

Future Circular Collider (FCC) - Status

LCWS2024, The University of Tokyo, 8 July 2024

Michael Benedikt, Frank Zimmermann, CERN
on behalf of FCC collaboration & FCCIS DS team



Swiss Accelerator
Research and
Technology

<http://cern.ch/fcc>

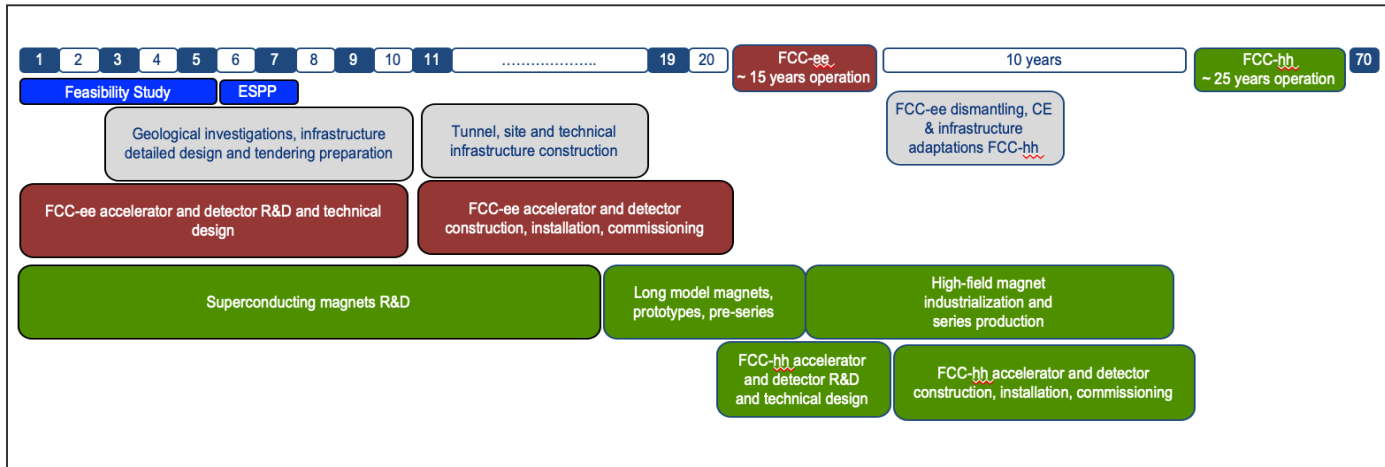


European
Commission

Horizon 2020
European Union funding
for Research & Innovation

FCC integrated program – “accelerated” schedule

FCC Conceptual Design Study started in 2014 leading to CDR in 2018



“Realistic” schedule taking into account:

- past experience in building colliders at CERN
- approval timeline: ESPP, Council decision
- that HL-LHC will run until 2041

Can be further accelerated if more resources become available

FS Mid-Term Review passed !

Deliverables:

- D1 : Definition of the baseline scenario
- D2 : Civil engineering
- D3 : Processes and implementation studies with the Host States
- D4 : Technical infrastructure
- D5 : FCC-ee accelerator
- D6: FCC-hh accelerator
- D7: Project cost and financial feasibility
- D8: Physics, experiments and detectors

Documents:

- Mid-term report (all deliverables except D7)
- Executive Summary of mid-term report
- Updated cost assessment (D7)
- Funding model (D7)

Approved deliverables:
https://indico.cern.ch/event/1197445/contributions/5034859/attachments/2510649/4315140/spc-e-1183-Rev2-c-e-3654-Rev2_FCC_Mid_Term_Review.pdf

All deliverables met, no technical showstoppers



Full Report

8 Chapters/Deliverables

~ 700 pp document

~ 16 editors

~ 500 contributors

Review process:

Oct
2023:

- **FCC Scientific Advisory Committee** chaired by Andrew Parker / Cambridge (sci. and tech. aspects)
- **Cost Review Panel** chaired by Norbert Holtkamp / Stanford (ad hoc committee; cost and financial asp.)

