



CERN's strategy for an environmentally responsible research

Sonja Kleiner on behalf of CERN

Einstein Telescope Sustainability Workshop
16 November 2023

About CERN



Founded in 1954

Run by 23 Member States

Employs about 3500 people

More than 12'000 Users

150'000 visitors annually

About CERN

Four pillars underpin CERN's mission

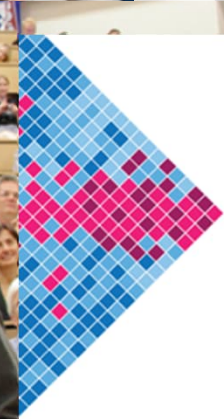




Higgs announcement seminar
July 2012



«I believe CERN should become a role model for an environmentally-aware scientific research laboratory»
- Fabiola Gianotti, CERN Director General, 2016



THE CERN SAFETY POLICY

CERN, an intergovernmental organization for fundamental research in particle physics, defines and implements a Safety Policy. Safety covers occupational health and safety, including radiation protection, the protection of the environment and the safe operation of CERN's installations, including radiation safety.

CERN strives for excellence in matters of Safety.

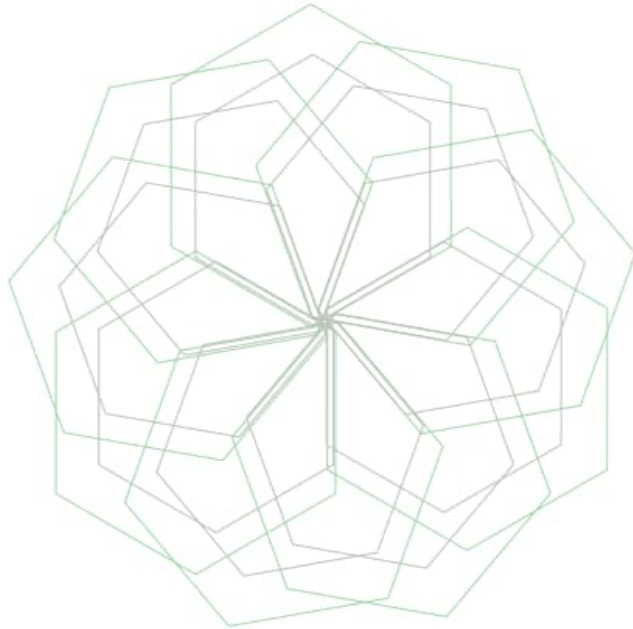
INTRODUCTION BY THE DIRECTOR-GENERAL

CERN strives for excellence. We strive for excellence in science, excellence in innovation, and excellence in everything we do. Safety is very much at the heart of that. The objective of CERN's Safety Policy is that the Organization's scientific and technical excellence be matched by excellence in matters of Safety. To this end CERN promotes environmentally aware research, best practices in matters of Safety and strives for the optimal protection of the health and safety of all those involved in its activities.

CERN's performance in matters of Safety is dependent on every one of us. I invite you to familiarize yourself with the CERN Safety Policy and our Safety Rules, and I am confident that you will actively contribute to CERN's excellence in matters of Safety through exemplary conduct and the use of best Safety practices when carrying out your activities at CERN.

Fabiola Gianotti
Director-General
8 July 2016

Transparent reporting



Environment
Report
2017 - 2018

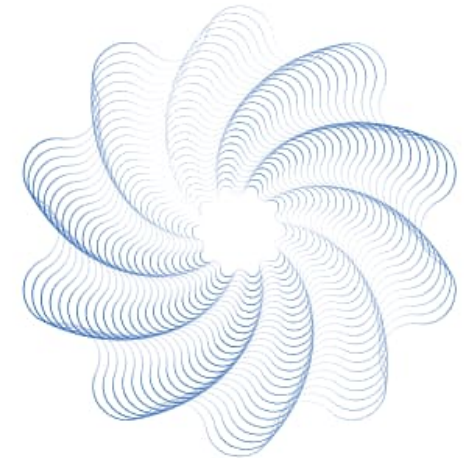
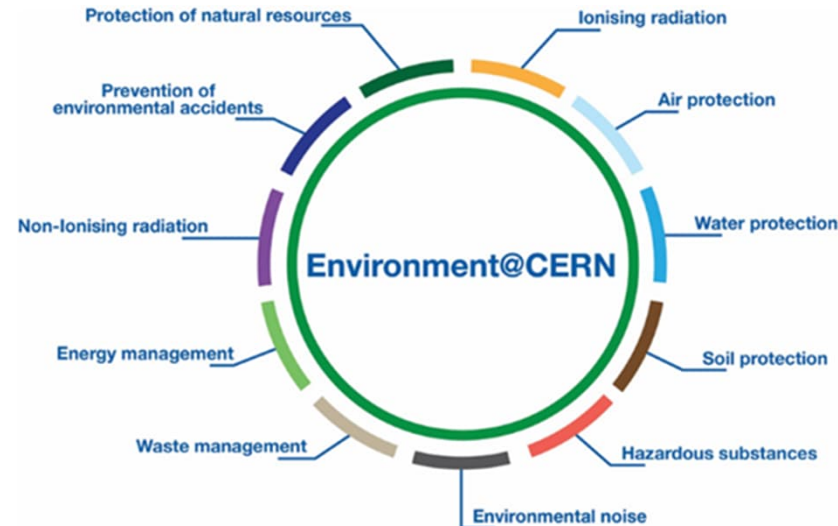


Public-facing reports

Strategy
Domains
Objectives
Reporting

CERN Environment Reports

- ❑ 11 Environmental Domains – prioritized objectives
- ❑ Following the *Global Reporting Initiative Standard*



