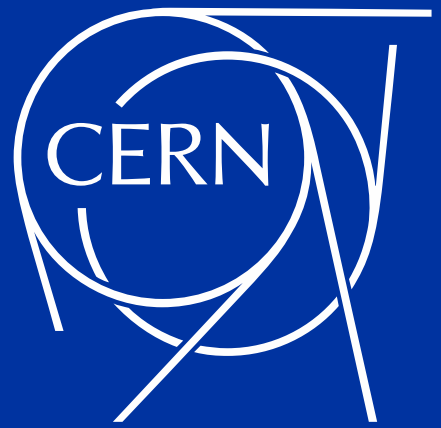


CERN’s first Environment Report

Sonja Kleiner on behalf of CERN

Workshop on Carbon Emissions at Future Facilities
9 November 2011

Outline

- ❑ Background of environmental protection at CERN
- ❑ Current environmental objectives
- ❑ CERN’s carbon emissions accounting for the first Environment Report
- ❑ Environmental evaluation process for the Future Circular Collider (FCC) feasibility study
- ❑ Conclusions

About CERN

23 Member States

~ 3600 employees

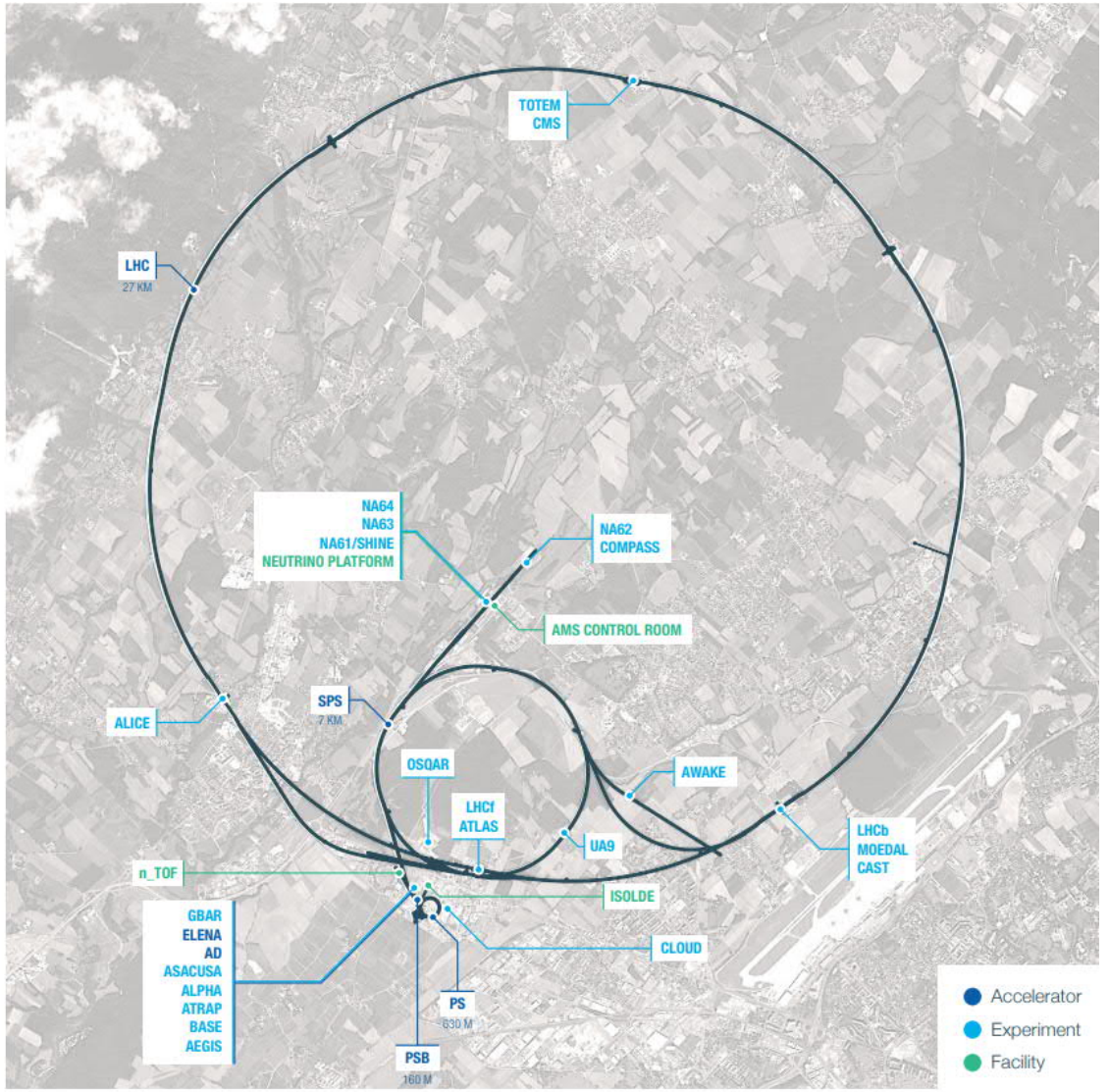
~ 12’500 scientists using the Laboratory’s facilities