Nov
2023:

- **CERN Scientific Policy Committee** and **CERN Finance Committee**

2 Feb
2024:

- **CERN Council**

→ **70-80 recommendations**

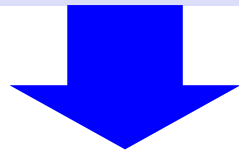
Main goals 2024 / beginning 2025

Complete technical work for Feasibility Study until end 2024

- Implementation of recommendations from the mid-term review
- Focus on “feasibility items” and items with important impact on cost/performance
- Develop a risk register
- Update cost estimate to reach cat 3 level on cost uncertainty.
- Further develop the funding model based on discussions with the Council

Continue work with host states on:

- project definition and responsibilities
- authorization procedures
- excavation material strategy
- regional implementation development



Conclude FS by March 2025 as input for ESPP update

Regional implementation activities

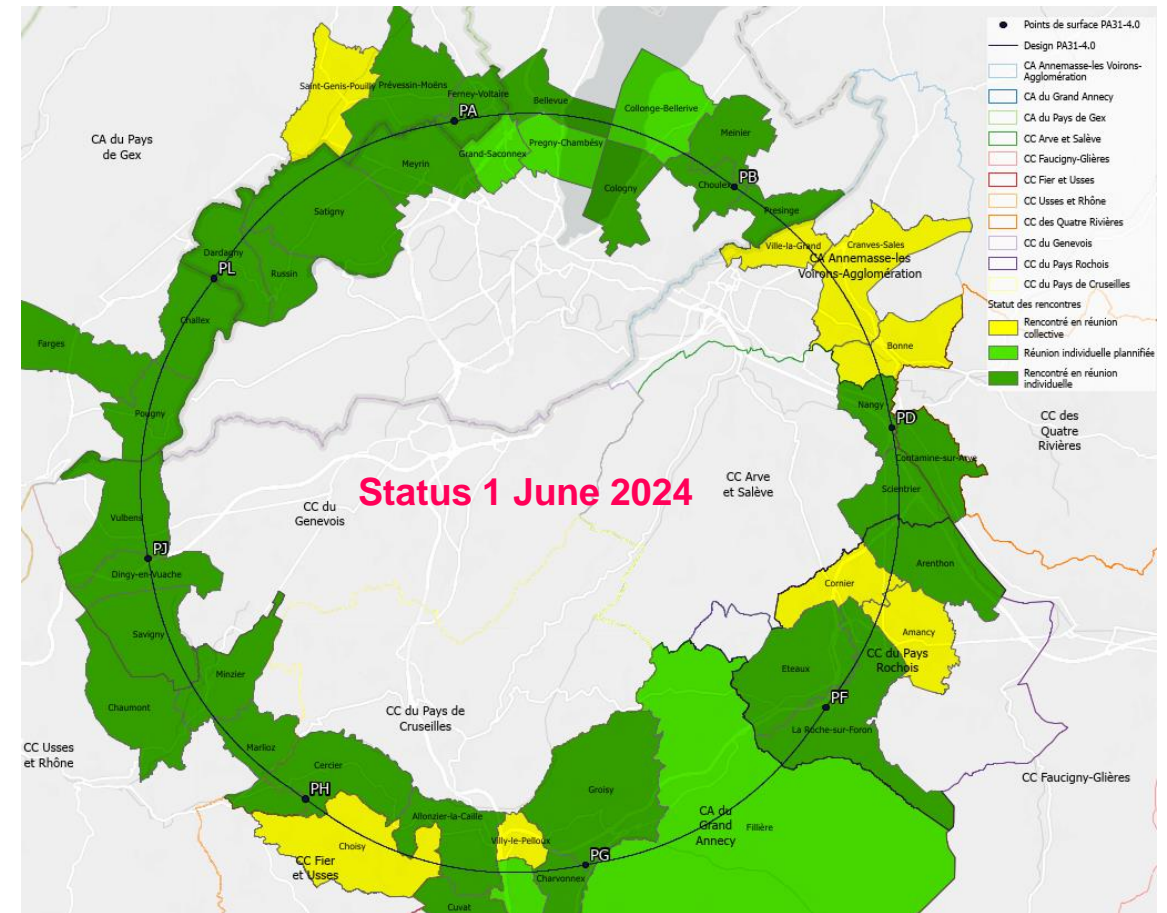
Meetings with municipalities in France (31) and Switzerland (10)

