European Strategy for Particle Physics 2026 Update – WG1 Report

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- Responses to the questions outlined in Section 3 of the ECFA guidelines for input from national HEP communities to the European Strategy for Particle Physics Update.
- Input from the **national HEP** communities.
- Two submission rounds: 31 March and 26 May.

Core aspects of national submissions

- Each national contribution (MS and AMS) to the European Strategy for Particle Physics 2026 Update is the result of a **bottom-up** process of coordinated community consultations, including workshops, surveys, and written inputs from scientists and institutions, culminating in a comprehensive document reflecting national priorities, scientific interests, and strategic recommendations.

- Many national contributions include an **overview of each country's current involvement in particle physics across experiments, theory, and technological development**.

- They outline national priorities for the successful operation of the full HL-LHC programme, future collider projects - such as circular, linear, or muon colliders - and comment on the scientific merit of non-collider initiatives, including neutrino experiments, dark matter searches, and astroparticle physics.

- These documents also present **perspectives on key technological developments in detectors and accelerators**, discuss sustainability and resource implications, and reflect on funding considerations.

- In addition, they emphasize the importance of **education, outreach, and talent development**, while offering recommendations on strengthening international collaboration and ensuring a strong European role in the global particle physics landscape.

- They reflect both **national ambitions** and a **commitment** to shared European and global scientific agendas.

- The documents share **long-term ideas** and suggest ways for each country to contribute to the future of particle physics.

Core aspects of national submissions

- Contributions from Non-Member States to the ESPPU reflects their commitment to advancing global particle physics and their strong interest in collaborating on Europe's major scientific initiatives.

- These contributions highlight support for future flagship projects at CERN - particularly the Higgs factory - as well as innovation in areas such as detector development and accelerator technologies.

- They also reflect shared scientific priorities, emphasize the value of continued R&D and training, and support strategic international partnerships that align with European goals.

Questions to be considered by countries/regions when forming and submitting their "national input" to the ESPP:
https://ecfa.web.cern.ch/ecfa-guidelines-inputs-national-hep-communities-european-strategy-particle-physics-0

a) Which is the preferred next major/flagship collider project for CERN?

b) What are the most important elements in the response to (a)?
i) Physics potential, ii) Long-term perspective, iii) Financial and human resources: requirements and effect on other projects, iv) Timing, v) Careers and training, vi) Sustainability

c) Should CERN/Europe proceed with the preferred option set out in (a) or should alternative options be considered:
i) if Japan proceeds with the ILC in a timely way? ii) if China proceeds with the CEPC on the announced timescale? iii) if the US proceeds with a muon collider? iv) if there are major new (unexpected) results from the HL-LHC or other HEP experiments?

d) Beyond the preferred option in (a), what other accelerator R&D topics (e.g. Highfield magnets, RF technology, alternative accelerators/colliders) should be pursued in parallel?

e) What is the prioritised list of alternative options if the preferred option set out in (a) is not feasible (due to cost, timing, international developments, or for other reasons)?

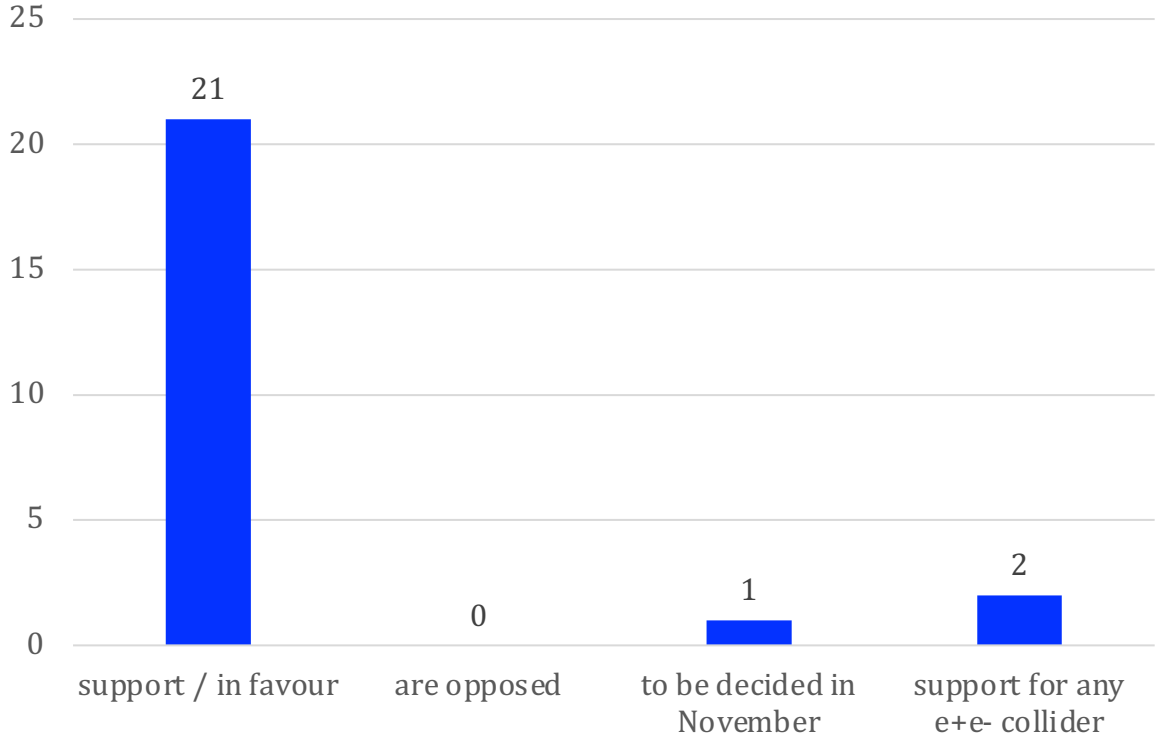
f) What are the most important elements in the response to (e)? (The set of considerations in 3b should be used).