18 fenced sites

Globe of Science and Innovation

3 Hotels, 3 Canteens, Kindergarten

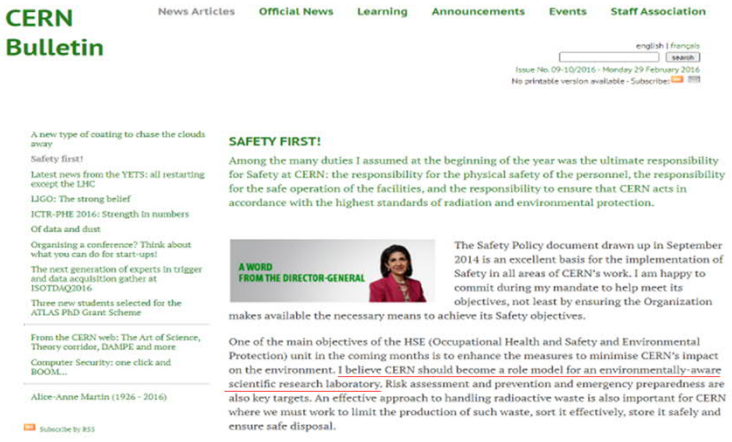
~ 653 Buildings (421’811 m^2)

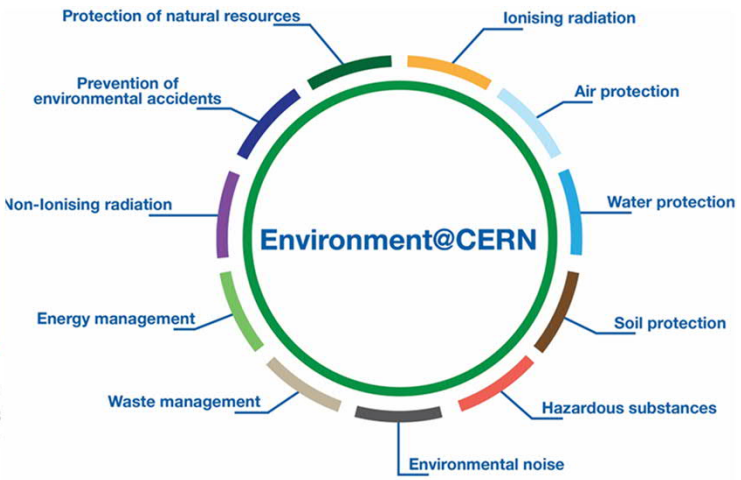


CERN’s accelerator complex and its experiments in 2019-2020.

Background of environmental protection at CERN (1/2)

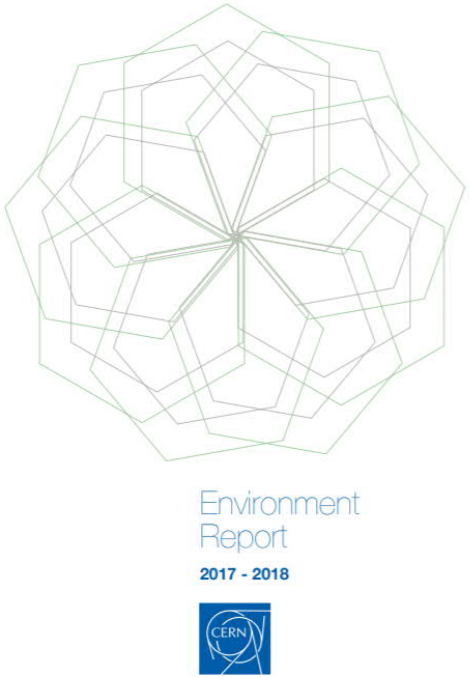
- The vision of CERN Director-General Fabiola Gianotti
- **S**afety at CERN includes the protection of the environment
- Dedicated panel on **Energy Management** established in 2015**,** incl. exchanges with other Large-Scale Research Infrastructures → **Increase efficiency** – **Use less** – **Recover more**
- **C**ERN **E**nvironmental **P**rotection **S**teering **B**oard established in 2016 – 11 Environmental Domains – prioritized objectives
- Site maintenance and renovation – Masterplan 2030 (2015) → Masterplan 2040 (2022)





Background of environmental protection at CERN (2/2)

- ❑ Publication of the first public CERN Environment Report → Sept 2020, covers 2017-2018
- ❑ Publication of the second report → Nov 2021, covers 2019-2020
- ❑ Next ones will be published every two years
- ❑ Following the *Global Reporting Initiative Standard*
- ❑ Materiality assessment carried out in 2019 with internal and external stakeholders