- PA – Ferney Voltaire (FR) – experiment site
- PB – Présinge/Choulex (CH) – technical site
- PD – Nangy (FR) – experiment site
- PF – Roche sur Foron/Etaux (FR) – technical site
- PG – Charvonnex/Groisy (FR) – experiment site
- PH – Cercier (FR) – technical site
- PJ – Vulbens/Dingy en Vuache (FR) experiment site
- PL – Challex (FR) – technical site

Detailed work with municipalities and host states

- identify land plots for surface sites
- understand specific aspects for design
- identify opportunities (waste heat, techn.)
- reserve land plots until project decision

→ The support of the host states is greatly appreciated and essential for the study progress!



Individual meeting

Individual meeting planned

Collective meeting

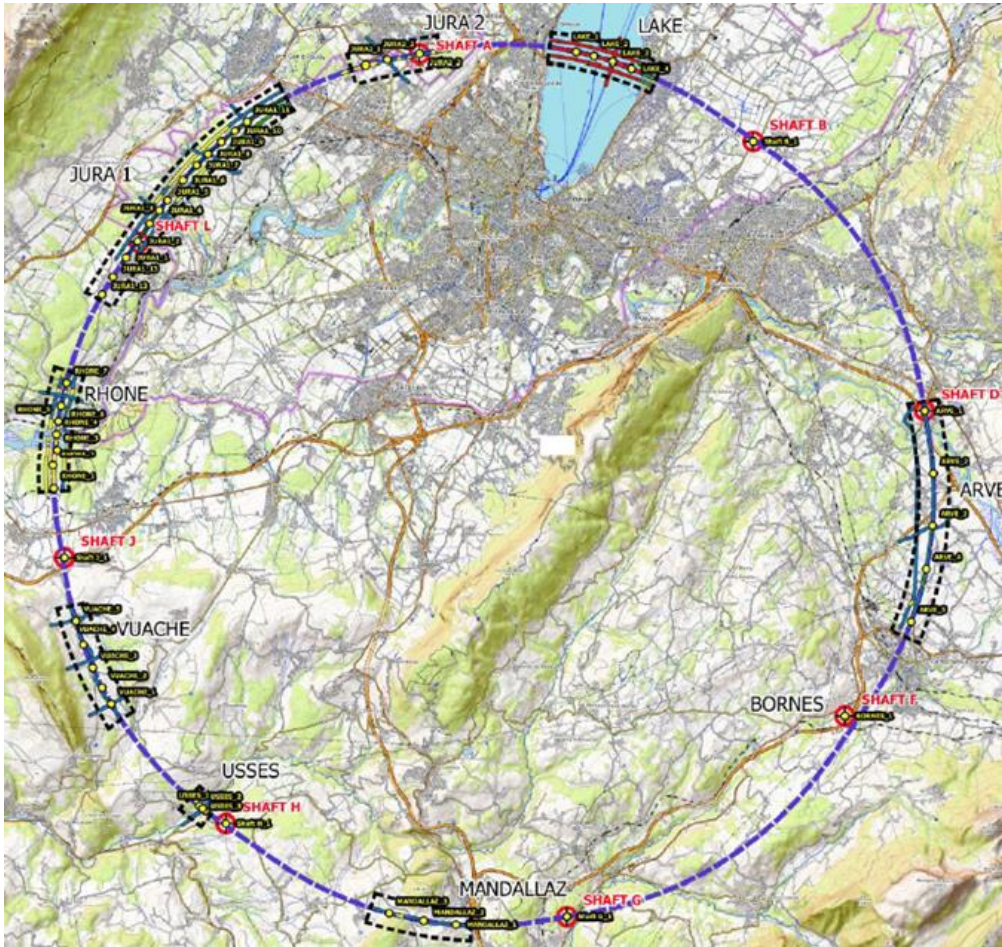
Status site investigations

Site investigations to identify exact location of geological interfaces:

