

Towards the Update of the European Strategy for Particle Physics



Karl Jakobs (Strategy Secretary)

*International Workshop on Future Linear Colliders
LCWS2024 Tokyo, 11th July 2024*

Update of the European Strategy

- In March 2024, the CERN Council approved the timeline for the next update of the European Strategy for Particle Physics with a completion date in June 2026
- The proposed timeline is determined by physics (LHC, HL-LHC, results from other colliders) and strategic considerations:
 - **Physics landscape:** physics results from the LHC and other colliders, HL-LHC upgrades ongoing, exploration of the Higgs sector remains central
 - **Excellent progress at CERN and beyond on the preparation for future colliders**
 - * **FCC Feasibility Study**
(mid-term report presented, excellent progress on the technical side - no showstoppers identified for an FCC-ee as a first stage of an integrated FCC programme)
Planned to complete the study in March 2025
 - * **Clearer view on the international landscape for future colliders**
 - ILC in Japan as a global project; so far no commitments
 - P5 process in the US (→ participation in an off-shore Higgs factory (ILC, FCC-ee))
 - Technical Design Report for CEPC in China released in Dec 2023;
Aim for adoption of the project in the next 5-year funding cycle(s) in 2025

→ Very relevant information will become available by the end of 2025

Update of the European Strategy

- *In addition:*

- ***Long timescales, long-term community engagement***

- * The gap between the end of the HL-LHC and the start of the next collider project should be minimised, to ensure continuity of expertise and commitment.

- * Wish of the young generation of physicists to have a clear vision of the future of our research field, as well as a credible timeline for the realisation of any future collider project

- **Strategy recommendations on the complementary physics programme** at CERN and beyond are important for establishing / upgrading relevant facilities



Remit of the European Strategy Group (ESG)

- *In June 2024, the CERN Council established and approved the **remit of the European Strategy Group***

*”The aim of the Strategy update should be to develop a **visionary and concrete plan** that greatly advances human knowledge in fundamental physics through the **realisation of the next flagship project at CERN**. This plan should attract and value **international collaboration** and should **allow Europe to continue to play a leading role in the field.**”*
- The ESG should take into consideration:
 - The **input of the particle physics community**;
 - The **status of implementation of the 2020 Strategy update**;
 - The **accomplishments over recent years**, including the results from the LHC and other experiments and facilities worldwide, the progress in the construction of the High-Luminosity LHC, the outcome of the Future Circular Collider Feasibility Study, and recent technological developments in accelerator, detector and computing;
 - **The international landscape of the field**
- *The Strategy update should include the **preferred option** for the next collider at CERN and **prioritised alternative options** to be pursued if the chosen preferred plan turns out not to be feasible or competitive.*



Remit of the European Strategy Group (ESG) (cont.)

- The Strategy update should also indicate **areas of priority for exploration complementary to colliders** and for other experiments to be considered **at CERN** and **at other laboratories in Europe**, as well as for participation **in projects outside Europe**.
- The ESG should review and update the Strategy and **add other items identified as relevant to the field**, including **accelerator, detector** and **computing R&D**, the **theory frontier**, actions to minimise the **environmental impact** and to improve the **sustainability** of accelerator-based particle physics, the strategy and initiatives to **attract, train and retain the young generations**, **public engagement and outreach**.



The Strategy Secretariat and European Strategy Group (ESG)

Strategy Secretariat:

Organising and running the ESPP process

Karl Jakobs (Strategy Secretary, Chair)

Hugh Montgomery (SPC Chair)

Dave Newbold (LDG Chair)

Paris Spicas (ECFA Chair)

European Strategy Group (ESG)

Preparation of the Strategy Document

- The Strategy Secretary (acting as Chair)
- One representative appointed by each CERN Member State
- One representative appointed by each of the laboratories represented in the Large Particle Physics Laboratory Directors Group (LDG), including its Chair
- The CERN Director-General
- The CERN Director-General elect
- The SPC Chair
- The ECFA Chair
- Invitees: President of CERN Council, one representative from each of the Associate Member and Observer States, one representative from the European Commission, the Chairs of APPEC, NuPECC and ESFRI, the members of the Physics Preparatory Group.