a) Which is the preferred next major/flagship collider project for CERN?

- **Broad consensus** among CERN Member States in support of the Future Circular Collider (FCC) integrated ee and hh programme as a key long-term project to maintain Europe's leadership in particle physics. (21 MS countries)
- **A phased approach** starting with the FCC-ee and transitioning to the FCC-hh has been supported for its strategic continuity, and re-use of existing infrastructure for the second phase of the project. (19 MS countries)
- The FCC-ee is **widely identified** as the preferred next flagship project due to its large potential as a Higgs and electroweak physics factory, scientific value, and technical feasibility. (20 MS countries)
- Strong support for **constructing the 91 km tunnel**, enabling future flexibility that supports both electron-positron (FCC-ee) and hadron-hadron (FCC-hh) collider.
- Alternative projects (e.g., Linear Collider Facility @CERN, CLIC, LEP3, LHeC) are mentioned, though none are seen as having the same comprehensive potential as the FCC.
- Delays would risk CERN's leadership and reduce global engagement.
- Strategic planning and financial viability are highlighted as key factors in decision-making.
- There is considerable support for fast-tracking FCC-hh with the present baseline design, with 14 T magnets and 85 TeV centre-of-mass energy to secure Europe's leadership in exploring high-energy frontiers.

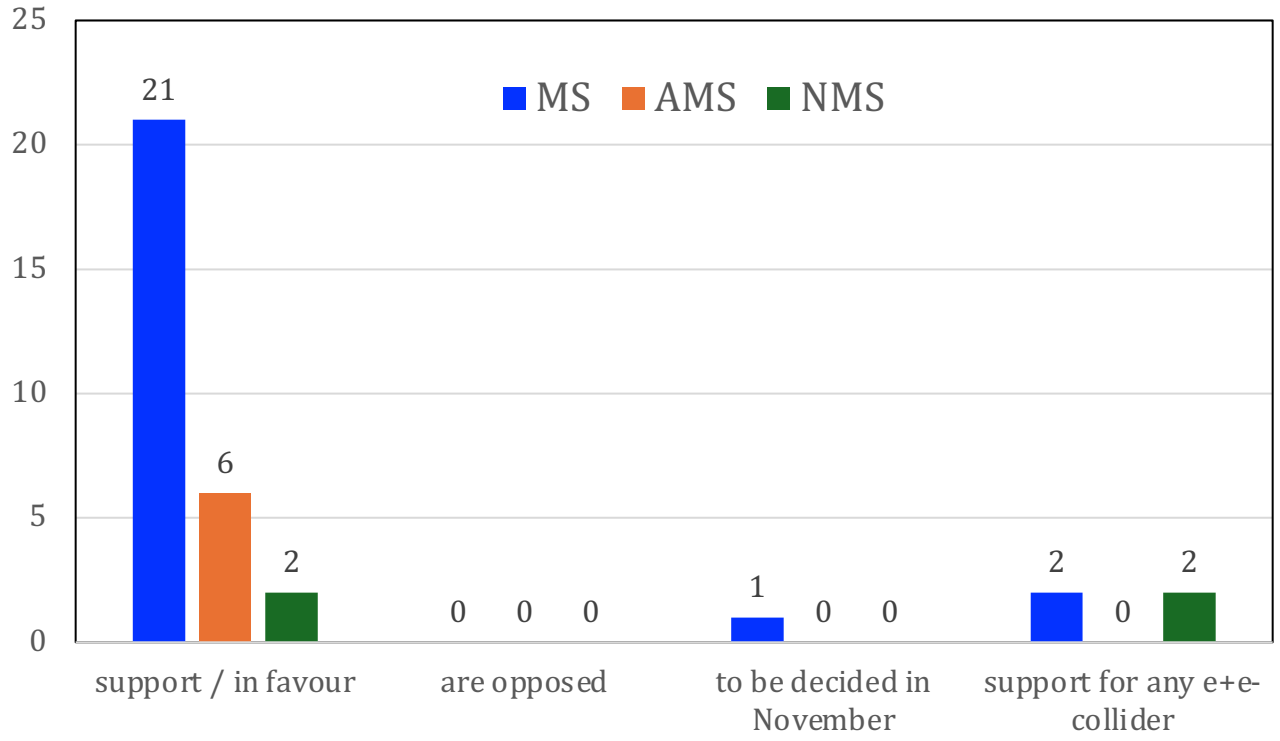
a) Which is the preferred next major/flagship collider project for CERN?