- Molasse layer vs moraines/limestone
- ~30 drillings
- ~100 km seismic lines

→ Start in July/August 2024

→ Vertical position and inclination of tunnel



Sondage A89 (2007) incliné de 45° de 125 ml (surface plateforme estimée : 12 x 12 m soit environ 150 m²)



Drilling work on the lake

Public information / engaging sessions

First public information and discussion meeting at the Science Gateway on 24 April at CERN



- Meeting for local community (CH, F)
- Discussion about "Progress of the Feasibility Study of the Future FCC circular collider"

La Roche-sur-Foron - Haute Savoie international fair, 27 April to 6 May

Unveiling the science of tomorrow: FCC Study takes centre stage at La Roche-sur-Foron exhibition

The Future Circular Collider team discussed the project's status and aspirations with a large number of attendees

15 MAY, 2024 | By Zoe Nikolaidou



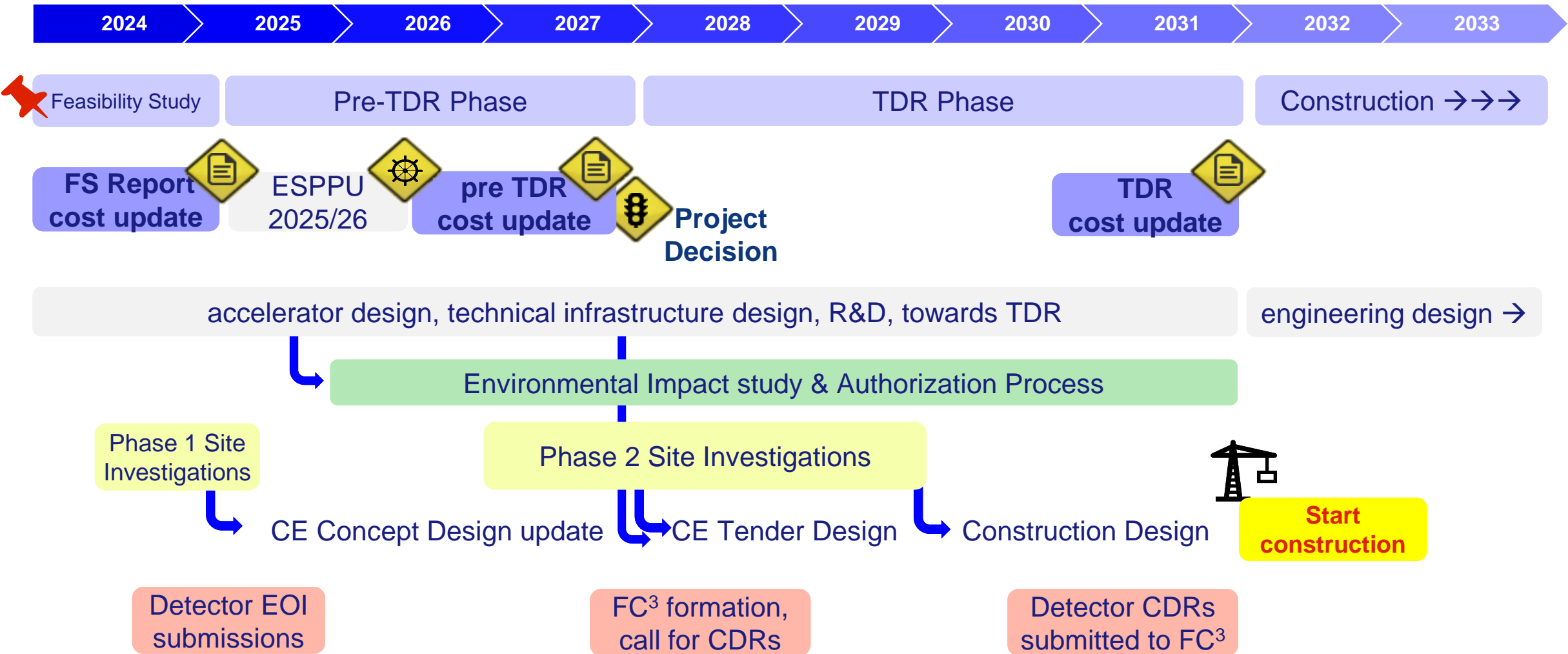
- CERN's participation enhanced by help of volunteers from the FCC team
- Discussions with over 2000 locals
- Various topics (from the required technological advancements to sustainability measures)

