



CERN Baltic Group

Proposal for
Feasibility Study
of
Advanced Particle Therapy Centre for the Baltics
Implementation plan

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Executive summary

The *Advanced Particle Therapy Centre for the Baltics* is an initiative established in 2022 by CERN Baltic Group. **The main goal of the initiative is to develop a modern large-scale scientific research infrastructure and clinical treatment centre in the Baltic States by integration of CERN designed particle accelerator technology.** From a scientific perspective, the infrastructure would allow the creation of a broad multi-disciplinary and high technology driven research programme, providing opportunities for world-class research and attracting talented specialists from the Baltics and beyond. From a clinical perspective, such a facility would provide a novel, “cutting edge” cancer treatment modality with helium ions of increased effectiveness that would improve the quality of life of treated cancer patients. From an economic perspective, healthcare cost savings, increased labour productivity, job creation and contribution to national economic growth in the Baltic States could be foreseen.

Through the efforts of the working group, the initiative has been presented to relevant stakeholders representing medical, scientific and political communities, having gathered a substantial support within the Baltic States.

A dedicated, scientifically and factually driven Feasibility Study is necessary to envision such a facility and consider any future developments of the initiative. The main goal of the Feasibility Study is to investigate the feasibility and possible scenarios of implementation of the proposed facility, by creation of Feasibility Study Report to be used as a tool for the decision making in the project continuation. It is envisioned, that the Feasibility Study will be **carried out within CERN framework and will be performed by Baltic States scientific institutions in collaboration with CERN, while including and informing the relevant local stakeholders (Stakeholder Advisory Board) and international experts (Scientific Advisory Board).** Feasibility Study is envisioned to be **2 years long and to be started in 2025.**

The Feasibility Study will be structured within **3 main working groups (“pillars”)** with 3 researchers - one from each of the Baltic countries - led by a senior researcher – the pillar leader. Each of the pillars is envisioned to be led by one of the 3 Baltic countries. The three pillars within the Feasibility study will focus on different crucial aspects of the facility:

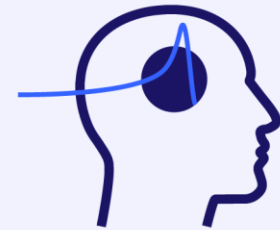
- **clinics and epidemiology:** relevant medical statistics, patient eligibility and research in clinical sciences;
- **technology and implementation:** technical requirements of the particle accelerator system, integration study and related research in technical and natural sciences;
- **economics and innovation:** cost estimates of the facility, economics related to patient throughput, definition of scientific research performance metrics and research on long-term funding models.

As the proposed facility is to be multi-functional, each of the pillars will tackle their respective aspect both from the scientific research and the clinical usage perspective, providing an outline proposal of respective research activity programmes. As certain aspects would need inputs from all 3 pillars, **transversal tasks are to be integrated within the framework of the Feasibility Study as well. They are to be focused on legal and regulatory aspects, information flow between the pillars, creation of risk analysis, investigations on educational necessities for the facility and exploration of alternative approaches for the facility.**

As the outcome, a toolbox of supporting documents will be created to support the decision making process for development of the facility and continuation of the project: **the Feasibility Study report, risk analysis, finalized conceptual layout and beam-time schedule and criteria for site selection of the facility.** Documents will provide factual basis to compare different scenarios of possible facility implementation, while also considering the possibility of no implementation and possible alternatives.



SCIENTIFIC RESEARCH INSTITUTION



CLINICAL TREATMENT CENTER



INDUSTRY INVOLVEMENT INFRASTRUCTURE

To envision the facility and consider any future developments - scientifically and factually driven

FEASIBILITY STUDY

- **Main goal:** investigate the feasibility and possible scenarios of facility's implementation
- **Expected duration:** 2 years
- **Expected launch:** 2025

CLINICAL AND EPIDEMIOLOGY

Lead: Senior researcher with proven knowledge in field



- Research programme in clinical sciences
- Relevant medical statistics in the region
- Eligibility criteria for proton therapy
- Patient referral, connections with PT community

 3 researchers or PhD students from each of the Baltic countries

TECHNOLOGY AND IMPLEMENTATION

Lead: Senior researcher with proven knowledge in field



- Research programme in natural and technical sciences
- Technical requirements of the facility
- Integration study and future upgradability
- Basis of cost estimates for accelerator and facility


 3 researchers or PhD students from each of the Baltic countries

ECONOMICS AND INNOVATION

Lead: Senior researcher with proven knowledge in field



- Research on long term funding, business engagement
- Organizational structure and governance model
- Full cost estimation and economic benefit analysis
- Evaluation of revenue streams

 3 researchers or PhD students from each of the Baltic countries

TRANSVERSAL TASKS

- Alternative solutions for the facility
- Aspects on regulatory and legal approvals
- Risk analysis and evaluation
- Information flow between pillars for cost estimates
- Education and training necessities



FEASIBILITY STUDY IS TO BE DONE WITHIN FRAMEWORK OF CERN WITH INVOLVEMENT OF TECHNICAL EXPERTS

1. Context. Motivation

In 2022, at 9th General Meeting of the CERN Baltic Group (CBG)¹ a designated Working Group “*Advanced Particle Therapy Centre in the Baltic States*” (APTCB) has been established. Mandate of the Working Group is the development of a flagship project within the CBG framework - creation of a modern, innovative scientific research and cancer treatment centre in the Baltic States in a close partnership with CERN Next Ion Medical Machine Study (NIMMS)² collaboration experts. The CERN NIMMS collaboration is a crucial partner for the APTCB initiative developments, as already from 2019 NIMMS collaboration has been working on development of various novel particle accelerator technologies for use in particle therapy. From early stage, NIMMS collaboration also started to focus on development of a novel particle accelerator system for helium ion therapy. Helium ion therapy accelerator is one of the flagship technologies of NIMMS – HeLICS (*Helium Light-Ion Compact Synchrotron*) – technology which is also envisioned as the core of the APTCB facility. Therefore, collaboration between APTCB and CERN NIMMS is crucial to ensure technology transfer into the proposed facility.

Continuing in 2022, a dedicated report on the conceptual idea was created for the initiative. The initially proposed concept of the APTCB facility aims at full-scale integration of CERN developed particle accelerator technology into a modern large-scale scientific research infrastructure and clinical treatment centre (*see Figure 1*). APTCB would act as a catalyst in the region to develop advanced research programmes in clinical, natural and technological sciences, as well as providing novel therapeutic capabilities in cancer treatment.



Figure 1: The purpose of the APTCB initiative is threefold: to become a recognized multi-disciplinary research institution, to become a reference clinical cancer treatment facility and, as a large-scale infrastructure, to be a catalyst for industry involvement.

Concept was further presented to different medical communities and stakeholders of scientific institutions through various regional conferences and workshops, as well as discussed with relevant political bodies. Furthermore, representatives of medical communities, research institutions and relevant ministries were invited to bi-lateral meetings with the APTCB Working Group in three Baltic States in 2022 :

¹ <https://indico.cern.ch/event/1138329/>

² <https://nimms.web.cern.ch/home>

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- October 18th – Riga, Latvia³;
- November 16th – Kaunas, Lithuania⁴;
- November 22nd – Tallinn, Estonia⁵.

The main goals of the bi-lateral meetings were to inform the communities on the overall technical concept of the facility and status of the initiative and, most importantly, discuss the view of the community on the project idea. Through these meetings, key critical aspects were identified for further directions of work on the initiative: cancer statistics in the three Baltic States, clinical indications for proton and ion beam therapy, technology readiness level of the proposed technology and accelerator complex, possible synergies with the nuclear medicine field and educational pathways necessary for personnel at such a facility.

To address these crucial aspects for the future of the initiative, a dedicated workshop “*Particle therapy – future for the Baltic States? State-of-play, synergies and challenges*” was held at the European Organization for Nuclear Research (CERN) on 25th of May, 2023⁶. In the workshop, the three Baltic States were represented both in-person and remotely by experts in clinical radiation therapy, nuclear medicine, radiology and medical physics. Political stakeholders were represented by the Baltic Assembly. Technological aspects were covered with participation of NIMMS collaboration experts.