Environment
Report
2019 - 2020



Current strategy for environment and sustainability

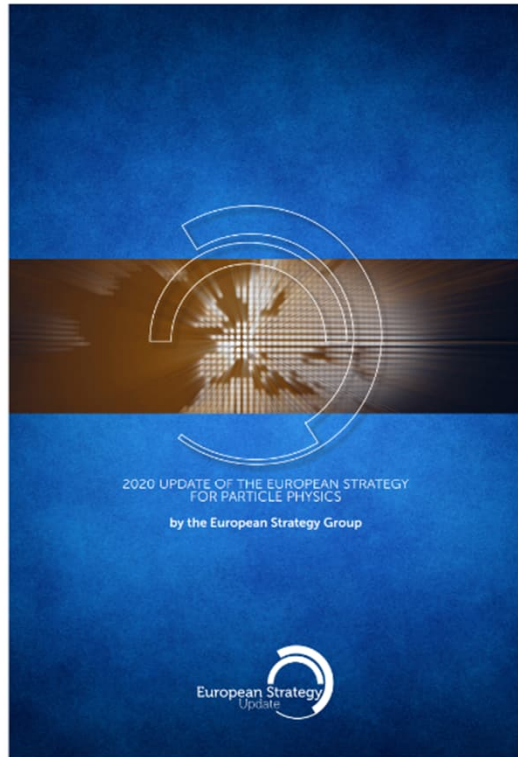
Three main lines of actions:

- ❑ Minimise the Laboratory's impact on the environment
- ❑ Pursue actions and technologies aiming at energy savings and reuse
- ❑ Identify and develop CERN's technologies that may contribute to mitigating the impact of society on the environment

Environment and sustainability are crucial aspects of projects and activities in the High Energy Physics field. Any future project should have minimal environmental footprint.



Current strategy for environment and sustainability



7

Environmental and societal impact

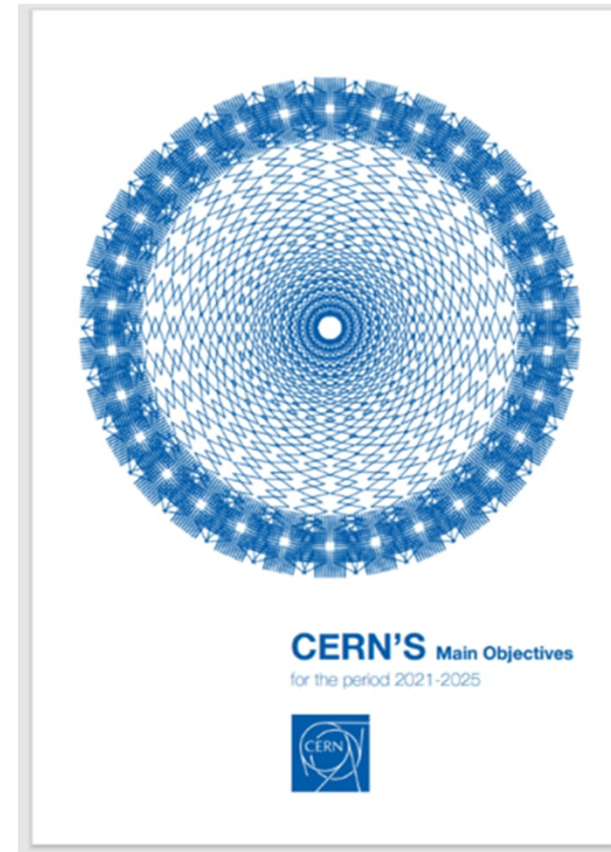
A. The energy efficiency of present and future accelerators, and of computing facilities, is and should remain an area requiring constant attention. Travel also represents an environmental challenge, due to the international nature of the field.

The environmental impact of particle physics activities should continue to be carefully studied and minimised. A detailed plan for the minimisation of environmental impact and for the saving and re-use of energy should be part of the approval process for any major project. Alternatives to travel should be explored and encouraged.

B. Particle physics, with its fundamental questions and technological innovations, attracts bright young minds. Their education and training are crucial for the needs of the field and of society at large. **For early-career researchers to thrive, the particle physics community should place strong emphasis on their supervision and training. Additional measures should be taken in large collaborations to increase the recognition of individuals developing and maintaining experiments, computing and software. The particle physics community commits to placing the principles of equality, diversity and inclusion at the heart of all its activities.**

C. Particle physics has contributed to advances in many fields that have brought great benefits to society. Awareness of knowledge and technology transfer and the associated societal impact is important at all phases of particle physics projects. **Particle physics research centres should promote knowledge and technology transfer and support their researchers in enabling it. The particle physics community should engage with industry to facilitate knowledge transfer and technological development.**

D. Exploring the fundamental properties of nature inspires and excites. It is part of the duty of researchers to share the excitement of scientific achievements with all stakeholders and the public. The concepts of the Standard Model, a well-established theory for elementary particles, are an integral part of culture. **Public engagement, education and communication in particle physics should continue to be recognised as important components of the scientific activity and receive adequate support. Particle physicists should work with the broad community of scientists to intensify engagement between scientific disciplines. The particle physics community should work with educators and relevant authorities to explore the adoption of basic knowledge of elementary particles and their interactions in the regular school curriculum.**



CERN & United Nations SDGs



SUSTAINABLE DEVELOPMENT GOALS

SDG 3 - HEALTH

CERN helps to develop technologies that contribute to better healthcare for all, such as medical imaging and hadron therapy.

SDG 4 - EDUCATION

Education is one of CERN's core missions. We offer high quality programmes that inspire thousands of students, teachers and young researchers each year.

SDG 5 - GENDER

Diversity is a core value for CERN. Our diversity policy aims at leveraging the added value that comes from bringing together people of different nationalities, genders, professions and ages.

SDG 7 - ENERGY

CERN develops strategies for minimise the increase of energy consumed by the installations, increase energy efficiency and implement energy recovery.

SDG 9 - INNOVATION

CERN inventions are brought to industry through knowledge transfer, to have a positive impact on society and innovation.

SDG 16 & 17 - INTERNATIONAL COOPERATION

CERN is a successful model for international collaboration. CERN gathers researchers from all over the world, contributing to human knowledge and peace, for the benefit of all.



THERAPY

Accelerators provide particle beams for more targeted cancer treatment.



BEAMLINE FOR SCHOOLS COMPETITION

Students from the two winning teams spend a week at CERN to carry out their experiment using a CERN accelerator.



25 BY 25 DIVERSITY & INCLUSION INITIATIVE

First ever targets-based strategy to boost the nationality and gender diversity within the Staff and Fellows population.



HEATING LOCAL HOUSING

Heat recovered from CERN's accelerator cooling systems to heat a new residential area in the town of Ferney-Voltaire, benefiting up to 8000 people.