On 15 May, RTS (Radio Télévision Suisse) broadcasted a special program celebrating CERN's 70th anniversary and hosted at CERN's Science Gateway.



- Comprehensive look at CERN's history, achievements, and future ambitions (FCC)
- Study experts interacting with the audience explaining the Future Circular Collider (FCC) project

Timeline till start of construction



Status of FCC global collaboration

Increasing international collaboration as a prerequisite for success:

→ links with **science, research & development** and **high-tech industry** will be essential to further advance and prepare the implementation of FCC



FCC Feasibility Study:

Aim is to further increase the collaboration, on all aspects, in particular on Accelerator and Particle/Experiments/Detectors

**141
Institutes**

**32
countries
+
CERN**



FCC Week 2024

Complete status of the FCC Study and all the latest advancements were presented at the Future Circular Collider Week 2024, in San Francisco, 10-14 June 2024

<https://fccweek2024.web.cern.ch/>



449 participants : 75 remote, 374 on site



Progress on international collaboration

Joint Statement of Intent between The United States of America and The European Organization for Nuclear Research concerning Future Planning for Large Research Infrastructure Facilities, Advanced Scientific Computing, and Open Science

26 April 2024

White House Office of Science and Technology Policy Principal Deputy U.S. Chief Technology Officer Deirdre Mulligan signed for the United States while Director-General Fabiola Gianotti signed for CERN.

The United States and CERN intend to:

- ◆ Enhance collaboration in future planning activities for large-scale, resource-intensive facilities with the goal of providing a sustainable and responsible pathway for the peaceful use of future accelerator technologies;
- ◆ Continue to collaborate in the feasibility study of the Future Circular Collider Higgs Factory (FCC-ee), the proposed major research facility planned to be hosted in Europe by CERN with international participation, with the intent of strengthening the global scientific enterprise and providing a clear pathway for future activities in open and trusted research environments; and
- ◆ Discuss potential collaboration on pilot projects on incorporating new analytics techniques and tools such as artificial intelligence (AI) into particle physics research at scale.