Through the data and experience shared, further developed with many fruitful discussions among the participants, a conclusive workshop report was prepared, containing all the information gathered⁷. Results of the workshop were also prepared as a scientific publication and published in a special issue of *Health and Technology* journal: *Hadrontherapy and BNCT: Current Status and Future Trends*⁸. Among the workshop conclusions, one of the main was:

“In order to proceed with this promising idea, a full-scale feasibility study of the project is needed. It shall assess feasibility of the facility of this research infrastructure from financial (business case), clinical (medical case), technological (technical outline, availability and R&D required) and multi-disciplinary scientific research perspective. In each of these segments, feasibility study would need the involvement of experts from every Baltic State and CERN researchers, as well as representatives of European particle therapy centres. The best existing platform for such feasibility study is CERN-based NIMMS collaboration.”

Thus, following the previous developments of the initiative, this document outlines the proposal of a dedicated Feasibility Study as the first step of long-term development of the APTCB initiative and further – the facility itself. The main purpose of the APTCB Feasibility Study is to produce a Feasibility Study Report summarizing the factual findings relevant to the three main aspects identified within the “Particle therapy – future

³ https://indico.cern.ch/category/16259/attachments/2587678/4464652/Summary_LVA_18_10_2022.pdf

⁴ https://indico.cern.ch/category/16259/attachments/2587678/4464651/Summary_LTU_16_11_2022.pdf

⁵ https://indico.cern.ch/category/16259/attachments/2587678/4464650/Summary_EST_22_11_22.pdf

⁶ <https://indico.cern.ch/event/1251461/>

⁷ https://indico.cern.ch/event/1251461/attachments/2743761/4773617/REPORT_25_05_2023.pdf

⁸ Pałskis, K., Korobeinikova, E. et al. “Particle therapy - future for the Baltic states?” – synthesis of the expert workshop report. *Health Technol.* 14, 965–972 (2024). <https://doi.org/10.1007/s12553-024-00875-2>

for the Baltic States? State-of-play, synergies and challenges” workshop. The Feasibility Study Report is to be used as decision tool for continuation or rejection of the APTCB project. Relevant details on the overall Feasibility Study proposal, organizational structure and stakeholder engagement plan creation, as well as proposed implementation of the feasibility study is presented in further details in the following sections of this document.

Following the conclusions of the “*Particle therapy – future for the Baltic States? State-of-play, synergies and challenges*” workshop, the Feasibility Study investigations should cover three main aspects of:

- **clinics and epidemiology:** assessing medical statistics that are relevant for APTCB development, patient eligibility aspects and selection models etc.;
- **technology and implementation of it:** definition of technical requirements and overall integration plan of CERN NIMMS particle accelerator technology into a full scale facility;
- **economical aspects, innovation and business strategy:** estimating costs of the facility for multiple stages (construction, installation, commissioning, operation, as well as decommissioning) along with creating strategies for long-term business engagement plans.

These three crucial aspects form the basis of the proposed Feasibility Study implementation, structure of the working groups and expected deliverables, which are elaborated in greater detail within **Section 5**. Other important aspects such as regulatory framework, educational necessities and general risk management strategy were also identified as highly relevant to assess the feasibility of the APTCB facility. As these aspects would cover all of the three main directions of the Feasibility Study - clinics, technology and economics – involvement of experts from all 3 working groups proposed for the Feasibility Study would be necessary. Thus, within the proposed framework of the Feasibility Study, these aspects are referred to as “transversal tasks” and are also elaborate on in greater detail within **Section 5**.

The currently proposed concept of the APTCB facility itself, as mentioned, is the **integration of helium synchrotron technology and all the capabilities into a modern large-scale scientific research infrastructure and clinical treatment centre**. The APTCB would be a catalyst in the Baltic States to develop advanced programmes in cancer research and therapy of international relevance.

The initially estimated time share for the APTCB facility is of **51% beam time for scientific research and 49% for clinical treatment of patients**. One of the goals of the Feasibility Study would be to investigate the separation of the beam time between the functions, though it should be noted that the proposed facility is primarily a scientific research center with additional clinical functionalities.

At this stage, an initial high-level functional layout proposal has been created (*see Figure 2*) encompassing all additional infrastructure necessary to achieve the envisioned goals of the APTCB facility both in scientific research and clinical usage perspectives. It should be noted that both the proposed initial time share and preliminary layout of APTCB facility are subjects to Feasibility Study themselves. A finalized proposal for beam-time usage and conceptual layout of the facility would be done at the end of the Feasibility Study, based on the factual basis and experiences of other centres gathered during the investigations.

While the primary focus of the Feasibility Study would be the currently proposed full-scale implementation scenario, the Feasibility Study is to assess also alternative scenarios. Partial implementation and no implementation scenarios will be also investigated. In the case of “no implementation scenario”, alternative solutions will be explored comparatively analysing the capacity to fulfil clinical and scientific research functions. In the perspective of investigating the different scenarios, the more general and broader questions will also be addressed such as the necessity of the facility for the Baltic States, whether the main proposed conceptual solution is best fit for purpose of clinical and scientific research and, as mentioned - are there other alternative solutions available to address the same functionality and motivation.

As mentioned before, the core envisioned functionalities of the APTCB facility are **multi-disciplinary scientific research activities** and **clinical treatment of patients**. Both perspectives provide a unique motivation for the development of the APTCB facility within the Baltic States. As the facility would provide a unique high technology hub and act as an infrastructure to involve local Baltic industries, while possibly lowering healthcare costs and decreasing the impact of cancer on labour productivity – **an economical motivation for the facility** is of high importance as well. Relevant political bodies and CERN representatives have also been involved in the development of the APTCB facility proposal, therefore there is also motivation for having the facility from political and long-term scientific collaboration point of view.

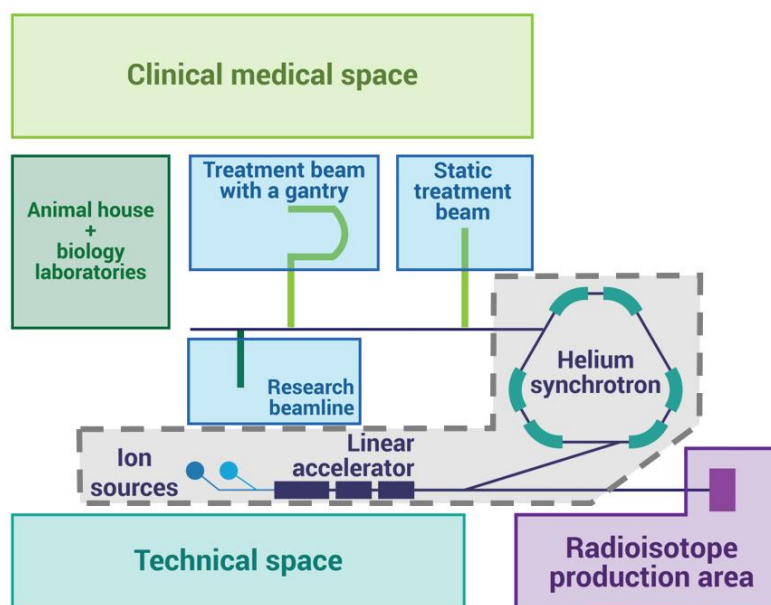


Figure 2: Proposed preliminary layout of the APTCB facility. Layout is to be finalized within the scope of the Feasibility Study. Within the shaded region are indicated technologies directly developed within NIMMS collaboration, while the others are subject to the Feasibility Study.

Motivation from a scientific research perspective for APTCB facility

Particle accelerator-based scientific centres can offer a broad spectrum of research possibilities in such disciplines as particle physics, nuclear physics, material science, biology, chemistry and many others, not even considering the numerous industrial applications. From

the perspective of APTCB facility, a particle accelerator system that is dedicated also to clinical use can provide numerous research opportunities related to cancer treatment. Thus, already at this stage, the importance of the scientific research function is clearly just as important as the clinical use, as a broad range of possible scientific research programmes can be foreseen for the facility. In the current proposal, the envisioned scientific activities can be divided into:

- **clinical sciences:** pre-clinical and clinical studies within radiation oncology, radiology and nuclear medicine, general research in cancer, radiobiology and nuclear medicine and biology relevant to radioisotope production and labelling for diagnostics and radioligand therapy;
- **natural and technical sciences:** medical physics within particle therapy, accelerator physics and all associated engineering technologies, certain aspects of nuclear physics and particle physics, as well as material science and radiation chemistry relevant to radioisotope production for diagnostics and radioligand therapy.