- **Broad consensus** among CERN Member States in support of the Future Circular Collider (FCC) as a key long-term project to maintain Europe's leadership in particle physics.



Support for FCC	Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom
Opposed	None
To be finalized in November	Netherlands
Support for any e^+e^- collider	Austria, Bulgaria

a) Which is the preferred next major/flagship collider project for CERN?



Support for FCC	MS: Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom
	AMS: Brazil, Croatia, Lithuania, Pakistan, Slovenia, Ukraine
	NMS: Canada, United States of America (The U.S. supports FCC-ee as the next major flagship project at CERN)
Opposed	None
To be finalized in November	Netherlands
Support for any e^+e^- collider	MS: Austria, Bulgaria; NMS: Australia, Japan

b) What are the most important elements in the response to 3a)? i) *Physics Potential*; ii) *Long-Term Vision*; iii) *Financial and human resources: requirements and effects on other projects*; iv) *Timing*; v) *Careers and training*; vi) *Sustainability*

- **The FCC project is widely supported for its outstanding physics potential and long-term strategic value.**
- **The investment is expected to yield long-term scientific and technological returns while maintaining Europe's leadership in particle physics.**
- **Human resources development** is considered a key aspect.
- Risks related to a potential post-HL-LHC gap in accelerator activity is noted, with **concerns raised about knowledge loss**.
- The challenges of early-career researchers **are recognized as important**.
  *(ECR perspective, Christina Dimitriadi (KTH), Ulrich Einhaus (KIT Karlsruhe), at 10:45)
- **Sustainability is widely considered to be a foundational principle.**

** A complete AMS and NMS input synthesis will be included in our future reports.*

c) Should CERN/Europe proceed with the preferred option set out in (a) or should alternative options be considered.

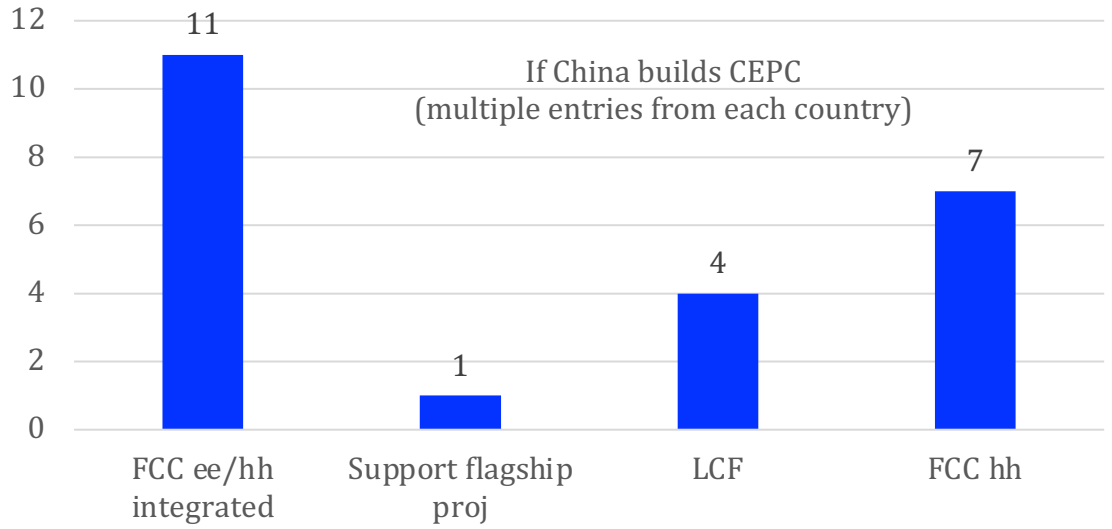
i. If Japan proceeds with the ILC in a timely way