A MAGNET IN THE LHC TUNNEL

Exploring the universe requires new technologies and ingenious engineering to build the machines that explore physics at a new frontier.



SESAME

This new synchrotron light source in Jordan started operation in 2017. It is a unique collaboration between eight Middle East members, modelled on CERN's governance structure.

High priority objectives – Horizon 2025

ENERGY

The laboratory is committed to limiting rises in electricity consumption to 5% up to the end of Run 3 (baseline 2018) – Target max 1314 GWh/y

EMISSIONS

CERN's objective is to reduce direct CO₂e emissions by 28% by the end of Run 3 (baseline 2018) – Target max 138 300 tCO₂e

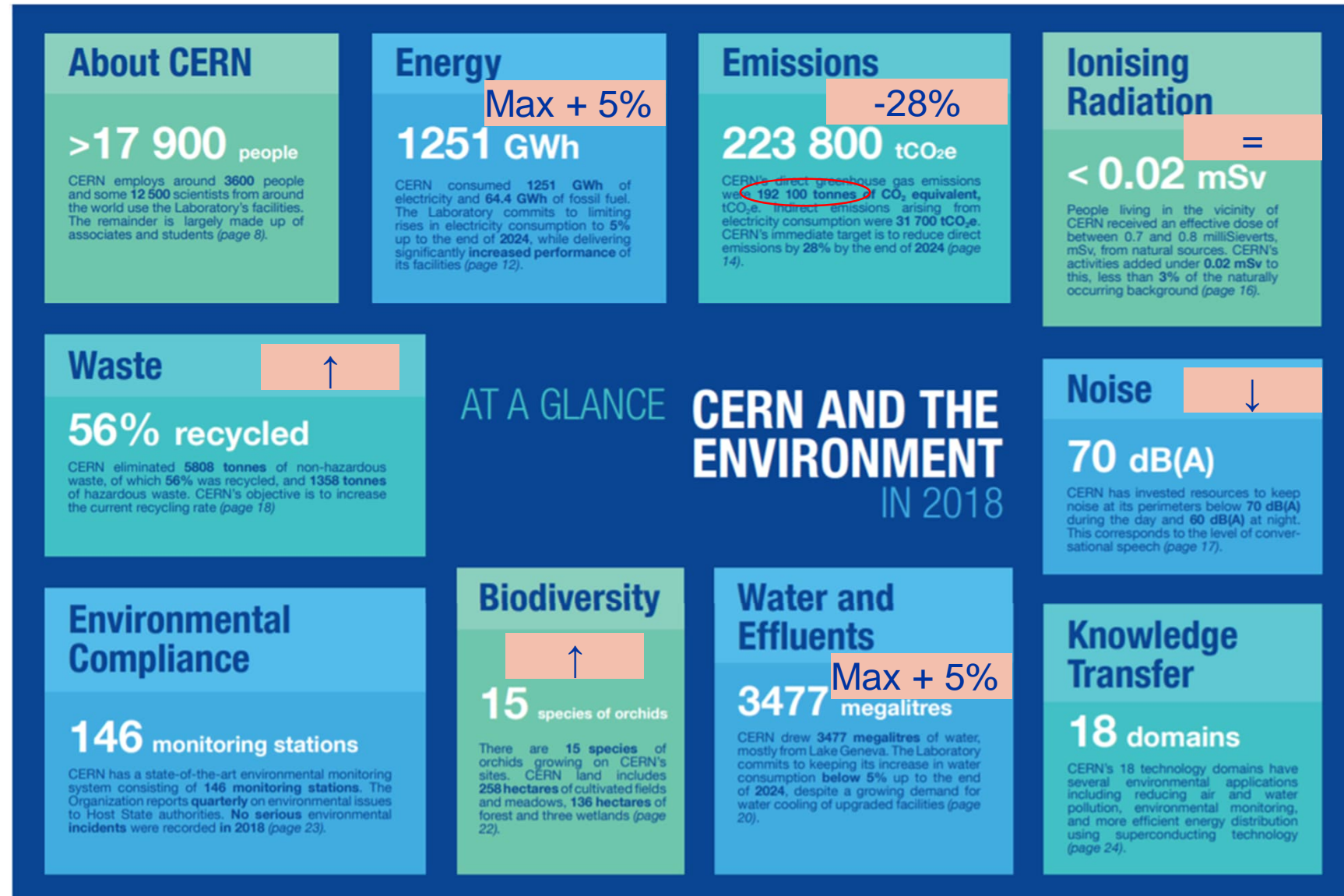
WATER AND EFFLUENTS

The laboratory is committed to keeping the increase in its water consumption to 5% up to the end of Run 3 (baseline 2018) – Target max 3651 ML

No showstopper to achieving these objectives by the first year of the Long Shutdown 3 (LS3)

General overview

- ❑ Objectives updated according to accelerator complex schedule
- ❑ Period 2025/2026 vs 2018
- ❑ Objectives for the period 2026-2030 under definition



Energy savings and reuse



EDMS 2777699



CERN Energy Policy

CERN, an intergovernmental organization for fundamental research in particle physics, defines and implements an Energy Policy. This policy covers all the energy sources needed for its activities and installations, whether they are based in France or in Switzerland. The policy is periodically reviewed.

1. Objectives

In line with the CERN Safety Policy, the Energy Policy is designed to continuously improve the Organization's energy performance and minimise the impact of its activities. Its specific goals are to:

- keep the energy required for its activities to a minimum,
- improve energy efficiency, and
- recover waste energy.