It should be pointed out, that this is the envisioned starting point of the scientific activities, which throughout the Feasibility Study could be updated based on experience from similar facilities or upgraded further in future stages of the facility development. **Although the development of research programme proposal is one of the envisioned tasks of the Feasibility Study, activities such as**

- radiobiological and pre-clinical studies for helium ion therapy;
- physics studies on helium ion beam characterization for therapeutical usage, dosimetrical treatment planning studies of helium ion therapy;
- physical, radiobiological and pre-clinical studies on ultra-high dose rate effects on biological systems in the perspective of *FLASH* therapy;
- novel dosimetry and *in-vivo* particle range verification method development for particle therapy;
- studies on physics and engineering aspects novel particle therapy delivery method development such *FLASH*, mini-beam, arc therapy and others;
- studies on physics and engineering aspects of medical synchrotrons and possible future upgrades;
- in perspective of nuclear medicine, novel production methods of medical radioisotopes, physical and radiochemical purification methods, quality assurance methods, labelling studies and novel radiopharmaceutical development;
- nuclear reaction cross-section measurements, especially in perspective of medical radioisotope production;
- radiation damage testing for materials in perspective of detector development, material science and other research fields.

and many others could be foreseen. During the development of the detailed scientific research activity plan proposal within the Feasibility Study, scientific research activities and experience from other similar facilities in Europe and globally is to be assessed. The goal of the plan proposal would be to complement the global research initiatives in particle therapy and other associated scientific disciplines.

It is envisioned to develop and take part in the scientific research efforts for helium ion therapy clinical translation: a novel direction in cancer treatment, which is described in more

detail in the following Section of clinical motivation. Therefore, scientific research efforts are crucial at this stage for full clinical translation of this modality. **Thus, from scientific research perspective the main motivation for APTCB is to create a regional scientific centre of excellence, developing a broad, world-class scientific research programme attractive to the scientific community from the Baltics and internationally. The scientific research efforts within the APTCB facility could provide valuable inputs for the development of helium ion therapy globally. The infrastructure would also act as a hub for industry involvement, paving the way for future R&D activities.**

In the broader context of Europe, two-thirds of the economic growth of European Union comes from research and innovation, where development of scientific research infrastructures are crucial. In the context of the Baltic States, such a scientific research centre would also align with the National Development Strategies of Estonia, Latvia and Lithuania^{9,10,11}, as clearly scientific research and R&D avenues stimulate innovation-led economic growth of the countries. Furthermore, this initiative would also heavily involve local industries for the delivery of proposed facility, expanding the expertise and “know-how” in particle accelerators and other complex technologies. The facility could attract both young and senior researchers from the Baltics and Europe and stimulate general interest of students for STEM-oriented career pathways and prevent “brain-drain” of young specialists from the region.

Motivation from a clinical perspective for APTCB facility

Out of the three primary methods for cancer treatment – surgery, chemotherapy and radiotherapy (RT) – RT as treatment modality in course of care is beneficial and required for more than 50% of patients. RT is frequently used in the treatment of the most widespread cancer types – breast, lung, colorectal, cervical and others. Even further, a specific modality of RT – particle therapy (PT), using positively charged ions instead of high energy photons in conventional therapy – has proven to be favourable for the treatment of certain types of cancer. While clinical evidence base needs to be expanded further, proton therapy has already shown benefits in the reduction of normal tissue complications in selected types of cancer and carbon ion therapy – in the treatment of radioresistant and hypoxic tumours^{12,13,14,15}. Despite this, access to this type of treatment globally is challenging due to the increased costs of particle accelerator used. Furthermore, analysing the access to particle therapy, the three Baltic States – Lithuania, Latvia and Estonia – is one of the few European regions without a dedicated particle therapy (proton or carbon ion) centre.

Additionally, as was mentioned for scientific research perspective, the APTCB facility aims to take part in the active research of helium-4 (*further – helium*) ion therapy. Helium ions

⁹ [Strateegia "Eesti 2035" | Eesti Vabariigi Valitsus](#)

¹⁰ [Latvijas nacionālais attīstības plāns 2021.–2027. gadam](#)

¹¹ [Lithuania 2030 Progress Strategy](#)

¹² Chen Z, Dominello MM, Joiner MC, Burmeister JW. *Proton versus photon radiation therapy: a clinical review*. *Front Oncol*. 2023; 13.

¹³ Mohan R. *A review of proton therapy – current status and future directions*. *Precision Radiation Oncol*. 2022;6(2):164–76.

¹⁴ Mohamad O, Yamada S, Durante M. *Clinical indications for Carbon Ion Radiotherapy*. *Clin Oncol*. 2018;30(5):317–29.

¹⁵ Malouff TD, Mahajan A, Krishnan S, Beltran C, Seneviratne DS, Trifiletti DM. *Carbon Ion Therapy: a modern review of an Emerging Technology*. *Front Oncol*. 2020; 10.

have had a recent re-emergence of interest in application for cancer therapy. A clear research interest can be seen in ion therapy centres both in Europe and Asia. From a physical perspective, use of helium ions compared to protons could greatly increase the dose conformality due to reduced range straggling and lateral scattering and also the increase the biological effectiveness. While in comparison to carbon ion beams - smaller and less demanding accelerator system would be necessary. Early treatment plan modelling studies have indeed shown helium ion therapy as a possible evolution of proton therapy, reducing the normal tissue toxicity in certain clinical scenarios^{16,17,18}.

Thus, from clinical perspective the main motivation for APTCB is to provide a novel tool of cancer treatment for radiation oncologists to use – the clinically established proton therapy with a long-term ambition of developing helium ion therapy for full clinical usage. Use of both proton and helium ions for therapy could reduce normal tissue exposure to ionizing radiation, thus for decreasing adverse side effects for certain cancer types and improving the overall quality of patient's life post-treatment.

It should be pointed out - that in operational conventional radiation therapy services make radiation oncologists are using established technology and focus on the daily clinical use of equipment developed in laboratories and industries in the previous decades. A close interaction between the end users - **the patients and the radiation oncologists** - and the developers - researchers and engineers - is fundamental when introducing such an advanced tool as particle therapy for radiation therapy. Therefore, within the Feasibility Study a clear engagement plan of relevant medical communities is crucial for success of the clinical aspects of the APTCB facility.

Motivation from an economic perspective for APTCB facility

While economic analysis for the APTCB facility is to be done in detailed manner within the Feasibility Study itself, clear macro-economic benefits can be foreseen through the implementation of the facility in terms of healthcare cost savings, increased labour productivity and the role of high technology infrastructure for innovation development, job creation and contribution to national economic growth.

As mentioned in the clinical motivation, particle therapy (proton and helium ion) is a more precise radiation therapy modality, minimizing the adverse effects and exposure of the normal tissue. Therefore particle therapy can reduce the incidence of secondary cancers, long-term health complications and improved quality of life. This in turn leads to lower overall healthcare costs by reducing the need for costly follow-up treatments and fewer additional hospital admissions. As an example, the benefits from reduced secondary cancer and adverse effect reduction with proton therapy is even more prominent in paediatric patients¹⁹.

¹⁶ Tessonnier T, Mairani A, Chen W et al. *Proton and Helium ion radiotherapy for meningioma tumors: a Monte Carlo-based treatment planning comparison*. Radiat Oncol 2018; 13(1).

¹⁷ Wickert R, Tessonnier T, Deng M, et al. *Radiotherapy with Helium ions has the potential to Improve both Endocrine and Neurocognitive Outcome in Pediatric patients with Ependymoma*. Cancers. 2022;14(23):5865.