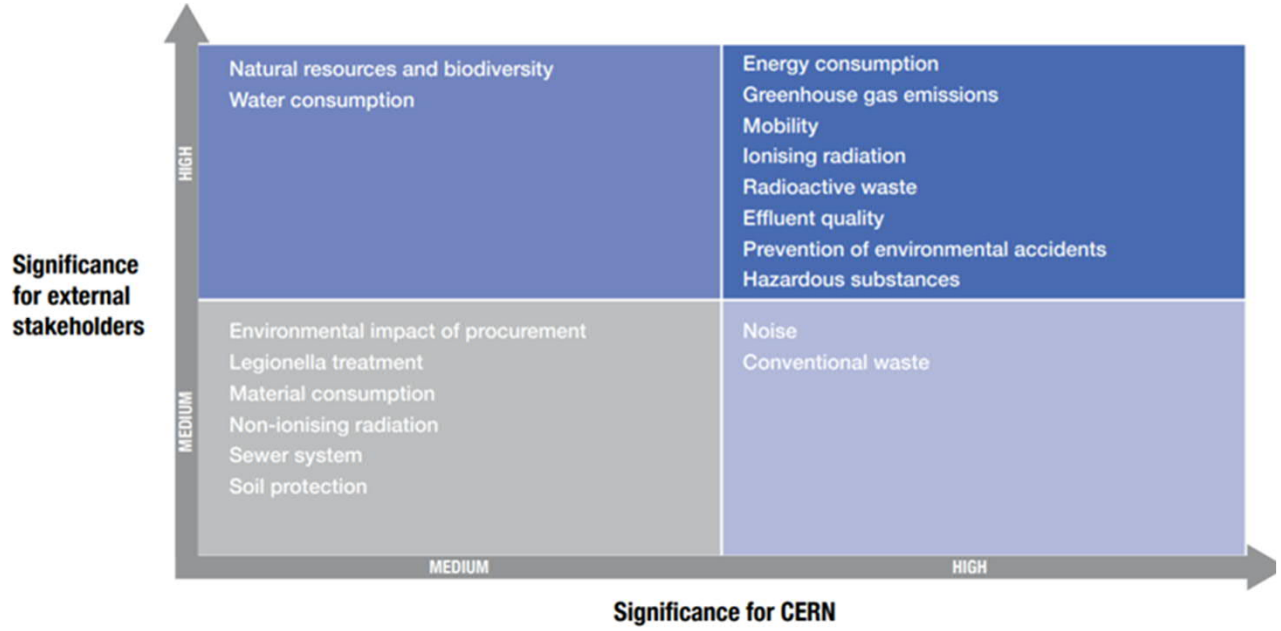


GRI CONTENT INDEX

For the Materiality Disclosures Service, GRI Services reviewed that the GRI content index is clearly presented and the references for Disclosures 102-40 to 102-49 align with appropriate sections in the body of the report. The service was performed on the English version of the report.

Materiality Disclosures

Standards and Disclosures	Title	Pages / Informations
GRI 101:2016 FOUNDATION		
GRI 102:2016 GENERAL DISCLOSURES		
Organizational Profile		
102-1	Name of the organization	8
102-2	Activities, brands, products, and services	8, 24
102-3	Location of headquarters	8
102-4	Location of operations	8
102-5	Ownership and legal form	8
102-6	Markets served	8
102-7	Scale of the organization	8
102-8	Information on employees and other workers	8
102-9	Supply chain	8
102-10	Significant changes to the organization and its supply chain	None
102-11	Precautionary Principle or approach	10, 16
102-12	External initiatives	9
102-13	Membership of associations	8
Strategy		
102-14	Statement from senior decision-maker	4, 5
Ethics and Integrity		
102-16	Values, principles, standards, and norms of behavior	9
Governance		
102-18	Governance structure	9
Stakeholder Engagement		
102-40	List of stakeholder groups	11
102-41	Collective bargaining agreements	The CERN Staff Association represents the CERN personnel, which is an important stakeholder group to the Organization. The Association represents the entire staff body on the Tripartite Forum on Conditions o