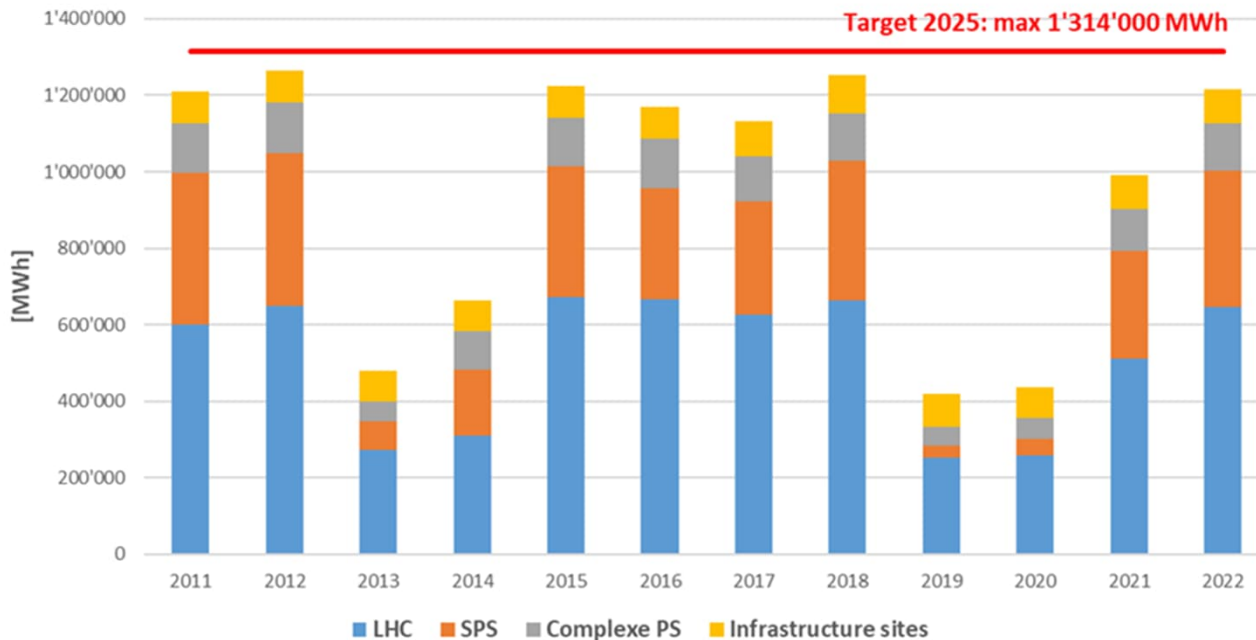
2. Means

The Organization makes the necessary means available, in particular to meet its Energy Policy objectives.

In particular, the Organization:

- implements structured, efficient and sustainable measures for the improvement of its energy performance,
- ensures that the Energy Policy objectives are integrated into the design of facilities and taken into account in the definition and implementation of projects,
- establishes appropriate internal regulations, keeps them up to date and ensures compliance with them,
- communicates proactively with all persons participating in its activities as well with the Host States and the public,
- collaborates with the Host States.

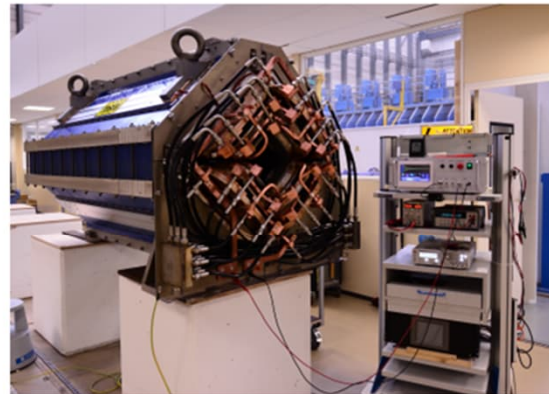
Electricity consumption



Energy savings and reuse

Savings up to a total of ~100 GWh/year in place since 2010 and first heat recovery project implemented

Facility upgrades: East Area Renovation (done during recent LS2)



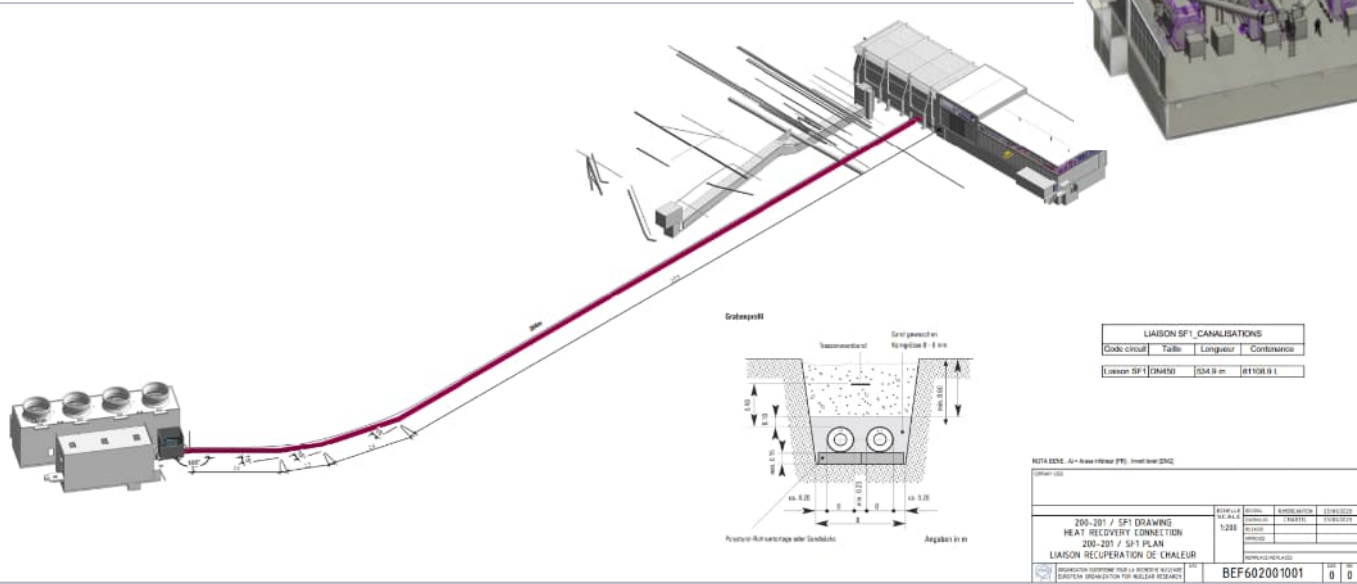
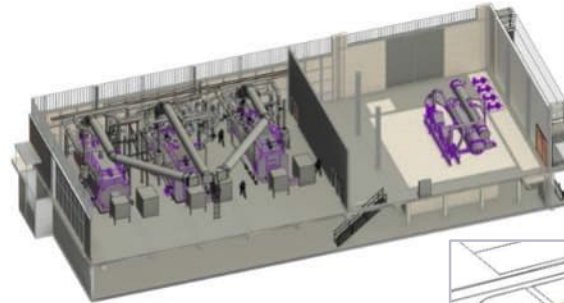
**Powering energy:
From 11 GWh/year to around 0.6 GWh/year
(> 90% reduction)**