National inputs that consider a potential ILC in Japan, consistently favour maintaining the FCC project.
The ILC is generally seen as having less physics potential and offering only a medium-term scientific perspective.
Several countries recall that a commitment from Japan has not yet been made.

ii. If China proceeds with the CEPC on the announced timescale

There's no unanimous view among the national inputs.
The largest set of inputs suggest sticking with the FCC-ee/hh integrated project.
Of the ones who suggest a switch, the majority shift focus to the FCC-hh, likely limited to 85-90 TeV due to technology limits. Only one input proposes dropping the FCC altogether.

FCC ee/hh integrated	BE, CH, DK, FI, FR, GR, HU, IT, PL, PT, SE
Support flagship	ES
LCF	DE, FR, NO, PT
FCC hh	AT, CZ, DE, FI, FR, PT, RS, UK



c) Should CERN/Europe proceed with the preferred option set out in (a) or should alternative options be considered.

iii. If the US proceeds with a muon collider

A muon collider faces higher technical risks and a longer development timeline.

By and large, national MS HEP community inputs see no reason to change the choice of preferred collider.

The P5 has suggested budget scenarios where both the muon collider demonstrator and the FCC-ee could be accommodated with minimal conflicts expected. A potential U.S. hosted muon collider will likely follow the completion of the FCC-ee construction. Given this, a planned muon collider effort in the U.S. should not influence the decision to move forward with the FCC-ee program at CERN.

At the request of the DOE and the NSF, the National Academies conducted a study to explore the long-term goals and future ambitions for particle physics. The recently-released study also envisions a dedicated U.S. national R&D program, with international coordination, including a muon collider technology demonstrator within the next 20 years as well as participation in the international Future Circular Collider Higgs factory currently under study at CERN.

iv. If there are major new (unexpected) results from the HL-LHC or other HEP experiments

Although some Member States acknowledge that the HL-LHC or other experiments might yield surprises and consider a possible extension of the HL-LHC, there is a strong agreement that any delay would be detrimental to the overall scientific program of CERN.

d) Beyond the preferred option, what other accelerator R&D topics?

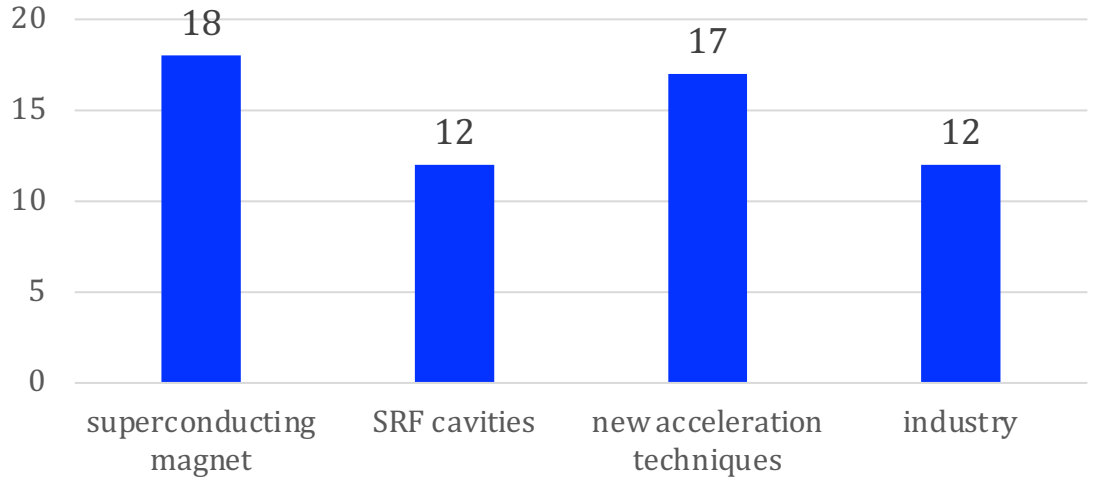
- Continued innovation in **superconducting magnet technology**, especially using HTS, is deemed essential for collider performance limits to be pushed.