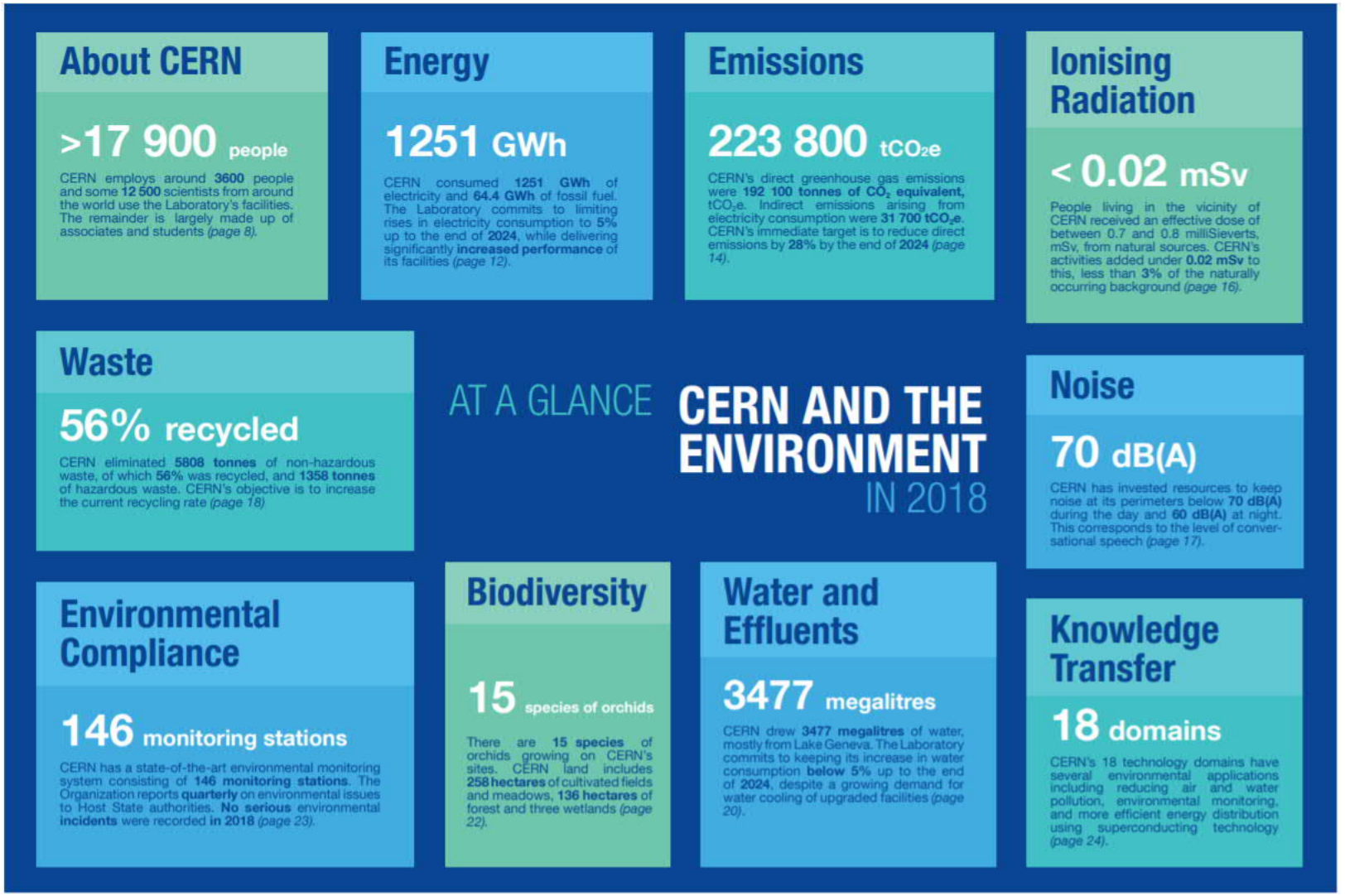
Current environmental objectives (1/2)

Highest priority objectives set for:

- ❑ reducing emissions of fluorinated gases from Large Experiments
- ❑ limiting the electrical power consumption
- ❑ limiting the water consumption
- ❑ reducing the impact of effluent water on receiving watercourses

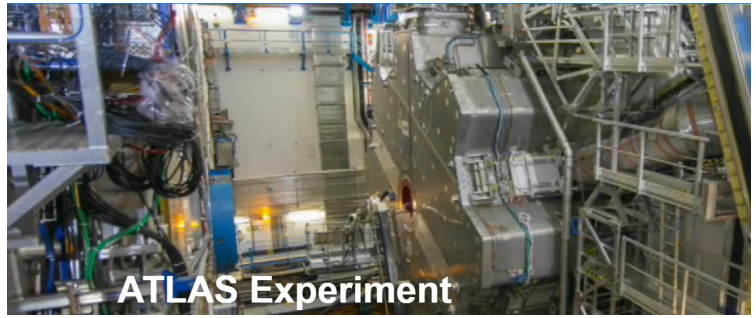
CERN Environment Report 2017-2018 available here

Publication of the 2019-2020 report after COP26



Current environmental objectives (2/2)

- Reduction target is focussed on direct greenhouse gas emissions
- Reduction target is directly linked to the emissions of fluorinated gases from the Large Experiments