Heat recovery from CERN-P8 to supply new housing in a neighbouring town (ZAC Ferney-Voltaire)

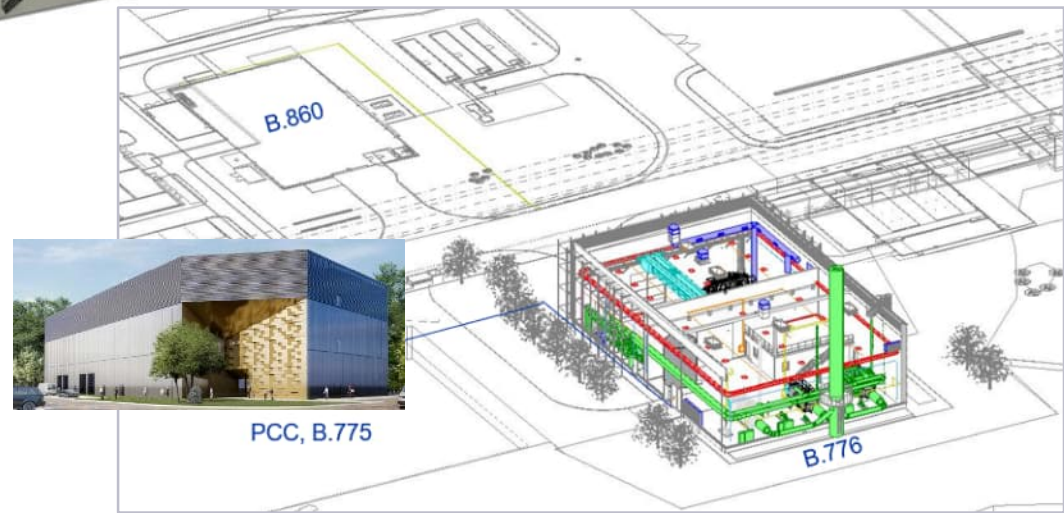


Energy savings and reuse

Ambitious projects for reducing gas consumption and re-use waste heat from facilities (- 60% gas consumption vs 2022 from 2026/2027 onwards)



Heating plant – Meyrin Site (CH)



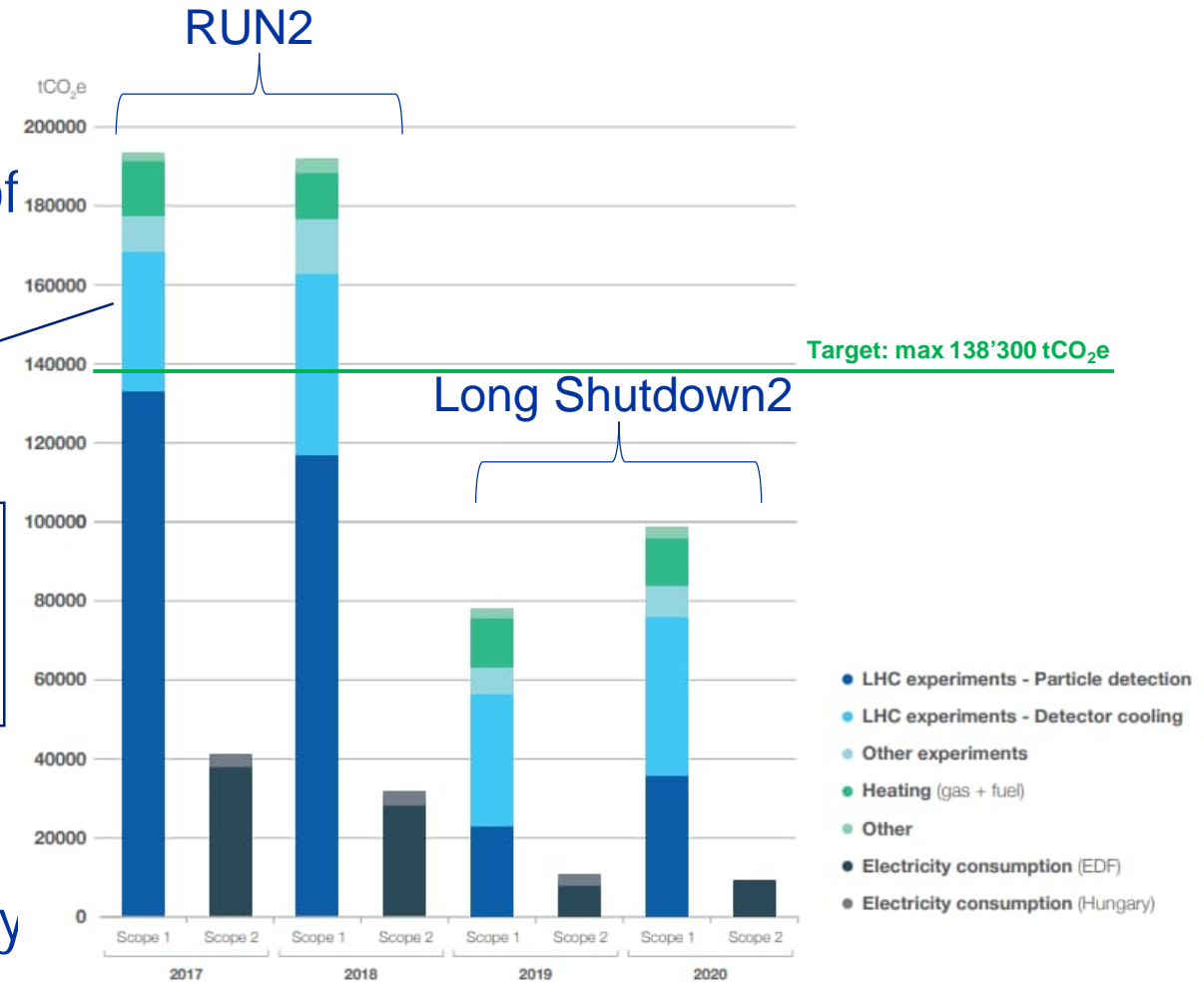
Heating plant – Prévessin site (F)

