global outlook for 4D Proton Therapy System and breaks down the forecast by Type, by Application, geography, and market size to highlight emerging pockets of opportunity. With a transparent methodology based on hundreds of bottom-up qualitative and quantitative market inputs, this study forecast offers a highly nuanced view of the current state and future trajectory in the global 4D Proton Therapy System.

This report presents a comprehensive overview, market shares, and growth opportunities of 4D Proton Therapy System market by product type, application, key manufacturers and key regions and countries.

Market Segmentation

Segmentation by Type:

Fixed

Mobile

Segmentation by Motion Management Method:

Internal Target Volume (ITV)

Respiratory Gating

Others

Segmentation by Motion Signal Source:

External Marker Monitoring

Surface Imaging

Implanted Marker

Electromagnetic Tracking

Segmentation by Image-guided Technology:

4D CT Simulation/Localization

4D Cone-beam CT

Orthogonal X-ray Tracking

Real-time MRI-guided

Others

Segmentation by Application:

Thoracic Tumor

Abdominal Tumor

Pelvic Tumor

Others

This report also splits the market by region:

Americas

United States

Canada

Mexico

Brazil

APAC

China

Japan

Korea

Southeast Asia

India

Australia

Europe

Germany

France

UK

Italy

Russia

Middle East & Africa

Egypt

South Africa

Israel

Turkey

GCC Countries

The below companies that are profiled have been selected based on inputs gathered from primary experts and analysing the company's coverage, product portfolio, its market penetration.

MHI

GE HealthCare

Elekta

Varian

C-RAD

Siemens

Philips Healthcare

Key Questions Addressed in this Report

What is the 10-year outlook for the global 4D Proton Therapy System market?

What factors are driving 4D Proton Therapy System market growth, globally and by region?

Which technologies are poised for the fastest growth by market and region?

How do 4D Proton Therapy System market opportunities vary by end market size?

How does 4D Proton Therapy System break out by Type, by Application?

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