¹⁸ Bonaccorsi SG, Tessonnier T, Hoeltgen L, et al. *Exploring helium ions' potential for Post-mastectomy Left-sided breast Cancer Radiotherapy*. Cancers. 2024;16(2):410.

¹⁹ Mizumoto M, Murayama S, Akimoto T, et al. *Long-term follow-up after proton beam therapy for pediatric tumors: a Japanese national survey*. Cancer Science 2017; 108(3): 444–447.

The reduced therapy side effects and increased quality of life of patients can also be translated into increased labour productivity. As an example, in the United States alone, cancer-related productivity loss costs employers over \$94 billion annually²⁰. Effective cancer treatment methods as particle therapy provided by the facility, could therefore reduce long-term sick leave of employees, improving national labour productivity in the Baltic States. Particle therapy also has the potential to reduce cancer mortality and increase life expectancy, especially in paediatric patients. Reduction in cancer mortality would translate into long-term economic benefits due to increased productivity and longer life expectancy²¹.

The global particle therapy market was valued at \$0.7 billion in 2023 and is poised to reach \$1.1 by 2027, with an expected annual growth of 8.2%²². Investments in high technology infrastructure, as the facility proposed, development would stimulate job creation in the Baltic States in fields such as construction, engineering, medical technology and specialized healthcare services. The operational phase of the facility would also generate numerous job positions for healthcare professionals and technical support personnel.

Investments in particle therapy and related technologies and infrastructure could drive growth in local companies that specialize in medical devices, significantly contributing to national GDP. Furthermore, infrastructure investments in scientific research and clinical treatment facilities often lead to the development of local ecosystems, including healthcare clusters and innovation hubs. Investment in such an infrastructure would significantly boost the capacity of Baltic scientific research groups and involvement in international collaborations – aspects that could translate into economical benefits through R&D initiatives and possible start-up creation. All these developments could significantly boost the national economies in the Baltic States and foster collaborations between universities, research institutions, and the healthcare industry.

Support from the policy makers

From the very beginning of this bottom-up initiative policy makers were informed, consulted and engaged throughout the continuation of the initiative. This included relevant national research and health authorities, ministries and research institutions, including top level management as well as selected government ministers and legislators in all three Baltic States. Furthermore, experts from permanent Representation in Brussels and COREPER I Ambassadors were continuously informed, while also advising CERN Baltic Group on the European Union policies and priorities.

The proposal of the facility has been presented at regional political stakeholder levels within the Baltic States – both at the level of relevant inter-ministerial level and at large – the inter-parliamentary-level of Baltic Assembly. Baltic Assembly has made several

²⁰ Islami F, Miller KD, Siegel RL, et al. *National and State Estimates of Lost Earnings From Cancer Deaths in the United States*. JAMA Oncol 2019; 5(9): e191460.

²¹ *Economic Cost of Cancer Mortality Is High in U.S., Regardless of How Cost Is Measured*. JNCI: Journal of the National Cancer Institute 2008; 100(24): 1741–1741.

²² <https://www.marketsandmarkets.com/Market-Reports/particle-therapy-market-12809137.html>

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resolutions^{23,24,25,26} of great relevance for the initiative, addressed to the parliaments and governments of Estonia, Lithuania and Latvia, as well as the Baltic Council of Ministers:

- to enable potential for cooperation with CERN for the development of science, research and technology in the Baltic States and allocate corresponding financial support within the State budgets;
- to assess the joint initiative of Advanced Particle Therapy Centre for the Baltic States;
- to engage the corresponding ministries, national agencies and relevant stakeholders and to jointly apply for co-financing from the European Union for implementing the joint initiative of Advanced Particle Therapy Centre for the Baltic States;
- the Baltic Assembly also emphasizes the importance of the initiative as an integrated flagship project for the Baltic States, falling entirely within the scope of the national policies of the Baltic States, Europe's Beating Cancer Plan and the Mission on Cancer of the European Union, especially in the fields of diagnostics, treatment and quality of life improvement for cancer patients and their families;
- **to implement a full-scale feasibility study of the joint initiative of the CERN Baltic Group and CERN on the Advanced Particle Therapy Centre for the Baltic States.**

The same stakeholder engagement approach shall be continued during the Feasibility Study. Further enhancing, strengthening and institutionalizing the engagement of stakeholders is an integral part of the Feasibility Study itself, which is elaborated upon in more detail in **Section 3**.

Discussions and support from CERN

The APTCB initiative will be an excellent demonstration of the impact on society of the particle physics research promoted by CERN. Its timely implementation is coherent with the CERN goals in terms of transfer to society of CERN technologies and is supported by CERN, within the limits given by its international status and by its technical priorities centred on particle physics. This project is considered as a very good example of regional bottom-up initiatives of the scientific communities of CERN Member and Associate Member states.

This Feasibility Study project is inherently linked with the NIMMS work at CERN. Apart from the scientific novelty, the NIMMS objectives are a clear motivator for the participating multidisciplinary community within this collaboration. The important Baltic contribution to NIMMS coming from this initiative has been a boost to transform NIMMS in a fully-fledged CERN Collaboration.

CERN with the help of collaborating institutes providing personnel resources will deliver in June 2025 a Technical Design Report (TDR) for the helium therapy and research facility with an annex on isotope production. This design will be available to all NIMMS collaborators and other interested partners in CERN Member and Associate Member States. Partners willing to use the technologies described in the TDR can integrate this design into a proposal to their funding agencies (an implementation plan, as the Feasibility Study for the

²³ [RESOLUTION of the digital 39th Session of the Baltic Assembly](#)

²⁴ [RESOLUTION of the 40th Session of the Baltic Assembly](#)

²⁵ [RESOLUTION of the 41st Session of the Baltic Assembly](#)

²⁶ [RESOLUTION of the 42nd Session of the Baltic Assembly](#)

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APTCB). When their proposal is approved, the Partners can negotiate with CERN an agreement to transfer the technology (drawings, fabrication procedures, expertise) for the components that are available at CERN. This transfer can be done at different levels of engagement, subject to negotiations at the appropriate level.

The progress of the relevant CERN Baltic Group working group and the idea of the Feasibility Study have been presented and discussed at the highest CERN body for medical applications, the CERN Medical Applications Steering Committee. All major CERN supported activities with concern to medical application are being discussed there at top-management level.

It is very important to highlight that CERN has agreed to host this Feasibility Study within its collaborative framework.

2. Overview of Feasibility Study Proposal. The long-term ambition of the APTCB facility

This section describes the proposal for the investigations to be carried out during the Feasibility Study. The Feasibility Study is to focus on 3 main areas:

- cancer epidemiology and other relevant medical statistics in the Baltic States and clinical aspects;
- technical integration of the helium synchrotron into a dedicated facility;
- economical aspects.

The main goals of the Feasibility Study are:

1. to investigate the **feasibility of the implementation of the APTCB facility** to a certain level;
2. to provide a **factual based Feasibility Study Report** to be used as tool for the decision making in the APTCB project continuation;
3. through the Feasibility Study Report and associated documents – to provide multiple possible scenarios for implementation at various levels: full, partial or no implementation, with possible alternatives.

The Feasibility Study will be carried out within CERN framework and it will be performed by Baltic States scientific institutions in collaboration with CERN NIMMS group, involving also regional medical communities and organizations in relevant fields (radiation therapy, nuclear medicine, radiology and medical physics), researcher groups and all other relevant stakeholders.

The duration of the Feasibility Study is envisioned to be 2 years, to be started in 2025. The duration of the Feasibility Study has been chosen from the perspective of the functionality of the facility – as it is not a commercial, clinical machine, multi-disciplinary detailed investigations are necessary as the facility is primarily for scientific research. Furthermore, a similar initiative of CERN medical accelerator technology transfer into clinical facilities – PIMMS^{27,28}, that was the starting point for CNAO (Italy)²⁹ and MedAustron (Austria)³⁰ facilities, was held for a similar duration time.