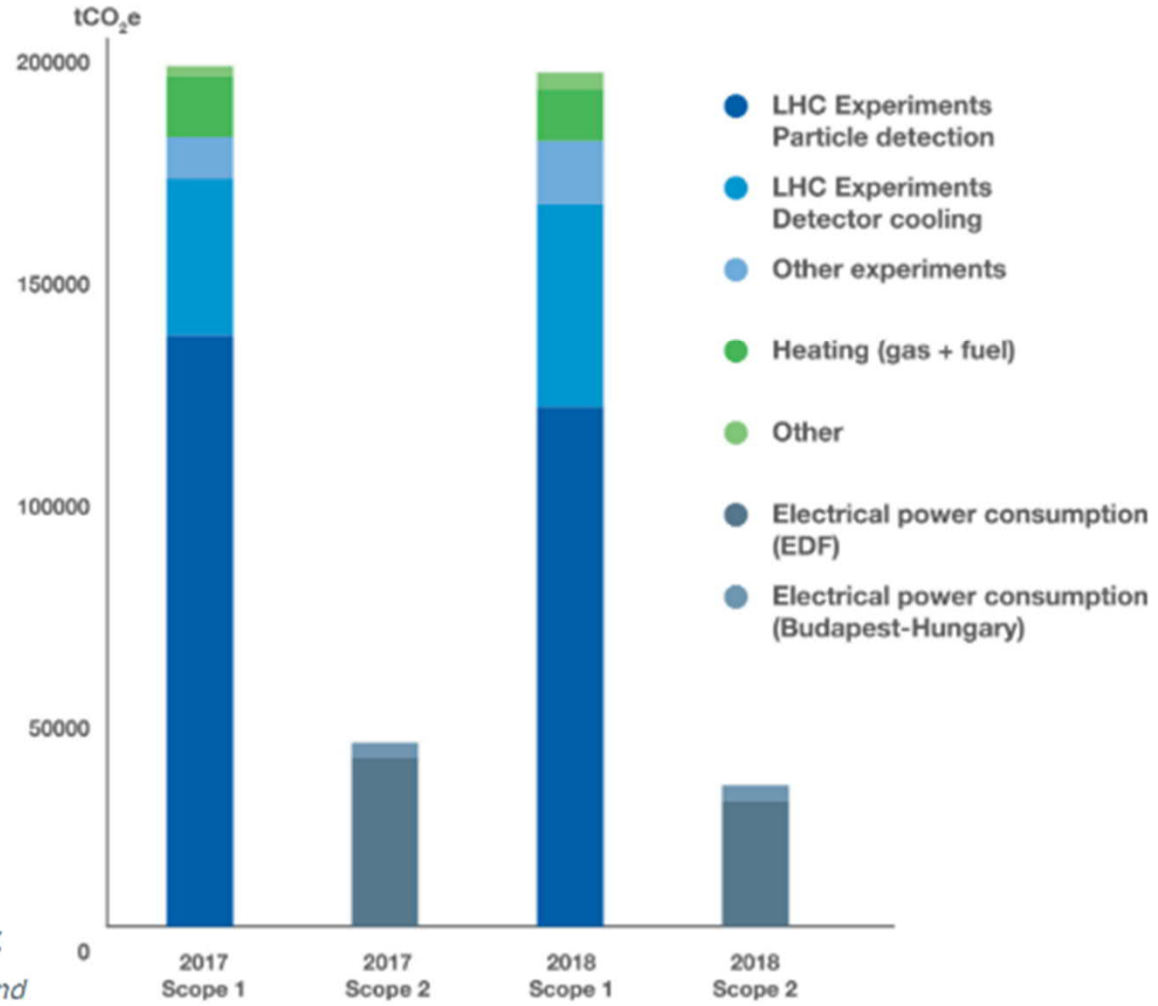
Emissions *Year 2018*

223 800 tCO_2e

CERN's direct greenhouse gas emissions were **192 100 tonnes of CO_2 equivalent,** tCO_2e. Indirect emissions arising from electricity consumption were **31 700 tCO_2e.** CERN's immediate target is to reduce direct emissions by **28%** by the end of **2024** *(page 14)*.

CERN's carbon emissions accounting (1/4)

- Scopes aligned to the Greenhouse Gas Protocol
- **Scope 1** = direct on-site emissions (combustion processes & fugitive emissions of fluorinated gases)
- **Scope 2** = indirect emissions linked to the electrical power consumption of CERN. Most of the electricity is fed by the 400kV French electricity network, with low carbon power footprint due to nuclear and hydroelectric power

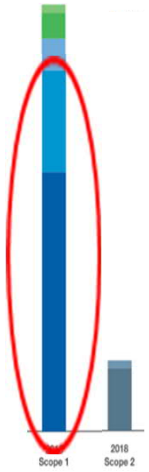


CERN SCOPE 1 AND SCOPE 2 EMISSIONS FOR 2017 AND 2018 BY CATEGORY.

Other includes air conditioning, electrical insulation, emergency generators and CERN vehicle fleet fuel consumption.

CERN's carbon emissions accounting (2/4)

- Main source of CO_2e within Scope 1 linked to fugitive emissions of F-gases such as HFC's, PFC's and SF_6 from the experiments
- F-gases are used in the experiments for detector cooling (mainly PFC's) and for particle detection (mainly HFC's)
- Continuous follow-up of the gas consumption and annual reporting of the CO_2e emissions
- Global Warming Potential (GWP) associated to the F-gases, based on the EU Regulation No 517/2014

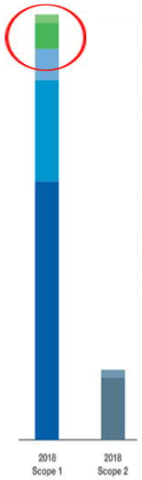


GROUP	GASES	tCO_2e 2017	tCO_2e 2018
PFC	CF_4, C_2F_6, C_3F_8, C_4F_{10}, C_6F_{14}	61 984	69 611
HFC	CHF_3 (HFC-23), $C_2H_2F_4$ (HFC-134a), HFC-404a, HFC-407c, HFC-410a, HFC R-422D, HFC-507	106 812	96 624
	SF_6	10 192	13 087
	CO_2	14 612	12 778
TOTAL SCOPE 1		193 600	192 100

BREAKDOWN OF SCOPE 1 EMISSIONS BY GAS TYPE. *Global warming potential, GWP, based on EU Regulation 517/2014 on fluorinated greenhouse gases, while HFC-407c, HFC-410a, HFC-404a, HFC R-422D, and HFC-507 are based on the IPCC Fifth Assessment Report, 2014 (AR5).*

CERN’s carbon emissions accounting (3/4)

- Other emissions sources linked to combustion processes within Scope 1 = mainly 2 Gas Heating Plants + CERN vehicle fleet
- Annual fossil fuel consumption from these categories converted in CO_2e through the **Bilan Carbone®** tool of the *Association Bilan Carbone*
- **Scope 2** = indirect emissions linked to the electrical power consumption of CERN. Annual consumption converted in CO_2e by using an averaged conversion factor provided by the supplier (*Electricité de France – EDF)*



BC BILAN CARBONE®

Energy

1251 GWh

CERN consumed **1251 GWh** of electricity and **64.4 GWh** of fossil fuel. The Laboratory commits to limiting rises in electricity consumption to **5%** up to the end of **2024**, while delivering significantly **increased performance** of its facilities *(page 12)*.