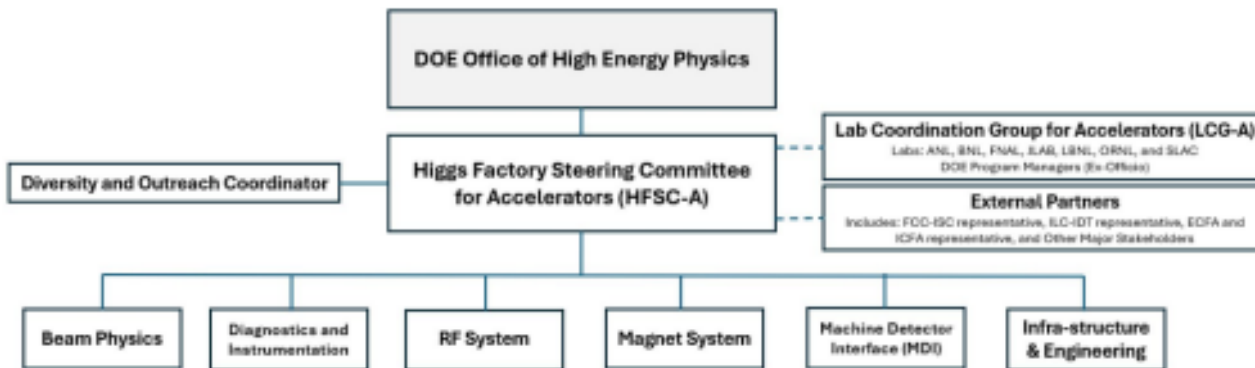
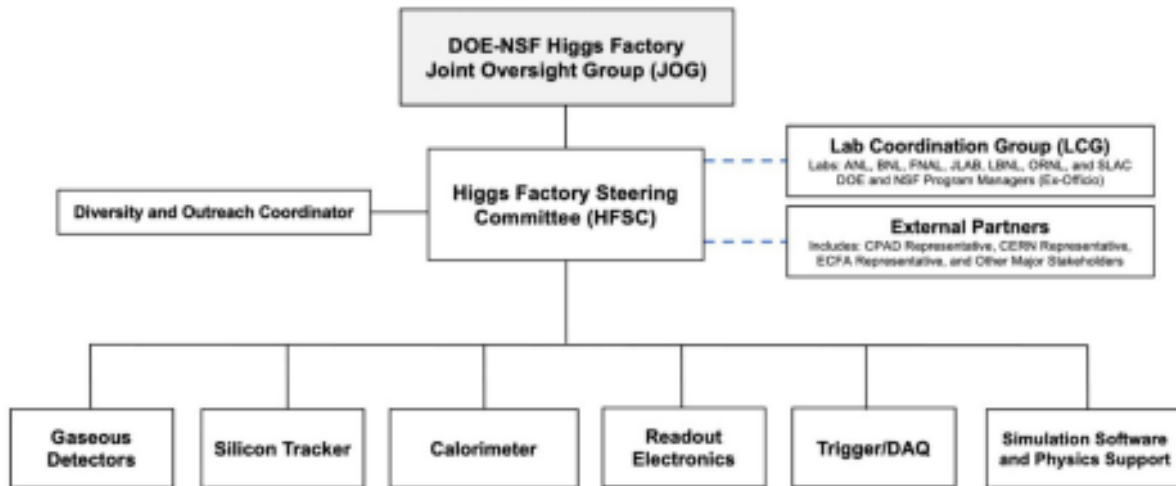
Should the CERN Member States determine the FCC-ee is likely to be CERN's next world-leading research facility following the high-luminosity Large Hadron Collider, the United States intends to collaborate on its construction and physics exploitation, subject to appropriate domestic approvals



US Organisation for Higgs Factory

DOE and NSF Higgs factory organisation

(organizations will evolve to follow the needs of the community)