The Feasibility Study stage would be the first milestone of long-term vision of the APTCB facility development project. If the outcome of the study would indicate general feasibility for development of such a facility, while also showing clear multi-disciplinary benefit for the Baltic States – further development stages would span a timeframe of 10 years. Currently envisioned preliminary plan for further development of the facility after a positive outcome of the Feasibility Study is indicated in Figure 3. While the envisioned plan is subject to changes and further discussions, the main phases should include design finalization stage, construction and commissioning of the facility, “start-up” and “ramp-up” phases, which are only then followed by full operation phase in 10-20 years. The expected time of operation of such a facility would be several decades before decommissioning or major upgrade initiative.

²⁷ <https://cds.cern.ch/record/385378>

²⁸ <https://cds.cern.ch/record/449577/>

²⁹ <https://fondazionecnao.it/en/>

³⁰ <https://www.medastron.at/en/>

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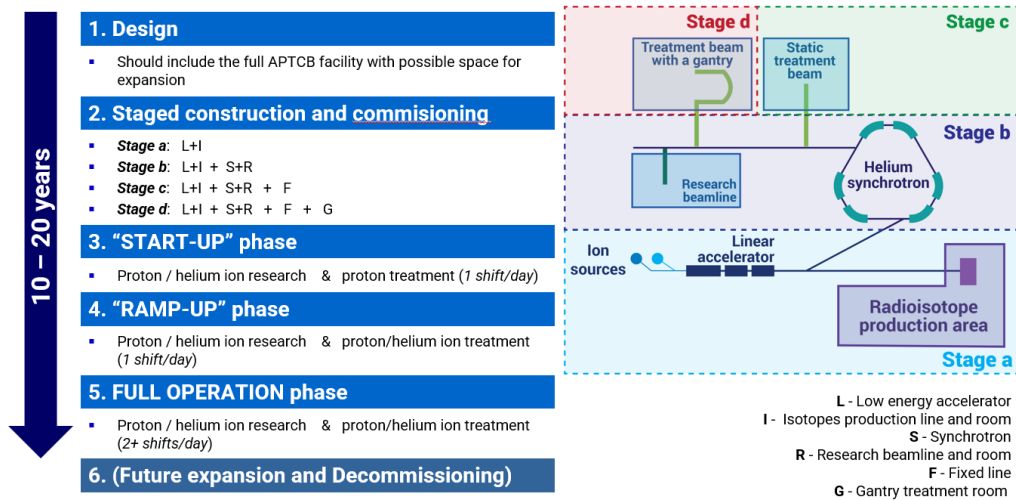


Figure 3: Preliminary timeframe of full implementation plan of the APTCB facility.

3. Stakeholder Analysis and Engagement Plan

An initial non-comprehensive list of Stakeholders identified for the Feasibility Study programme is, for the time being, the following:

- **Relevant political, academic, and cultural Stakeholders from the 3 Baltic States:** this category includes the relevant ministries in the 3 Baltic States in the fields of health, science, education and finance, as well as other local and regional entities, Universities and cultural authorities.
- **International political and decision-making stakeholders:** this category relates to other international entities involved in the decision making from a political and financial point of view with grants and financial support (European partners)
- **Clinical hospitals and radiation oncologist, radiologist, nuclear medicine specialist and medical physicist communities:** they will be consulted and involved for identifying and defining the clinical needs as well as for creating the initial network for future patients' referral
- **Patient associations and NGOs:** they should be consulted and informed during the full course of the Feasibility Study to include aspect related to general patient care that goes outside of the purely clinical sphere.
- **Nuclear safety authorities:** they will be consulted and involved for the planning and installation of the facility.
- **Other European particle therapy centres:** they should be involved as consultants and partners for the planning phase and for the development of common research directions.
- **Economical actors in the region (like high-tech companies and service providers):** they may be involved for specific installation and implementation needs and they may benefit from the creation of a high-tech large-scale facility in the region.
- **Scientific community:** research groups from universities, regional research institutions and from companies in the sectors interested in using the accelerator facility for R&D purpose.

Other stakeholders that may be affected (*or perceive to be affected*) by the Feasibility Study programme could be:

- Companies working in the proton-therapy sectors;
- Local radiotherapy associations not willing to collaborate on particle therapy project;
- Local associations who may be against hosting a large technology infrastructure from an environmental point of view.

A full and detailed list of stakeholders, including an engagement plan, should be prepared, discussed among collaboration board, scientific advisory board and steering committee and released at the beginning of the Feasibility Study. The list of stakeholders should be periodically updated during the full duration of the Feasibility Study.

The identified stakeholders relevant for the Feasibility Study and APTCB initiative at large will form the basis of Stakeholder Advisory board, which is elaborated in more detail in **Section 4**.

4. Proposed Organizational Structure

The proposed organizational structure for the Feasibility Study is depicted in Figure 4. A brief description of the composition and role of the main bodies is given in the following paragraphs.

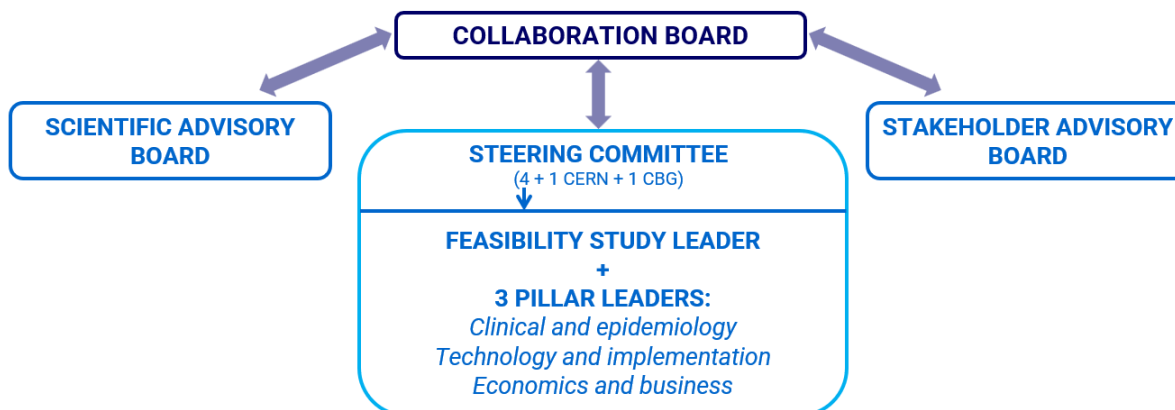


Figure 4: Proposed organizational structure for the Feasibility Study.

Collaboration Board

The Collaboration Board brings together representatives of the institutes and stakeholders involved in the Feasibility Study. They represent the worldwide particle therapy research community and form the supervision and governing body for the Feasibility Study, integrating the information from the advisory boards and giving direction to the steering committee.

The Collaboration Board is composed as follows:

- one representative per institution contributing to the Feasibility Study;
- a representative of CERN as one of the participants in the Feasibility Study;
- a representative of whole CERN Baltic Group (*chair or vice-chair*);
- the chair of the scientific advisory board;
- the chair of the stakeholder advisory board;
- the Feasibility Study leader;
- representatives from the respective Ministry in each of the Baltic States providing the funding for the Feasibility Study;

The Collaboration Board elects its Chair from among its members, and meets twice a year.

Scientific Advisory Board

The Scientific Advisory Board is a panel of independent experts in the fields relevant to the APTCB facility and Feasibility Study, but that are not directly involved. It is the body that will advise on the progress and on the outcome of the Feasibility Study and will play a **role of referee** for the Feasibility Study.

The Scientific Advisory Board is composed by **up to 8-10 persons** who are recognized experts in the various aspects relevant in the proposed scope of the facility – medical physicists,

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radiation oncologists, accelerator physicists and other specialists in particle therapy and nuclear medicine. The Scientific Advisory Board elects its Chair from among its members, and meets twice a year.

Stakeholder Advisory Board

The Stakeholder Advisory Board will bring together the partners and the institutions involved in the study, with the **aim of giving advice** to the Collaboration Board. Partner institutions should represent each of the 3 Baltic States and include, but would be not limited to:

- relevant ministries in the fields of health, science, education and finance;
- scientific universities and regional research institutions;
- multidisciplinary medical expert teams representing oncologists, radiation oncologists, radiologists and nuclear medicine specialists and respective professional associations at large;
- experts in medical physics and biomedical technologies, while also representing respective professional associations at large;
- patient organizations.