- **High-performance SRF cavities** are regarded as foundational for linear and circular accelerators, with research targeted at higher gradients and quality factors and industrial application transition.

- **Groundbreaking methods** such as Plasma Wakefield Acceleration, Muon Acceleration and Cooling, Energy Recovery Linacs, and Terahertz Acceleration are to be invested in, requiring extensive R&D and demonstration facilities.

- **Industry engagement** is to be strengthened to accelerate technology transfer and innovation. Accelerator R&D benefits beyond particle physics - to medicine, energy, and other infrastructures - are to be highlighted to support investment.

Superconducting magnet technology	AT, BE, CH, DE, DK, ES, FI, FR, GR IT, NL,PL, PT, RO, RS, SE, SK, UK
SRF cavities	AT, BE, DE, ES, FI, FR, GR, IT, PL, RO, RS, UK
New acceleration techniques	AT, BE, DE, DK, EE, ES, FR, GR, IT, NL, PL, PT, RO, RS, SE, SK, UK
Industry engagement	AT, BE, DE, ES, FR, IT, NL, PL, RO, RS, SE, UK



- Among the accelerator R&D priorities, the U.S. has focused on superconducting magnet technology, high-performance SRF cavities, and new acceleration techniques. (not counted in the histogram)

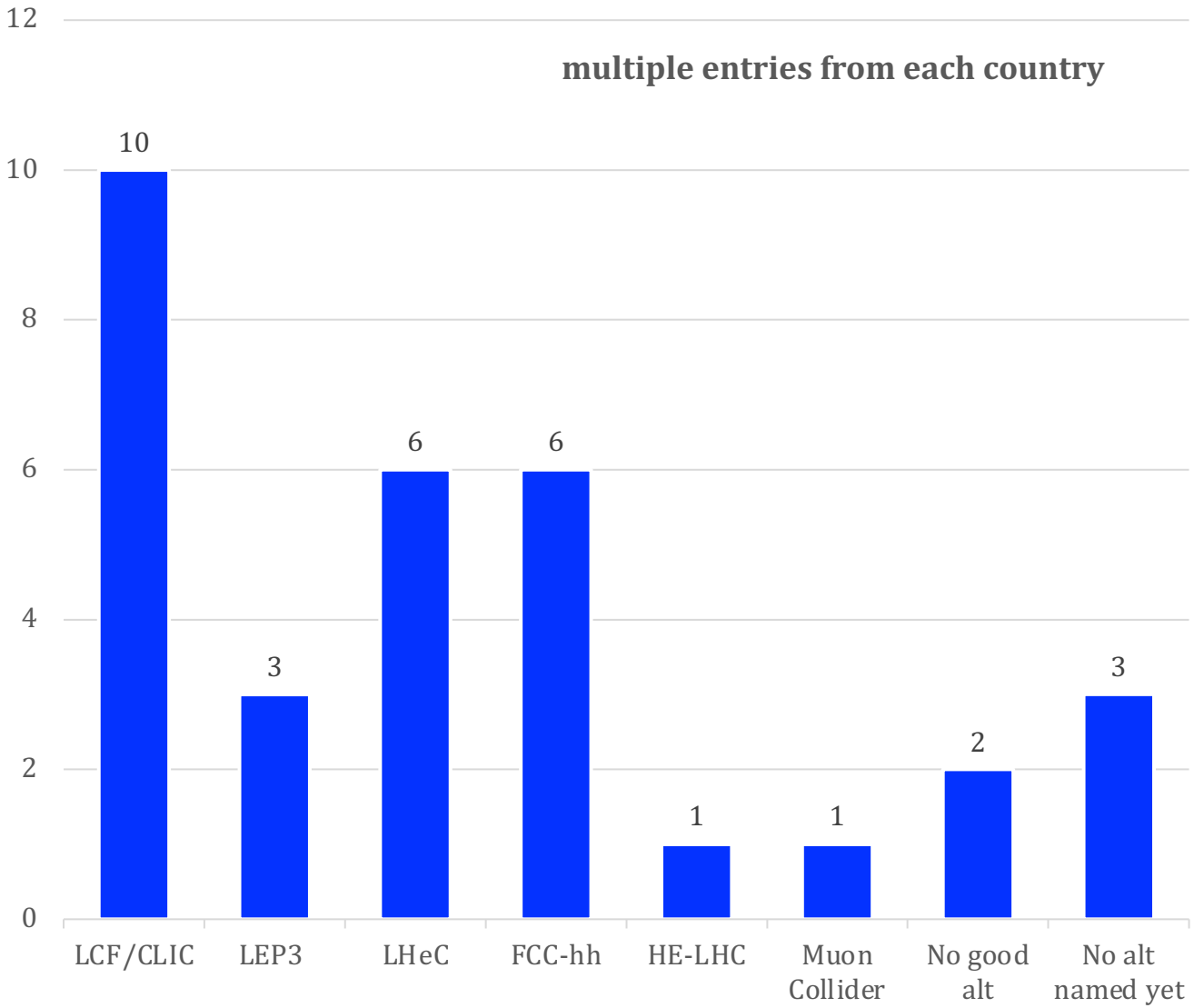
e) What is the prioritised list of alternative options if the preferred option is not feasible?