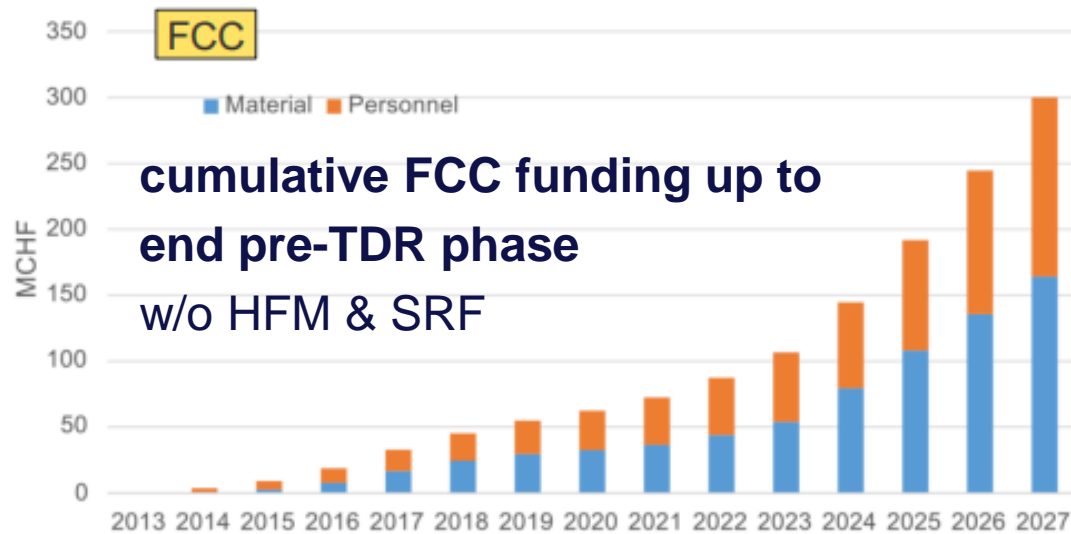
Charge

1. Physics and technical feasibility studies, including any associated design and R&D efforts, to advance various experiment detector concepts at a future Higgs factory;
 2. Prioritization and stewardship of the national R&D efforts should funds be identified by DOE and/or NSF;
 3. Development of the pre-project detector R&D scope that will be required prior to DOE and/or NSF initiating any detector project at a future e+e- collider;
 4. Conceptualization of the software and computing framework that will be needed to advance physics studies and R&D efforts; and to collect, store, and analyze the large volumes of physics data at future collider experiments;
 5. In consultation with DOE and NSF program managers, develop various funding models that will be required to support the R&D efforts described in items (3) and (4) above; and
 6. Ensure collaborations by the U.S. with our partners are cost-effectively carried out to advance the future Higgs factory initiatives. (CPAD, ECFA, DRD, others).
- Prepare the groundwork to respond to the PS Recommendation 6: "[Convene a targeted panel to review] the level and nature of US contribution in a specific Higgs factory including an evaluation of the associated schedule, budget, and risks once crucial information becomes available"

Sarah Eno

Recent decisions by CERN Council

- **February 2024:** special Council meeting: **successful Mid-Term Review**; all objectives met, lots of praise & positive feedback, recommendations & guidance
- **March 2024:** **ESPPU schedule 2025/2026** approved with input by March 2025, conclusions mid 2026; **compatible with “accelerated” FCC schedule**
- **June 2024:** approval of modified CERN Medium Term Plan (MTP), including more resources for FCC-FS completion and for FCC pre-TDR phase



Additional expenses in June 2024 MTP to prepare for CERN's future

Future Circular Collider (FCC)

Additional resources for the Feasibility Study → 13 MCHF (until March 2025, when final report will be submitted)

Funding for “pre-TDR phase” → 82 MCHF (April 2025-end 2027)

Superconducting radiofrequency technology (SRF)

Ramp up R&D for future accelerators (until now 2.3 MCHF/year) → 9.7 MCHF (2025-2027)

FCC Main Goals for Coming Years

- **Next milestone: by March 2025 completion of the FCC Feasibility Study**
- **By 2027-2028, possible FCC project approval, start of CE design contract:**
 - specifications to enable CE tender design by 2028
 - refined input for environmental evaluation and project authorisation process
 - requires overall integration study and designs based on technical pre-design of accelerators, technical infrastructure and detectors
- **By 2031-32, possible start of CE construction:**
 - CE groundbreaking
 - TDR to enable prototyping, industrialization towards component production

→ Strong collaboration with US and further int'l partners essential for success !