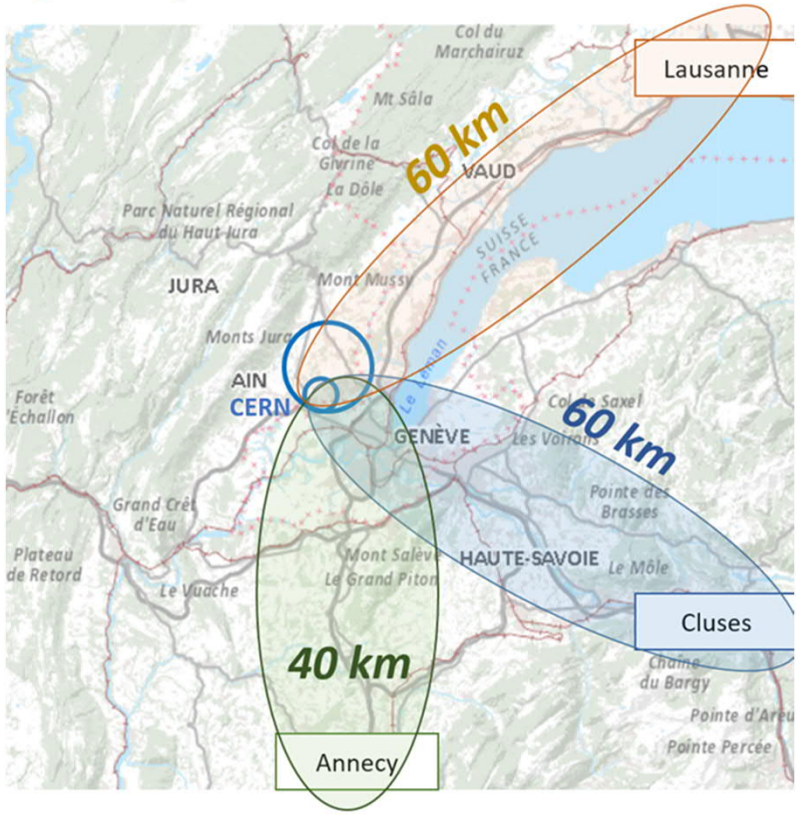
Emissions

223 800 tCO_2e

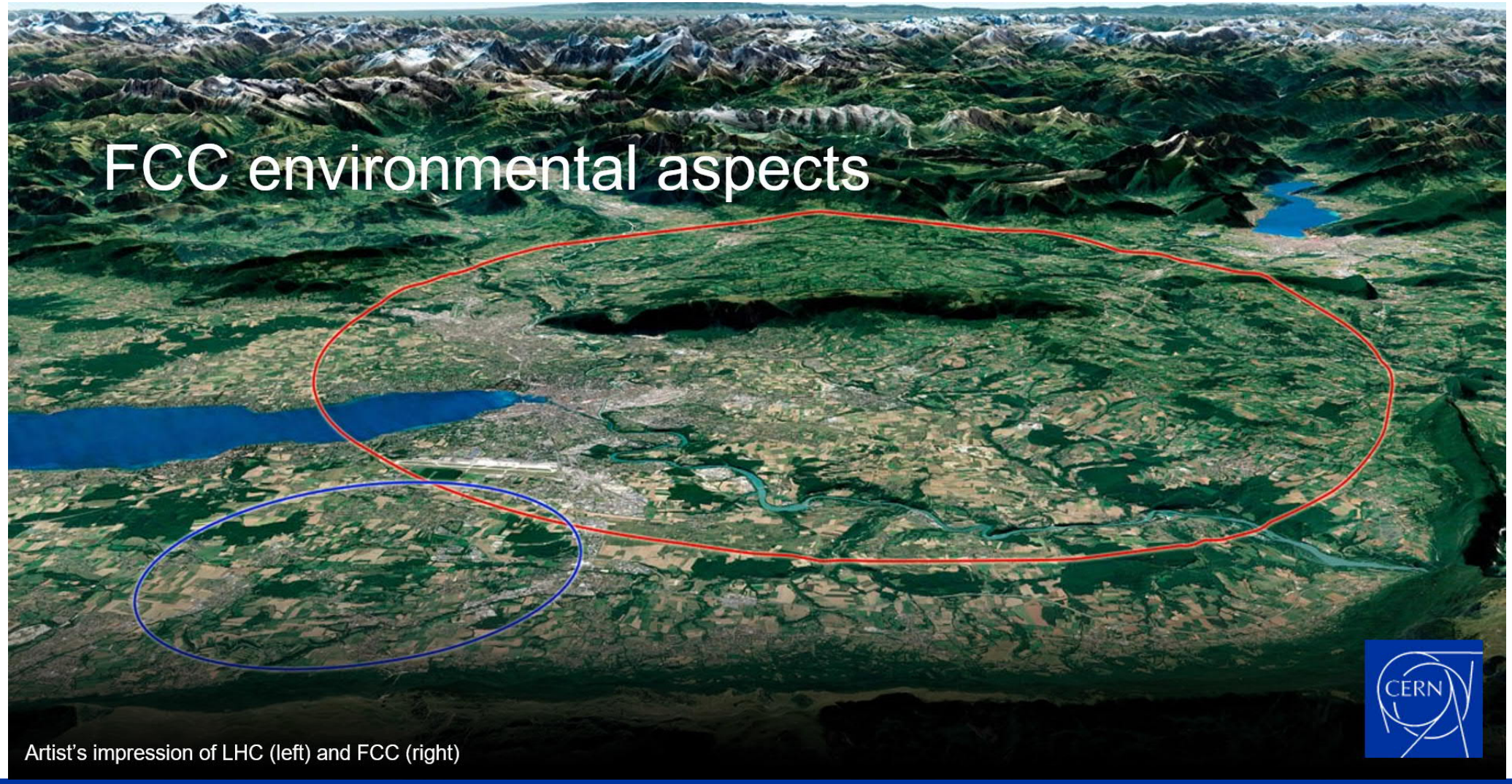
CERN’s direct greenhouse gas emissions were **192 100 tonnes of CO_2 equivalent,** tCO_2e. Indirect emissions arising from electricity consumption were **31 700 tCO_2e**. CERN’s immediate target is to reduce direct emissions by **28%** by the end of **2024** *(page 14)*.