Emissions

Ambitious projects for reducing fugitive emissions of fluorinated gases from ATLAS and CMS experiments (detector cooling)

From LS3 on – CO₂ cooling instead of F-Gas cooling ~ - 40'000 tCO₂e

Scope 3 ~ 9'000 tCO₂e/y (such as personnel commutes, duty travel, catering) + ~100'000 tCO₂e/y procurement (environmentally responsible procurement project launched in 2021)



CERN SCOPE 1 AND SCOPE 2 EMISSIONS FOR 2017-2020 BY CATEGORY.
 Other includes air conditioning, electrical insulation, emergency generators and CERN vehicle fleet fuel consumption. Emission factors for electricity: EDF Bilan des émissions de GES 2002-2020 for EDF and Bilan Carbone® V8 for Hungary.

Water and effluents

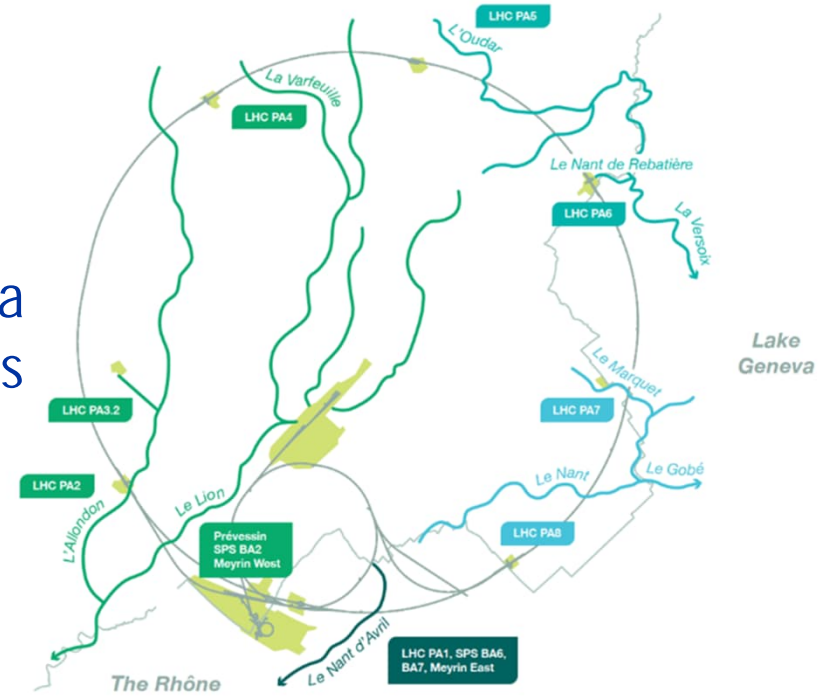
CERN strives to minimise its water consumption through continuous consolidation and improvement of its cooling and sanitation infrastructures

Since 2000, water consumption has decreased by some 80%, from 15'000 megalitres to 3'234 megalitres in 2022.



Water and effluents

Ambitious project for reducing the current impact linked to the blowdown of the LHC & SPS cooling tower circuits (released into a local stream: about - 90% of effluent water volume and pollutants load from 2027/2028)

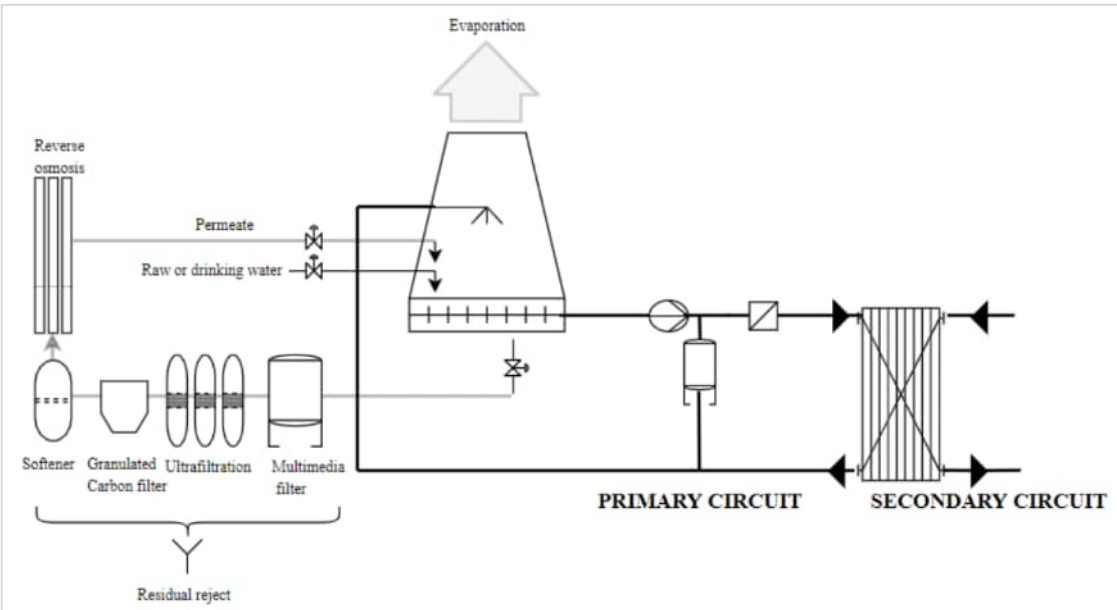


Affluent of the Allondon ■ Affluent of the Rhône ■ Affluent of the Marquet, Gobé, Vengeron ■ Affluent of the Versoix



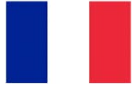
CHARTRE DE REVITALISATION DU NANT D'AVRIL