- Ten countries (DE, ES, FI, FR, NO, PL, PT, SE, RS, SK) list a linear collider at CERN as the second-best choice, with one (FI) mentioning the need for it to be affordable and another (UK) highlighting it as a viable strategic alternative. Two (DE, ES) of these countries highlight the benefits of polarized beams, the potential for two interaction points, and its ability to be upgraded.

- Two countries (CH, HU) see no reason for another option, as they would be equally costly.

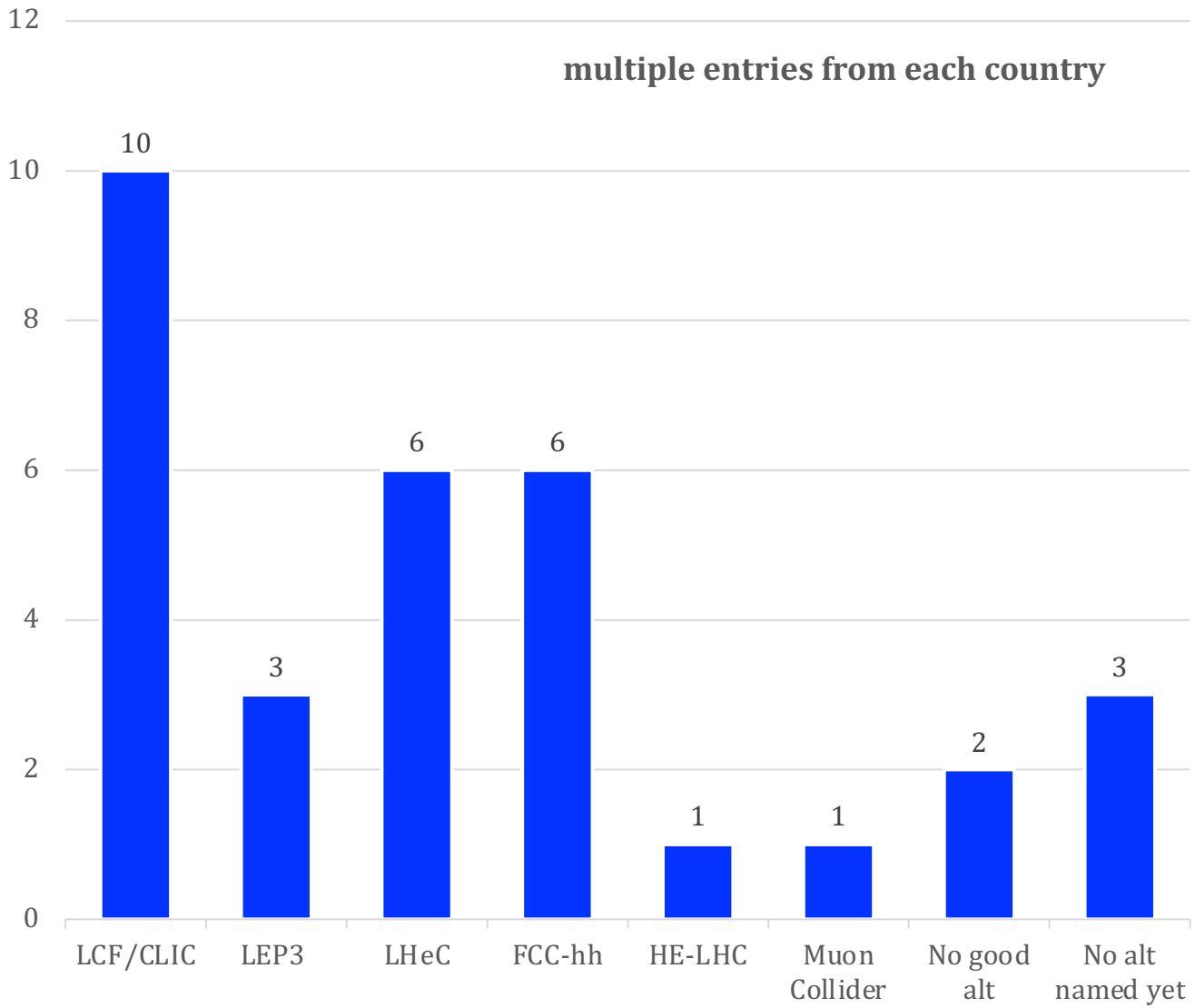
- Three countries (BE, GR, UK) mention LEP3 as a genuinely less costly alternative to the FCC-ee.