VIENNA

HOFBURG

19-23 MAY
FCC
WEEK
2025

Save the dates: 19 – 23 May 2025

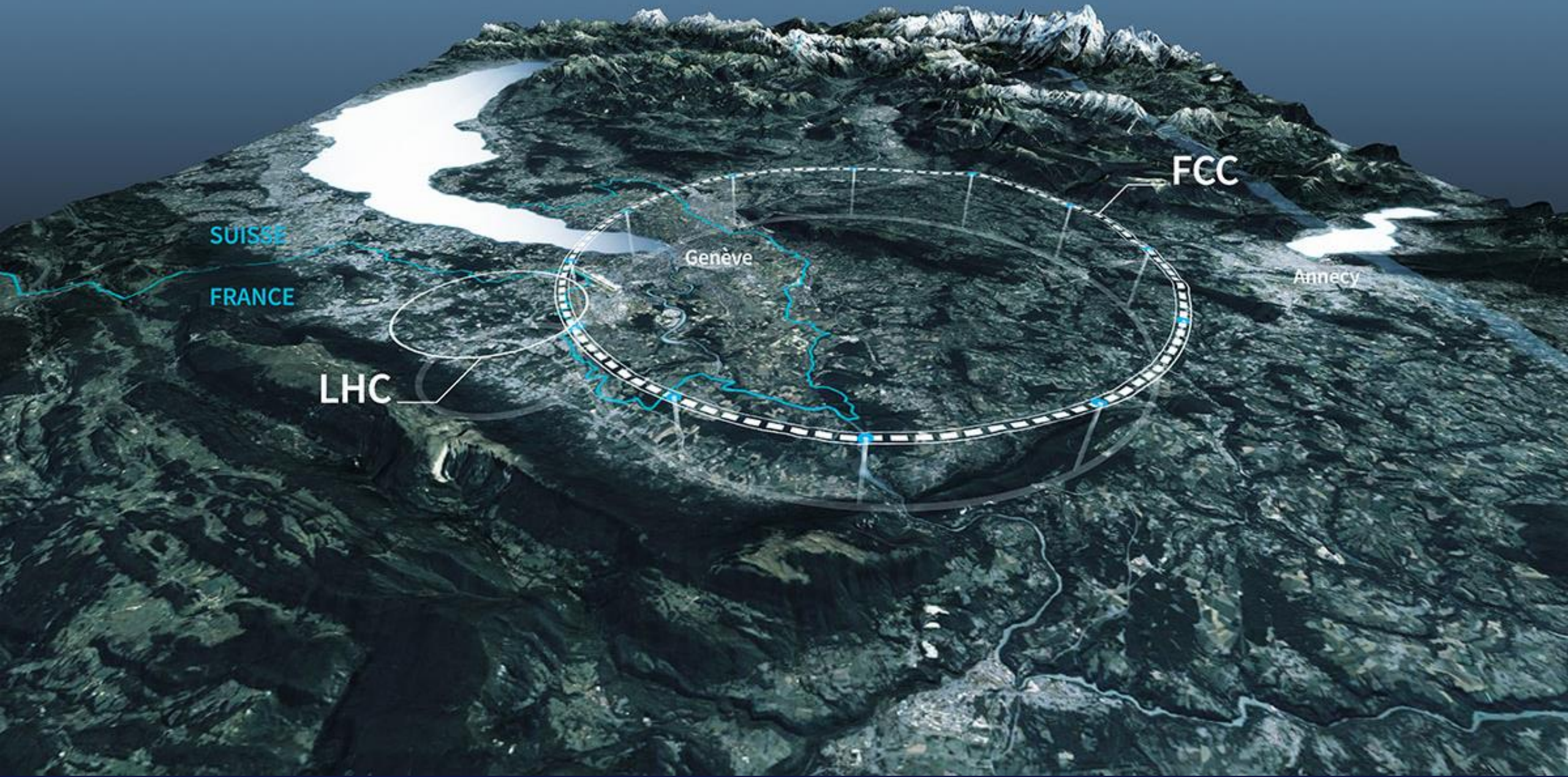
thank you for your attention

今後とも良い
ご協力をよろしく
お願いいたします



home.cern





SUISSE

FRANCE

Genève

Annecy

LHC

FCC