APPROCHE PARTICIPATIVE POUR UNE GESTION INTEGRÉE DU COURS D'EAU ET DU TERRITOIRE

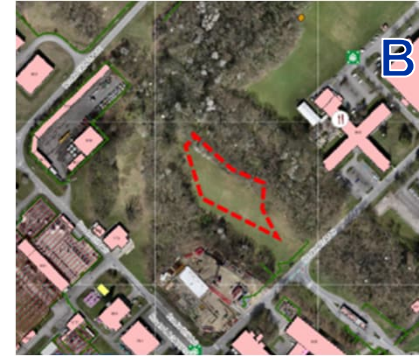


Water and effluents

Progressive implementation of additional retention basins for rainwater regulation and protection of the watercourses receiving CERN effluents



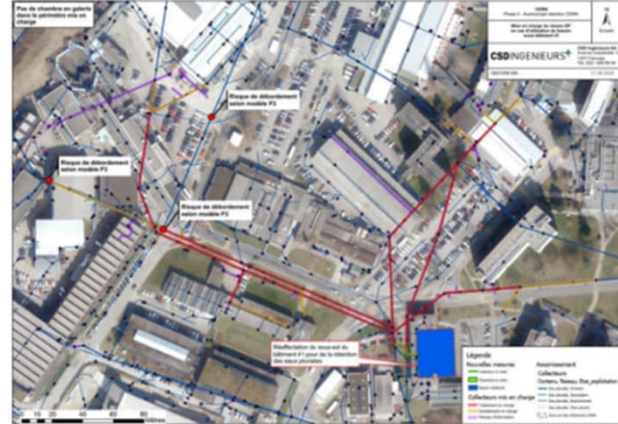
BR2



BR1



Influence du bassin sur le fonctionnement des réseaux EP en amont



Concept under study

Identify and develop CERN's technologies



RENEWABLE AND LOW-CARBON ENERGY

Production
Transformation
Distribution
Storage



CLEAN TRANSPORTATION AND FUTURE MOBILITY

Aviation
Shipping
Rail
Automotive

SUSTAINABILITY AND GREEN SCIENCE

Power Management
Heat Management
Industrial Processes

CLIMATE CHANGE AND POLLUTION CONTROL

Monitoring
Modelling
Mitigation

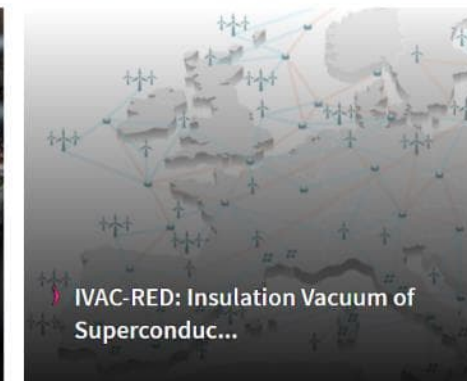
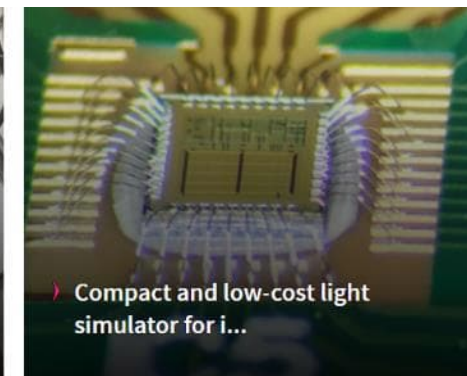
CERN Innovation Programme on Environmental Applications (CIPEA) – launched in March 2022

Identify and develop CERN's technologies

More than 30 ideas submitted

15 innovative project proposals presented

8 projects selected to receive financial support of external partners or the Knowledge Transfer (KT) Fund



CIPEA Innovation Day
27 June

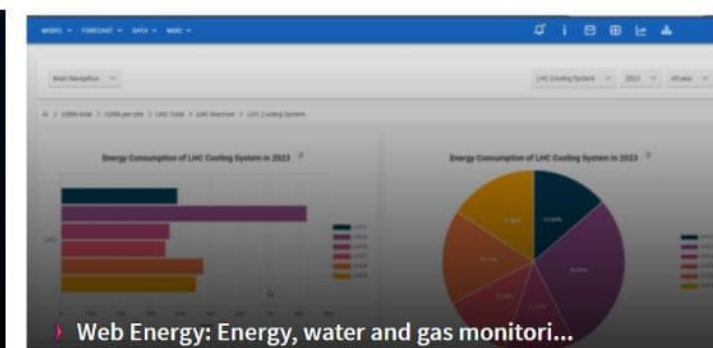
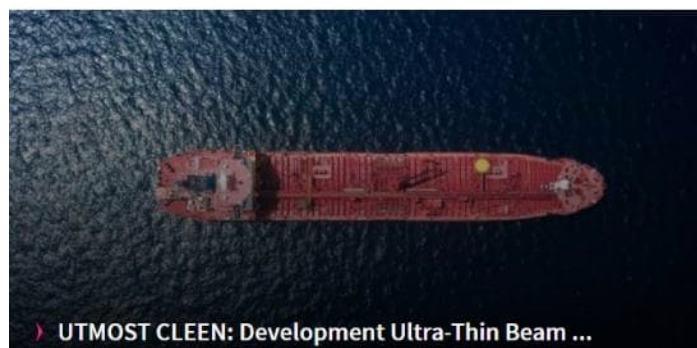
09h00 - Main Auditorium
14h00 - IdeaSquare
<https://indico.cern.ch/e/cipeainnovday>