The Stakeholder Advisory Board will have one representative from each partner institution involved in the Feasibility Study and will interact and seek external stakeholders during the whole course of the study as additional participants within Stakeholder Advisory Board. As identification and joining of additional stakeholders can be foreseen throughout the duration of the Feasibility Study, Stakeholder Advisory Board is responsible for definition of a certain mechanism and admission rules for addition of new members at the beginning of the Feasibility Study.

5. Proposed working plan of the Feasibility Study

To assess the full-scale feasibility of the APTCB facility, different multi-disciplinary aspects of the facility must be considered, which can be grouped in different categories. Some of the key questions to be answered within the Feasibility study are listed in Table 1.

Table 1. Key questions to be answered within the Feasibility Study.

Clinical	<ul style="list-style-type: none"> • How large is the clinical need for a particle therapy facility? • What type of research related to cancer treatment can be conducted at a particle therapy facility? • How many patients would be eligible for particle therapy in the Baltics States? • How many patients could be eligible specifically for helium ion therapy in long-term operation, what would be the methods of evaluation?
Technological	<ul style="list-style-type: none"> • What is the maturity of the accelerator design? • What is the maturity of the accelerator's components and technology readiness? • What would be the needed development projects? • What auxiliary services and infrastructure are necessary? • What could be possible alternatives for the envisioned technology, providing solution in both scientific research and clinical domain?
Economical	<ul style="list-style-type: none"> • Is there a clear definition of the scope of full APTCB project? • What are the stages of the project? • What is a cost estimate for the full project? • What are operational and decommissioning-associated costs of the facility? • What is the impact of this project? • Where will the funding come from? • Is there political support (<i>EU/government/public entities/hospitals</i>)?
Regulatory	<ul style="list-style-type: none"> • What are the regulatory steps? (<i>examples from other HT sites</i>) • Is there an impact of regulatory on technical design?
Operational	<ul style="list-style-type: none"> • What is the necessary technical knowledge build-up? • What training programmes would be needed?

Main Objectives

The main objectives of the Feasibility Study are:

- to explore and analyse the available information in multi-disciplinary areas of interest related to the proposed usage of APTCB facility;
- at the end of Feasibility Study: to provide a factual based report that can be used as decision making tool for the future of the APTCB project;

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- to provide clear justification for necessity of such a facility in the Baltic States from scientific research, clinical, economical and international scientific collaboration perspective.
- to explore possible alternative technological solutions of the proposed APTCB concept for comparative analysis.

All the information and material collected during the Feasibility Study will be freely available and used as foundation for the possible future steps of the APTCB project. As the information will be freely available, it can be used by other interested parties in the future considering integration of the NIMMS HeLICS accelerator or similar design into a full-scale research and treatment facility.

Proposed structure of the working groups

To address the multi-disciplinary nature of the proposed facility, the Feasibility Study will be structured into three main working groups, which will be further referred as “pillars”. **The three pillars are set to investigate the clinical, technical and financial feasibility of the APTCB facility.** As different additional considerations related to aspects such regulatory framework, cost estimates, risk assessment and education would require inputs from experts of multiple pillars, these tasks will be addressed as transversal tasks. The proposed structure of the Feasibility Study implementation plan is depicted in Figure 5. Each of the pillars will have the main coordinator (“pillar leader”) and at least 3 members that could be graduate students, senior researchers and other participants from the different Baltic universities and research groups. This section will further outline the different tasks proposed for each of the pillars, along with the expected deliverables and definition for scope of work.

CLINICAL and EPIDEMIOLOGY	TECHNOLOGY and IMPLEMENTATION	ECONOMICS and INNOVATION
Research programme in clinical sciences	Research programme: natural and «tech» sciences	Research: long term funding, business engagement
Relevant medical statistics in the region	Technical requirements of the facility	Organizational structure and governance model
Eligibility criteria for proton therapy	Integration study and future upgrades	Full cost estimates and economic benefits
Patient referral, connections with HT community	Basis of cost estimates for accelerator and facility	Identification and evaluation of revenue streams
TRANSVERSAL TASKS		
Alternative approaches to the facility		
Regulatory and legal approvals		
Information flow for cost estimates		
Risk analysis and evaluation		
Education and training		

Figure 5: Proposed Feasibility study implementation plan, indicating research activities for the three pillars and transversal tasks.

5.1. Clinical and Epidemiology aspects

The first pillar of the Feasibility Study will **focus on clinical and epidemiological aspects related to the APTCB.**

The goals for this pillar are:

- to propose an outline of possible research programme in clinical sciences to be implemented in APTCB facility;

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- to focus on the clinical readiness of the 3 Baltic States for usage particle therapy and possible novel approaches in nuclear medicine, through evaluation of statistical data – cancer incidence, mortality and modalities and procedures used in radiotherapy, radiation oncology, radiology, nuclear medicine and other relevant medical disciplines;
- to provide estimation of number of patients eligible for particle therapy within the 3 Baltic States;
- to provide a proposal for the choice of a patient eligibility and selection model and referral mechanism.

In scope of work:

- The collection of statistical information from existing cancer registries and additional data sources, if applicable (*resources at national health institutions and ministry level*);
- The creation of recommendations for eligibility criteria model and referral mechanisms;
- The creation of outline for research programme of APTCB facility in clinical sciences for advanced cancer treatments modalities and basic science (radiobiology, radiopharmaceutical production etc.).

Out of scope of work:

- Considerations or implementation of additionally necessary aspects in the registries for the future (*only existing sources to be used*);
- Actual implementation of eligibility criteria model and referral mechanisms;
- Actual research proposals and grant applications related to the future research programme of the facility;
- Proposed research activity outline should be limited to clinically oriented research fields: pre-clinical and clinical science in radiation oncology, radiobiology and radiopharmaceutical production for nuclear medicine. Although, other relevant scientific fields can be considered for addition, based on networking with experts from other similar facilities.

An initial overview of the **tasks and deliverables** for the researchers involved in this pillar is given in Table 2.

Table 2. Tasks and expected deliverables of “Clinical and Epidemiology” pillar.

	TASKS	DELIVERABLES
1.1	<i>Definition of APTCB research programme in clinical sciences</i>	D1: Report with proposed scientific research outline for clinically-oriented research fields - <i>pre-clinical and clinical in radiation oncology, radiobiology and nuclear medicine (radiopharmaceuticals)</i> – based on state-of-the-art and networking with relevant facilities. Report to include already active research groups in the relevant fields within the Baltic States.
1.2	<i>Relevant medical statistics in the region</i>	D2: Conclusive report about current number of cancer patients, radiotherapy treatments and other relevant statistical parameters, as well as parameters relevant to assess capacity in nuclear medicine. Report is to provide also possible eligible fraction of cancer patients for particle therapy based on literature studies and also extrapolation of the trends over the coming 10-20 years.
1.3	<i>Patient eligibility criteria for proton therapy</i>	D3: Report describing the options, approaches and models for patient eligibility for particle therapy based on international experience. Report is to also provide overview of existing clinical evidence as basis for eligibility. D4: Recommendations for most suitable patient selection and eligibility estimation methodology for the Baltic States.
1.4	<i>Patient referral, connections with particle therapy community</i>	D5: Report on existing methods of referral in Baltic States for other cancer treatment methods (<i>conventional radiotherapy, chemotherapy etc.</i>), provision of comparison with other relevant countries having particle therapy facility. D6: Recommendations for most suitable patient referral methodology for Baltic States.

5.2. Technology and Implementation aspects

The second pillar of the Feasibility Study **will focus on technology and implementation aspects related to the APTCB.**

The goals for this pillar are:

- to propose an outline of possible research programme in natural and technical sciences to be implemented in APTCB facility;
- to define the technical requirements for a facility, based on helium ion accelerator technology;
- to develop on the integration aspects for a large-scale, high-tech research and therapy infrastructure.