CERN’s carbon emissions accounting (4/4)

- In the next report (2019-2020), data on **Scope 3** emissions will be available
- Categories investigated were Business travel, Personnel commutes , Catering, waste and water purification. About 5% of the CERN’s 2018 carbon footprint. Within these categories, Personnel commutes has the highest CO_2e footprint
- CERN’s procurement related CO_2 emissions were also investigated but are not included yet. “Sustainable procurement” project launched this year
- Accounting for Scope 3 carried out by a consultant through the **SimaPro** software (using ecoinvent v3.6 and Exiobase databases)



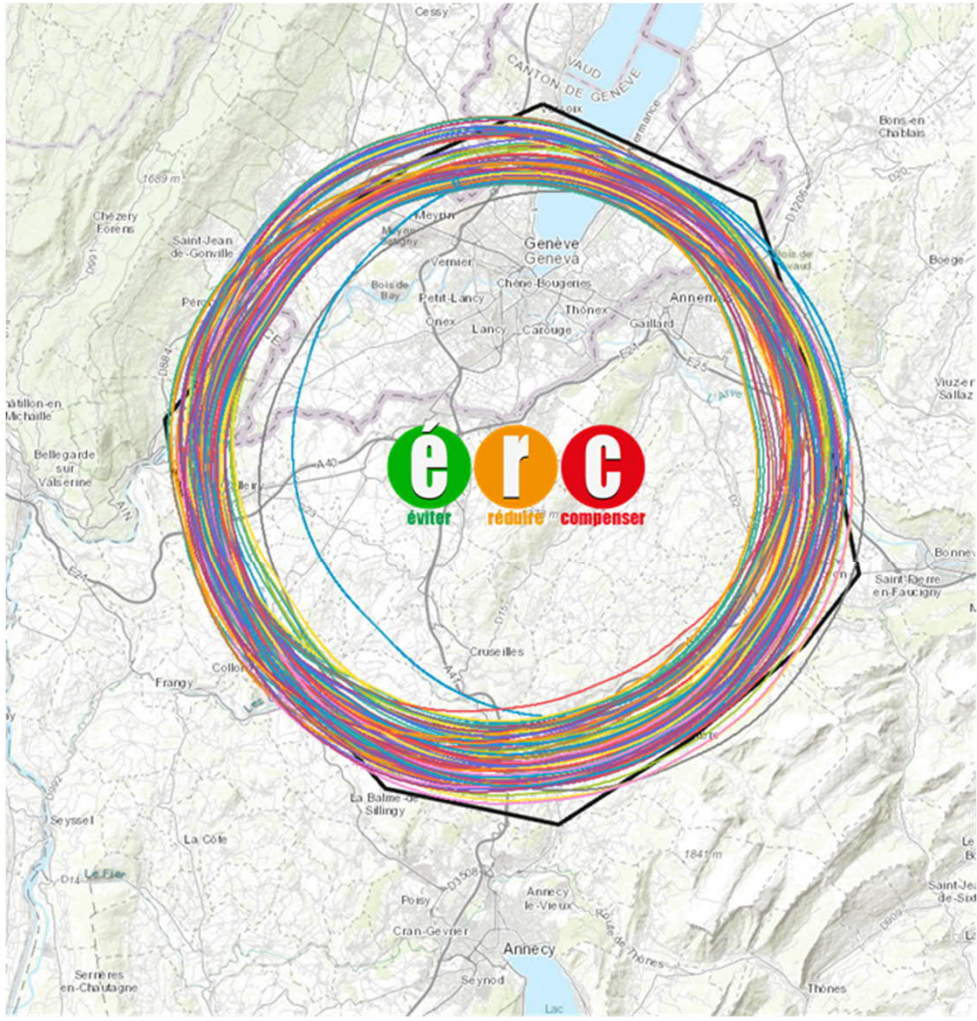
Environmental Evaluation Process for FCC feasibility study (1/4)