The Physics Preparatory Group (PPG)

Physics Preparatory Group (PPG): collects input from the community, organises the Open Symposium, prepares the Briefing Book

- Strategy Secretary (acting as Chair)
- **Four members appointed by Council on the recommendation of the SPC**
- **Four members appointed by Council on the recommendation of ECFA**
- **One representative appointed by CERN**
- Two representatives from the Americas and two representatives from Asia (appointed by the respective regional representatives in ICFA)
- The SPC Chair
- The ECFA Chair
- The LDG Chair



Timeline

September 2024 Council

Council appointment of the members of the PPG

December 2024 Council

Council decision on the **venues for the Open Symposium** and the **Strategy Drafting Session**

Call for proposals to host these events have gone out;
Dates of both events have been fixed

31 March 2025

Deadline for the submission of input from the community

23 – 27 June 2025

Open Symposium

End of September 2025

Submission of the “Briefing Book” to the ESG

01 – 05 December 2025

Strategy Drafting Session

End January 2026

Submission of the Draft Strategy Document to the Council for feedback

March-June 2026 Council Sessions

Discussion of the Draft Strategy Document by the Council followed by the updating of the Strategy by the Council.



Community Involvement

- Input and involvement of the community is important!
(... and explicitly asked for in the remit)

Goal must be to reach a consensus in the community on the way forward for our field

- There are several ways the community should provide input:

(i) Submission of input from the community by 31 March 2025

Input from projects (FCC, CLIC, ..., Muon Collider, ..., theory, ...) expected

Input from national communities expected (process has already started in several countries)

....

→ Key input will become available only at that time

- * Final report on FCC feasibility study (including progress on financial feasibility)

- * Important input from alternative projects

- * Reports on accelerator R&D, detector R&D, ...

- * ...

Therefore, we see a need for further community input (at the basis of national input) at later stages



Community Involvement (cont.)

(ii) Open Symposium 23 – 27 June 2025

In addition to plenary (and parallel) presentations, this Symposium should be organised such that there is room for discussions

(iii) Based on the collected input (March 2025) and Briefing Book (Sept. 2025) **further input from the national communities is welcome**

A proposal on how to collect and structure this input will be presented by ECFA

Summary on Community Input

31 March 2025

Deadline for the submission of input from the community

Further input from national communities

23 – 27 June 2025

Open Symposium

End of September 2025

Submission of the “Briefing Book”

Further input from national communities, deadline 14 Nov 2025

01 – 05 December 2025

Strategy Drafting Session



Important considerations

- In this Strategy Update process we must converge on a preferred option for the next collider at CERN plus alternative options (prioritised)

This may imply as well strong focus on certain R&D lines

→ It will provide the basis for a decision on construction of the next major collider at CERN by Council in 2027/28

- In addition to input from the community at large, we must make sure that input for all plausible options for the flagship project (large collider) will be obtained by 31 March 2025
- In addition other areas of physics must be covered;
Also here, we are asked to define priorities



Baseline and possible alternative scenarios

Current baseline – justified by 2020 Strategy – :

FCC integrated programme (FCC-ee followed by a hadron collider of at least 100 TeV)

Possible alternative scenarios (for next collider, following the HL-LHC)

- Realisation of a lower-energy hadron collider (50 – 80 TeV) on an earlier timescale (2050 – 2055)
- Linear Collider at CERN (CLIC, ...)
- Muon Collider at CERN
- Further exploitation of the LHC physics programme, eventually with the addition of e-h collisions
- ...

Non-exhaustive list, other scenarios may come up and be proposed by the community



Required input on baseline and alternative scenarios

FCC integrated programme: Input via FCC Feasibility Study final report

(technical feasibility, physics potential, environmental impact, ..., update on the financial feasibility)

In addition: reports from review committees will appear later in 2025

Lower-energy hadron collider

Two important inputs are needed:

- (i) When will HFM magnets, e.g. accelerator magnets of 12 T, become available?
What technology? What price tag? Required R&D? To what extent can timeline be accelerated?
Input from → LDG + HFM Collaboration (Accelerator Roadmap) + international experts(?)
- (ii) Physics potential of a 91 km hadron collider with e.g. 8.3 T and 12 T magnets



Required input on baseline and alternative scenarios

- **Linear Collider at CERN (CLIC, ...)**
Input via “Linear Collider community”
(technical feasibility, physics potential, what energies, energy upgrades?, timeline, **cost update**, environmental impact)
- **Muon Collider at CERN**
Input via “Muon Collider community”
(technical feasibility, physics potential, R&D steps, timeline – for R&D and construction -, cost, environmental impact)
- **Further exploitation of LHC physics programme**

(**physics potential, technical feasibility, R&D steps, timeline, cost**, environmental impact)



Next Steps

- We plan to inform the community soon, before the summer break, providing more details
- Web page with links to basic documents, timeline, how to submit input etc. to be set up
- Physic Preparatory Group will be completed by Council in its September meeting (appointing of SPC and ECFA members, on recommendation by SPC/ECFA)