- No prioritised alternatives have been named yet by three other countries (CZ, DK, SK). The U.S. national input did not express a prioritized list.



e) What is the prioritised list of alternative options if the preferred option is not feasible?

- Two countries (AT, NL) aren't yet committed to a preferred option. One country (NL) suggests a feasibility study for at least one alternative to the FCC-ee.
- A muon collider would be the top alternative for one country (GR), and an option for later consideration for two others (RS, NO). For other countries, it's seen as interesting but not yet ready.
- Six countries (BE, DE, FR, NL, SE, UK) support the LHeC, mostly as an intermediate project.
- Hadron collider options are also mentioned by five other countries (DE, IT, RS, GR, UK). One country (RO) brings up a lower energy hadron collider with an ep collision option.



f) What are the most important elements in the response to (e)?

- *Physics Potential:*
  - The selected project should address fundamental questions in particle physics and demonstrate strong potential for either groundbreaking discoveries or high-precision measurements. This criterion is emphasized by 12 countries (AT, BE, DK, ES, FI, GR, NO, PL, RS, CH, SE, UK).
  - While some alternative proposals may involve compromises - such as reduced energy or luminosity compared to the preferred FCC program (BE, CH, SE, UK, RS) - their scientific objectives should nonetheless align with the community's strategic priorities, for example by serving as a dedicated Higgs factory (DE, PL, UK). Moreover, these alternatives are expected to either explore complementary physics domains or build upon the results anticipated from the HL-LHC (AT, BE, DK, FI, NO).

- *Financial and Human Resources / Cost / Affordability:* These considerations become particularly important if the preferred option proves unfeasible primarily due to cost - a concern highlighted by six countries (BE, DE, GR, NO, RO, RS). In such cases, three countries (AT, BE, NO) regard less resource-intensive projects, or those that can be realized within existing budgetary frameworks, as viable alternatives.

- *Timing:* To maintain expertise and provide opportunities for the community, especially for early-career researchers, it is crucial to ensure the research program continues without long gaps between major facilities, a point emphasized by 10 countries (BE, CA, DK, GR, RO, RS, FI, ES, UK, SI).

- *Long-term Perspective / Maintaining CERN's Role:* Alternatives are assessed based on their potential to advance particle physics and to reinforce CERN's status as a leading global centre in the field, a point highlighted by nine countries (AT, BE, FI, GR, RO, RS, SE, UK, SI). The evaluation also considers the potential for future upgrades or subsequent phases, such as the development of hadron colliders following lepton colliders, which was noted by four countries (PL, SI, SE, CH).

f) What are the most important elements in the response to (e)?

- *Careers and Training:* A key concern addressed by pursuing new projects is providing opportunities for young scientists and engineers and preventing a loss of expertise in the field, as highlighted by 9 countries (DK, FI, GR, IT, RO, RS, ES, UK, SI).

- *International Developments:* The global landscape of projects, such as the ILC, CEPC, and Muon Collider, can influence the strategic choice of alternatives at CERN to ensure complementarity or competitiveness, a factor highlighted by 4 countries (DK, GR, RO, RS).