Discover CERN's new ideas to tackle environmental challenges on a global scale

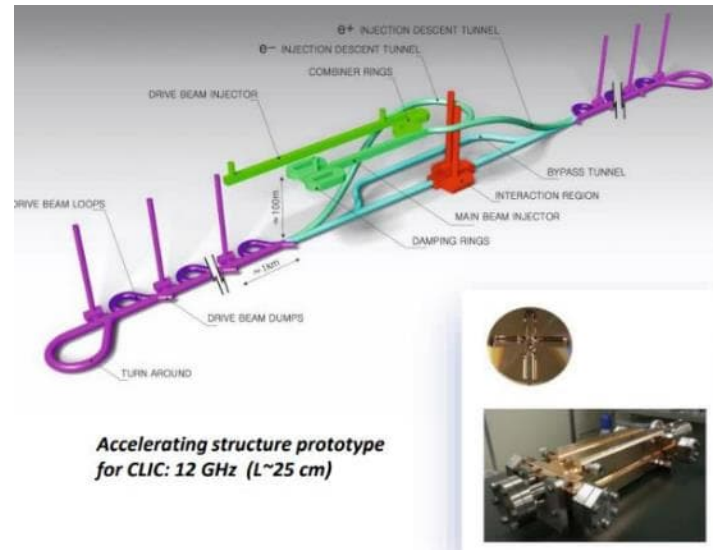
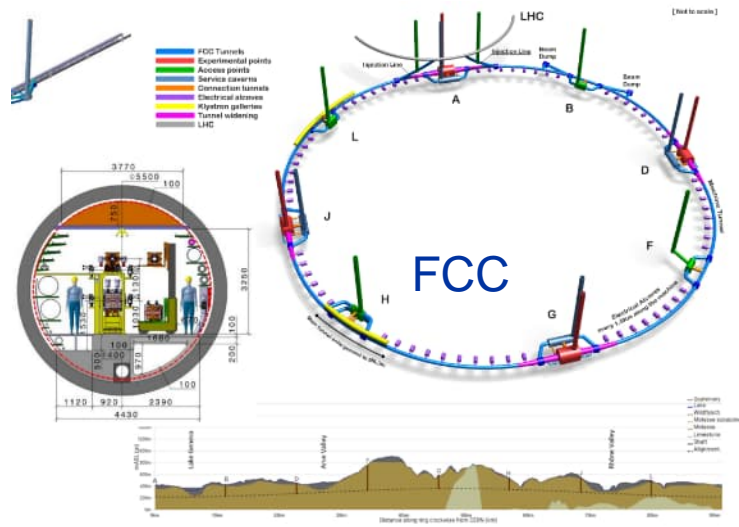
Find out how CERN activities can impact the environment positively thanks to the ingenuity, creativity, and enthusiasm of its community

CIPEA
CERN Innovation Programme on Environmental Applications

Main Auditorium
IdeaSquare



Future colliders studies



Accelerating structure prototype for CLIC: 12 GHz ($L \sim 25$ cm)

LONDON
United Kingdom

05 – 09 June
**FCC
WEEK
2023**

<https://cern.ch/fccweek2023>

Logos for CERN, Future Circular Collider, and Science and Technology Facilities Council are present. At the bottom, logos for partner institutions are listed: University of Cambridge, Imperial College, UCL, King's College London, Queen Mary, University of Manchester, and University of Cambridge.

Future colliders studies



R&D Roadmaps for Future Accelerators & Detectors

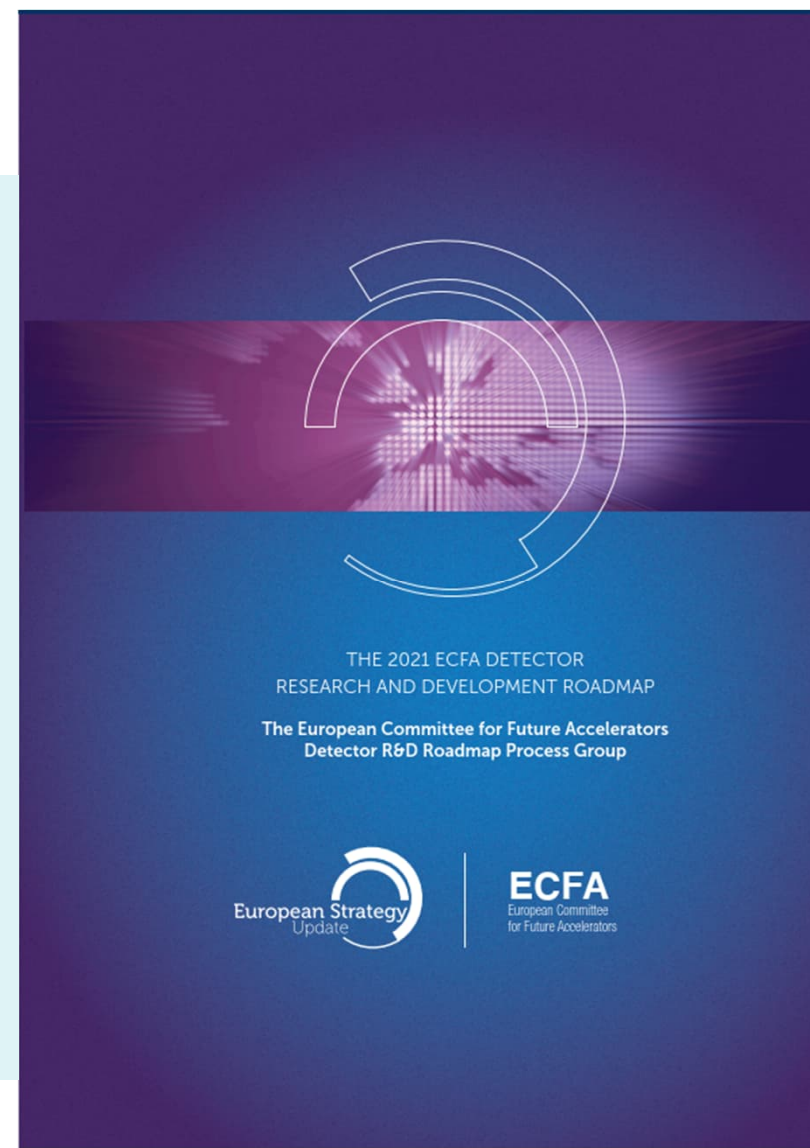
paving the way for:

Energy efficient technologies

Energy efficient accelerator concepts

Sustainability aspects

Eco-friendly gases for particle detection



THE 2021 ECFA DETECTOR
RESEARCH AND DEVELOPMENT ROADMAP
The European Committee for Future Accelerators
Detector R&D Roadmap Process Group

European Strategy
Update

ECFA
European Committee
for Future Accelerators

Challenges ahead

- ❑ Pursue launched actions in matters of Environment and Sustainability – Strengthen the overall strategy up to Horizon 2030
- ❑ Follow-up the implementation of the ambitious projects decided for impact minimisation, energy savings and reuse – The next Long Shutdown (2026-2028) is a key milestone for CERN

Environment and sustainability constitute a focus area for CERN now and in the future