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In scope are:

- The collection of design data on helium ion accelerator technology developed by CERN based collaboration (NIMMS HeLICS).
- Identification of possible technological gaps of the NIMMS HeLICS accelerator technology;
- Creation of a proposal for NIMMS HeLICS technology implementation and site technical requirement definition for a facility development in the Baltic States;
- The creation of outline for research programme of APTCB facility in natural and technical sciences.

Out of scope are:

- The development (*designing, prototyping etc.*) of new additional technology;
- Actual research proposals and grant applications related to the future research programme of the facility;
- Proposed research activity outline should be limited to natural and technological science research fields: medical physics, dosimetry, accelerator physics and technologies, nuclear physics, particle physics, material science and radiation chemistry relevant for radiopharmaceutical production. Although, other relevant scientific fields can be considered for addition, based on networking with experts from other similar facilities.

An initial overview of the **tasks and deliverables** for the researchers involved in this pillar are given in Table 3.

Table 3. Tasks and expected deliverables of “Technology and Implementation” pillar.

	TASKS	DELIVERABLES
2.1	<i>Definition of APTCB research programme in natural and technological sciences</i>	D7: Report with defined research goals for research fields in natural and technological sciences – <i>medical physics, dosimetry, accelerator physics and technologies, nuclear physics, particle physics, material science and radiation chemistry (radiopharmaceutical production)</i> – based on state-of-the-art and networking with relevant facilities. Report to include already active research groups in the relevant fields within the Baltic States.
2.2	<i>Technical requirements for APTCB facility design</i>	D8: Report with defined particle accelerator requirements based on the NIMMS HeLICS technology D9: Report of additional technologies necessary for clinical implementation: <i>dose delivery methods and registration tools, general control system, integration with oncology information system, choice of pre-treatment and in-room imaging options</i> D10: Report on technical aspects of parallel radioisotope production: <i>isotopes of interest, beam-time allocation and definition of additional technical requirements for this functionality</i>
2.3	<i>Integration study and outlooks of future upgradability</i>	D11: Baseline of Product Breakdown Structure (PBS) and main interfaces. D12: Report on the design of main systems and sub-systems with functional analysis.
2.4	<i>Basis of cost estimates</i>	D13: Report of base information needed for cost estimation of the accelerator system and facility as whole

5.3. Economics and Innovation aspects

The third pillar of the Feasibility Study will **focus on economics, business and innovation related aspects of the APTCB.**

The goals for this pillar are:

- to explore possible long term funding solutions;
- to define the business case and basis of a business model for APTCB facility;
- to evaluate economical aspects of the scientific research function of the facility;
- to evaluate and provide full cost estimates related to the construction and long-term operation of the APTCB facility;
- to evaluate economic benefits of the facility from different perspectives (*industry involvement, job creation, healthcare costs and labour productivity*)
- to evaluate revenue streams of the proposed facility through services, grants, collaboration and licensing agreements and possibilities of medical tourism, while providing basis for key evaluation metrics.

In scope are:

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- Creation of a report based on existing factual basis and experience from other centres in the economical domains of various revenue streams, installation and operation costs, R&D projects and business engagement
- Development of the initial basis for further development of the business plan of the facility, identifying main revenue streams and evaluating them through the perspective of key metrics.
- Formation of basis for possible economic benefits of the facility from different perspectives (*industry involvement, job creation, healthcare costs and labour productivity*)
- Research on possible novel funding models of such a facility, while also identifying the economic aspects related to the scientific research functions.

Out of scope are:

- Creation of a finalized and detailed project management plan;
- Creation of a finalized business plan for the facility;
- Creation of a certification plan for the facility;
- Creation of proposals for upgrades of the facility.

An initial overview of the **tasks and deliverables** for the researchers involved in this pillar are given in Table 4.

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Table 4. Tasks and expected deliverables of “Economics and Innovation” pillar.

	TASKS	DELIVERABLES
3.1	<i>Research on long term funding model, business engagement and economical aspects of research function</i>	<p>D14: Report on existing and possible industrial engagement opportunities. Report is to include a database of relevant companies.</p> <p>D15: Proposal of a novel funding model for the facility, while also identifying proper performance indicators for the scientific research activities.</p>
3.2	<i>Definition of organizational structure and governance model</i>	<p>D16: Proposal of operational schedule and organizational structure for APTCB facility</p> <p>D17: Proposal of «organigram» and APTCB project resource plan.</p>
3.3	<i>Full cost estimation for the facility and economic benefit analysis</i>	<p>D18: Report on full cost estimates, including construction, commissioning, installation and operational phases, as well as eventual decommissioning. Report is to be done based on data provided by second pillar for construction, while providing basis of estimates for other stages, also including additional experience from other centres.</p> <p>D19: Report on possible economic benefits of the facility and future projections, based on international experience and studies (<i>impact on healthcare costs, increase of labour productivity, industry engagement and job creation</i>)</p>
3.4	<i>Identification and evaluation of revenue streams of the facility</i>	<p>D20: Report on the different revenue streams for the facility based on international experience of particle therapy centres and scientific research institutions (<i>clinical and scientific research services, grants, collaboration and licensing agreements, medical tourism</i>)</p> <p>D21: Report on evaluation of the different proposed revenue streams, focusing on the key metrics such as possible annual revenue per source and growth rate. Basis of the “breakeven analysis” and expected profitability timeline should be provided.</p>

5.4. Transversal tasks

Alongside with the main tasks and corresponding deliverables of the three pillars, there are other aspects of APTCB facility covering multiple aspects related to the three main pillars. Investigations on these aspects would require inputs from the various researcher teams of the Feasibility Study, thus requiring “transversal tasks”. For transversal tasks, the pillar leaders together with the Feasibility Study leader will be responsible to address these tasks and collect the needed information, that can be performed based on the methods most appropriate for each subject from the three pillars. The four areas of interest identified for transversal tasks and respectively expected deliverables are summarized in Table 5.

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Table 5. Transversal tasks and respectively expected deliverables.

	TASKS	DELIVERABLES
T.1	<p>Alternative solutions for the facility <i>Description: as different implementation scenarios of the APTCB facility are to be explored, for “implementation” scenario alternative solutions from existing dual-function (scientific research and clinical use) facilities are to be explored with the provision of data for comparative analysis in clinical, scientific research, technological and economical domains</i></p>	<p>D22: Factual basis of alternative solutions for the facility for comparative analysis in scenario of “no implementation” <i>Results of the task are to be used as inputs for Risk Assessment</i></p>
T.2	<p>Regulatory and legal approvals <i>Description: general investigation on existing and necessary regulatory, licencing and certification framework and creation of strategic approach to these aspects of the APTCB;</i></p>	<p>D23: Report on compliance of the facility with current relevant regulations at national and international level (<i>healthcare research, medical treatments, environmental regulations and data protection</i>) D24: Report on necessary licenses or certifications for the operation of the facility, with a roadmap for the process <i>Results of the task are to be used as inputs for Risk Assessment</i></p>
T.3	<p>Information flow for cost estimates <i>Description: clear definition of process inputs and outputs between the different pillars for the analysis of the costs for the different phases of the APTCB life-cycle;</i></p>	<p>D25: Creation of information flow scheme between the pillars for cost estimates <i>Results of the task are to be used as inputs for Risk Assessment</i></p>
T.4	<p>Risk analysis and evaluations <i>Description: creation and management of a risk registry with a suitable risk management plan to be used as initial reference for all risk-related documentation for the APTCB. Risk analysis is to cover all major domains such as financial, operational, regulatory etc.</i></p>	<p>D26: Creation of Risk Assessment Matrix D27: Creation of Risk Management Plan</p>
T.5	<p>Education and trainings <i>Description: exploration of required specialization and dedicated training programmes for the roles that will be needed for construction, commissioning, operation and maintenance of the APTCB</i></p>	<p>D28: Creation of human resource matrix D29: Creation of proposals for education and training plans <i>Results of the task are to be used as inputs for Risk Assessment</i></p>

Milestones and overall timeline for the Feasibility Study

The Feasibility Study is expected to run over a time frame of two years (24 months, from m00 to m24). The milestones (M0 to M3) for the Feasibility Study are proposed as following:

- M0 (m03): Kick-off meeting
 - Definition of study plan
 - Stakeholders' definition
 - Definition of Feasibility Study document management plan
- M1 (m12): Mid-term Review
 - Validation of work in scope of initial plan
 - Presentation and discussion of first findings and results
 - Risk Evaluations
- M2 (m21): Feasibility Study Report first draft
 - Finalization of deliverables reports
 - Initial draft of the Feasibility Study Report
- M3 (m24): Release of the Feasibility Study Report
 - Completion of the Feasibility Study Report
 - Release of Risk matrix

As mentioned above, the definition of working plan within each of the three pillars of the Feasibility Study is to be created by the respective pillar leaders, consulting with the involved team of researchers, and should be finalized and presented at the time of milestone M0. Creation of the timeline or Gantt chart for each of the pillars internally is the responsibility of the respective pillar leader. An example template is given in Figure 6.