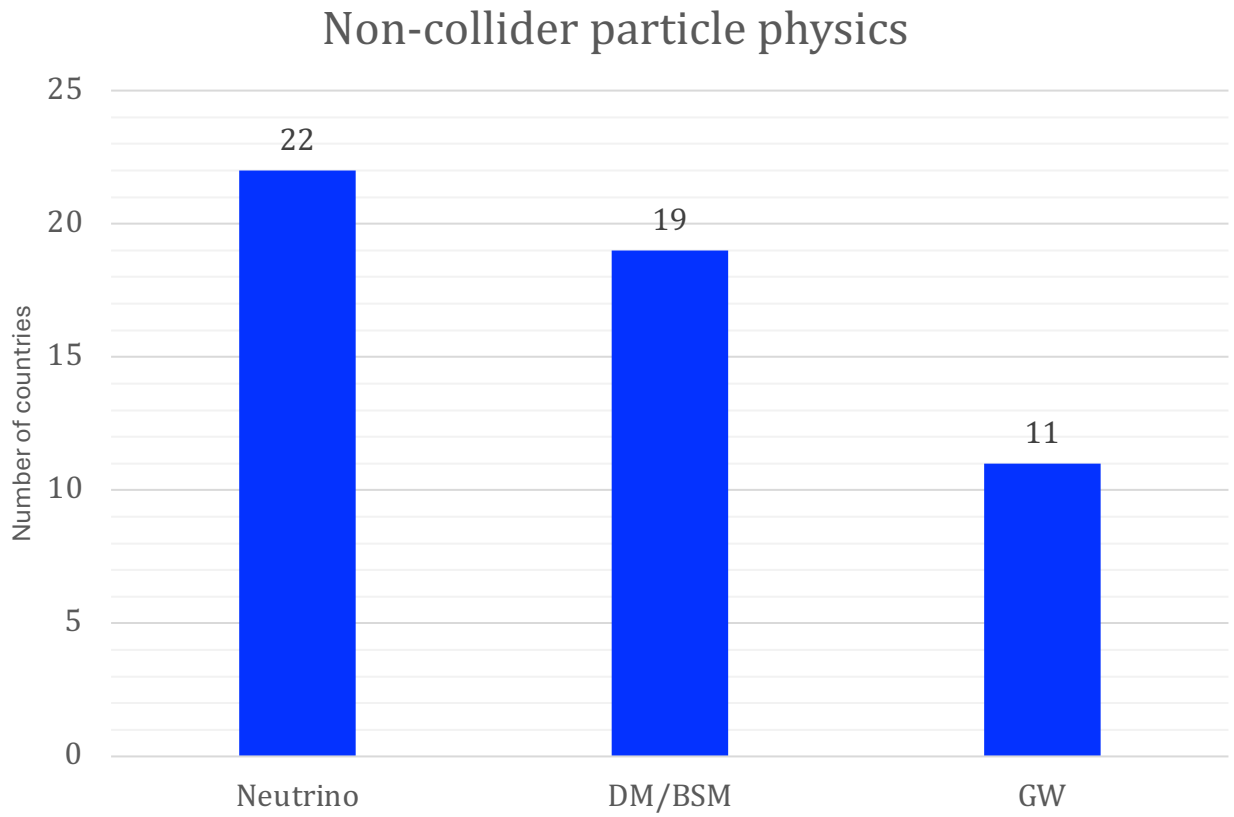
- *Sustainability:* While sometimes not the top priority compared to physics or cost, the environmental impact and long-term energy sustainability are recognized as important factors for future projects by 9 countries (BE, ES, GR, RO, RS, DK, FR, SI, UK).

- Some countries didn't present prioritized alternatives.

- Three countries (CH, HU, SE) believe no truly viable alternative exists compared to the preferred program, based on factors like physics potential, timeline, or community support.

Concluding remarks

- The national contributions highlight national scientific priorities and strategic recommendations.
- One of the **key messages is the broad support** for the FCC integrated ee and hh programme, which clearly stands out as the top-priority option for the future of collider-based particle physics.
- If the FCC is not feasible, **no clear consensus on an alternative collider path emerges yet**, underscoring the importance of **continued dialogue and assessment**.
- Reminder: national HEP communities may, and are encouraged, to address the question of alternative options by submitting **updated contributions by 14 November 2025**.
- **Strong and consistent support for accelerator R&D**, recognizing its essential role in enabling future discoveries and maintaining technological leadership.
- **Near unanimity that we should keep Europe at the forefront of particle physics.**



Many countries consider that is it essential to pursue non-collider particle physics in addition to main collider program.

Neutrino	BE, BG, CZ, DK, FI, FR, DE, GR, HU, IL, IT, NL, NO, PL, PT, RO, RS, SK, ES, SW, CH, UK
DM/BSM	AT, BG, DK, FI, FR, DE, GR, IL, IT, NL, NO, PL, PT, RO, RS, ES, SW, CH, UK
GW	AT, BE, FI, FR, DE, GR, IL, IT, NL, NO, PL, PT, RO, RS, ES, SW, CH, UK