National input from the United Kingdom to the 2026 Update to the European Strategy for Particle Physics: Addendum on prioritisation of alternative options if the preferred option is not feasible or not competitive

Compiled on behalf of the UK's national particle physics community

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The UK community held further discussions in October 2025 to prepare this addendum, supported by online polls conducted before and during the meeting to gauge the level of consensus. This document provides answers to the three questions posed by the ESG related to possible "plan B" alternatives in the scenarios that the preferred next flagship collider is either not feasible or not competitive. More detailed discussions of the alternative scenarios, but without prioritisation, can be found in the first UK submission to the ESPPU.[1]

In formulating this input, the community reaffirmed that maintaining the diversity of the European particle physics programme should remain a core principle, even if this means progressing more gradually with future colliders and/or intermediate projects to ensure balance and long-term sustainability of the field.

1 What is the preferred large-scale post-LHC accelerator for CERN?

The UK community's preferred large-scale post-LHC accelerator is a new large-circumference tunnel at CERN (the FCC tunnel), enabling an integrated FCC-ee → FCC-hh programme or a direct FCC-hh pathway.

The community strongly supports this vision while emphasising the need for continued diversity of CERN's programme, which is essential to the field's vitality. Recognising that such an endeavour will require substantial resources beyond CERN's current budget, the UK community gives CERN a clear mandate to seek additional funding and expresses full support for its leadership in pursuing this.

2 What is the preferred alternative, if the preferred option is not feasible?

Taking the preferred plan A to be FCC proceeding on the current proposed timescales two pathways are considered in this scenario.

2.a FCC delayed by > 10 years

If the start of FCC were delayed by around a decade in addition to the current baseline interval between the end of HL-LHC operation and the start of FCC-ee, the highest priority would be to maintain momentum toward the FCC through an appropriate intermediate programme.

In this case, community discussions showed a modest preference for further exploiting the existing LHC infrastructure within budget constraints. Additional notable physics can be obtained by extending p–p collisions and exploiting additional facilities such as those targeting forward (FPF) and transverse physics, and those enabling e–p and e–ion collisions via an LHeC. Realising LHeC requires the development of novel energy recovery linac (ERL) technologies to deliver the strongest scientific impact. It was also discussed that e-p collisions with reduced ERL

[1] https://indico.cern.ch/event/1439855/contributions/6461578/

performance, or no ERL, could be considered to reduce both the cost and construction duration of the project whilst still providing unique physics output.

LEP3 received more limited support, partly due to its early stage of conceptual development and concerns about its possible impact (including causing possible delays) on the FCC programme. It was nevertheless recognised as a potentially useful element in a strategy that provides continuity of collider physics at CERN and preserves flexibility, including potentially critical flexibility on the timing of the tunnel spend. Ideally, feasibility work on both LEP3 and LHeC would have allowed a more balanced assessment, but the community was effectively required to form a view in the absence of studies of sufficient maturity.

2.b FCC is technologically or financially unfeasible

In the case that FCC is unaffordable the plan-B alternative should be affordable without an increase in the CERN subscription beyond the usual indexing, and without relying on special contributions beyond in-kind, proportionate contributions from non-member states.

The three guiding principles under this scenario are:

- Avoiding a long (>10 year) gap in collider physics at CERN
- Maintaining strategic flexibility to eventually reach the 10 TeV pCM scale.
- Preserving the diversity of the particle physics programme as an essential element of Europe's strength and balance.

Under this scenario CERN should pursue

- An intermediate collider project as already discussed above with the preference toward further exploiting the existing LHC infrastructure (p-p/FPF, e-p, e-ion, LEP3, as outlined above).
- A significant, sustained accelerator R&D programme toward the 10 TeV pCM scale. High-priority topics identified by the community include high-field magnets and novel acceleration technologies (muon collider demonstrators, plasma wakefield accelerators), and R+D towards more environmentally sustainable accelerators.

A linear collider remains a scientifically strong option with an established road-map, for which there is solid but not majority support within the community. Whilst subsequent higher energy upgrades would provide decades of collider output at CERN, concerns about the lack of a clear route to the 10 TeV pCM energy scale were raised. Along with high energy hadron colliders there was some support for a muon collider to access the 10 TeV pCM scale but this would require a longer R&D road-map.

3 What is the preferred alternative, if the preferred option is not competitive?

The UK community took note of the recent announcement from CEPC. The answer to this question was considered based on an alternative e^+e^- collider becoming available in the 10 years following the HL-LHC. In this case the top priority of the UK community is to develop FCC-hh, possibly at a lower energy, in a shorter time frame. An intermediate bridging project, as discussed above, should be pursued in parallel to avoid more than a decade gap in collider physics at CERN.