The deliverables from each pillar will be the basis for the Feasibility Study Report and will be finalized at the time of milestone M2.

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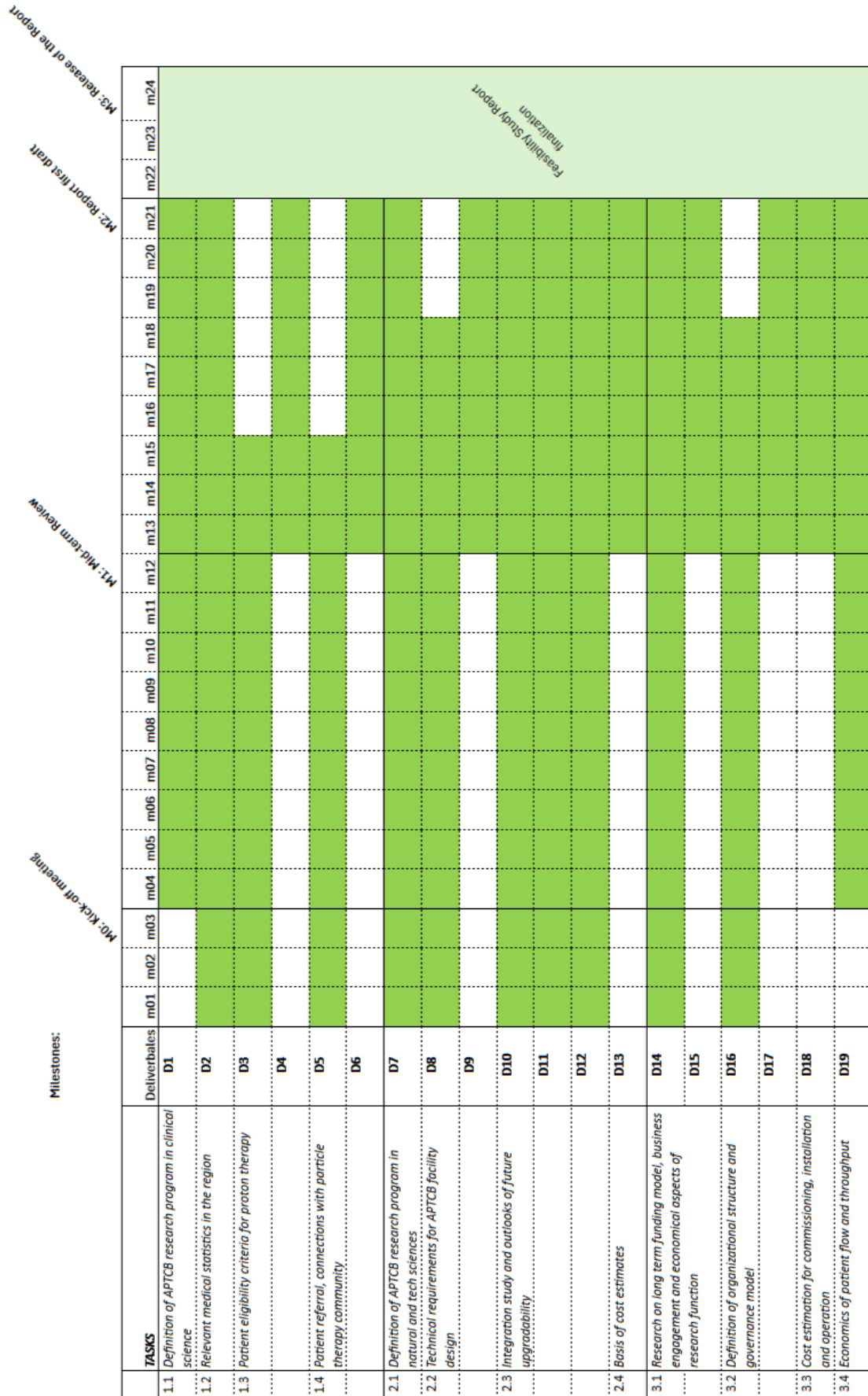


Figure 6: An example template Gantt chart for project timeline finalization by Feasibility Study pillar leaders

6. Expected Outcomes

The Feasibility Study will be the initial, exploratory phase for the long-term APTCB project. It will be the first step towards bridging the gap between clinical and scientific research needs in particle therapy and technology in the 3 Baltic states.

The main tangible outcome for the Feasibility Study is the Feasibility Study Report. The Feasibility Study Report is to include all the factual basis collected within deliverables, while building upon it further as well. The information collected within the Feasibility Study Report is to be used as decision making tool for the future of the APTCB project: facility construction and full implementation of the proposal. Other documents will be created along with the Feasibility Study report, that can be used for decision making process:

- risk analysis associated with APTCB proposal and overall risk management strategy;
- finalized and factual-based proposal for layout of the APTCB facility;
- finalized and factual-based beam-time usage proposal for the APTCB facility;
- finalized and factual-based list of selection criteria for the choice of most suitable APTCB facility construction site.
- initial proposal for the expected staging for full-scale development of APTCB facility;
- initial basis for a business plan for the APTCB facility.

Importantly, the Feasibility Study report and other accompanying documents are to provide the basis for multiple possible scenarios, not a definitive solution, for the decision making stakeholders, while also providing factual basis for comparison of the different options. Exact different scenarios are to be decided within the Feasibility Study, but should at least include:

- full-scale implementation scenario, with varying weights of scientific research and clinical treatment functions;
- partial implementation scenario, limiting certain technical functionalities of the proposed facility;
- scenario of not implementing the facility, while identifying possible alternatives through analysis of existing technologies and facilities of similar functionality in terms of scientific research and clinical treatment.

Apart from the main tangible outcomes of the Feasibility Study related to the proposed infrastructure itself, multiple community, both medical and clinical, benefits could be foreseen:

- the reinforcement of the synergies between the different Baltic research groups and medical societies;
- strengthening the collaboration between Baltic research groups and CERN;
- the detailed documentation created is planned to be open access, thus it could be used as “*white papers*” and “*roadmaps*” for use of CERN NIMMS HeLICS technology implementation even outside of the Baltic States;
- the created basis for possible business plans and for scientific research programmes could be of interest and implemented within other particle accelerator facilities.

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The proposal of the Feasibility Study is a call for the relevant stakeholders within the Baltic States to invest the necessary resources – both financial and human resources within the scientific communities – for the preparation of a clear factually-driven basis for the APTCB facility proposal within the next 3 years. The acquired information will be the turning point for the decision on the launch of the APTCB full-scale implementation project: a facility that has the potential to provide an important “step-forward” for the 3 Baltic States in terms of scientific research, technology development and cancer treatment opportunities, as well as being a catalyst for creation of “*know-how*” within the field of particle accelerator technologies and other “high-tech” systems.

Necessary additions to the Implementation Plan Proposal

Based on initial reviews of CERN Baltic Group member institutions, there are 3 main areas that need to be further expanded and developed for successful launch of the Feasibility Study:

- **stakeholder identification and engagement plan:** more in-depth analysis is needed for identifying all the relevant stakeholders for the initiative and strategy for their involvement for the successful launch of the Feasibility Study;
- **detailed time-scale of the Feasibility Study project and milestone definition**
- **action plan after the Feasibility Study:** main milestones after the finish of Feasibility Study and Report preparation need to be identified as actions for the future of the initiative.