Artist's impression of LHC (left) and FCC (right)

Environmental Evaluation Process for FCC feasibility study (2/4)

- For the Future Circular Collider feasibility study, integration of an **“Eco-design”** approach from the first conceptual design phase onwards, balancing – Scientific excellence – Territorial compatibility – Implementation and operation aspects
- The environmental evaluation process follows the **“Avoid-Reduce-Compensate”** approach of the French environmental law
- Multi-year development of the accelerator system and infrastructures requires an iterative approach
- Early engagement of stakeholders, so that performance for scientific research is maintained



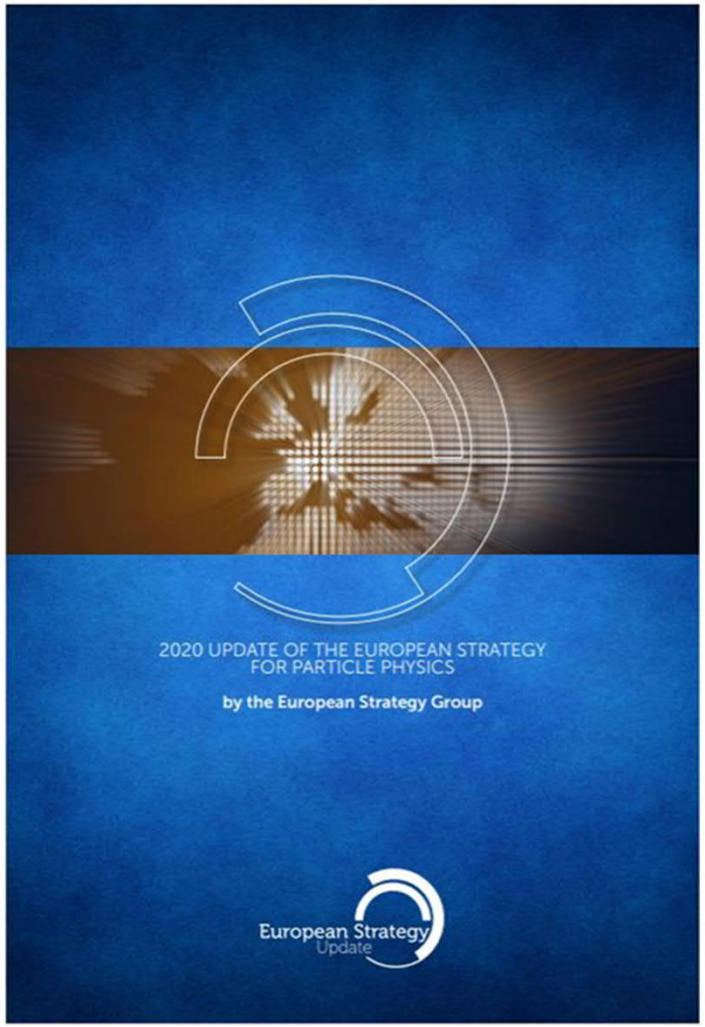
About 100 alignments of 12 site and 8 site scenarios studies together with French and Swiss Host State partners between 2015 and 2021.

Environmental Evaluation Process for FCC feasibility study (3/4)

- **Environment** within the environmental evaluation process includes aspects such as geology, urbanism, society health and safety, technical development opportunities, synergies and conflicts with other planned projects, technical risks…
- Transboundary aspects are considered (European *Espoo* and *Aarhus* Conventions)
- Iterative co-development with the Host State partners on high-priority topics such as:
  - Consumption of resources: land, soil, water
  - Limitation of impacts, e.g. through re-use of **excavated materials**, reduction of surface footprints, energy efficient designs, reduction of traffic and nuisances during construction
  - Creation of added value, e.g. supply of waste heat, sharing of technical infrastructures (e.g. electricity, telecommunications, water supply and treatment)
- Environmental Evaluation process is currently in a preparatory phase (initial state analysis, methodology setup, concept approval by the Host State partners)

Environmental Evaluation Process for FCC feasibility study (4/4)

- Process takes into account the recommendations established in the framework of the **Update of the European Strategy for Particle Physics** in June 2020
- Carbon footprint assessment(s) for various categories will be done progressively, also under guidance of the Host State partners



7

Environmental and societal impact

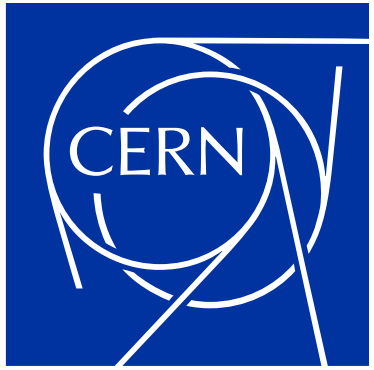
A. The energy efficiency of present and future accelerators, and of computing facilities, is and should remain an area requiring constant attention. Travel also represents an environmental challenge, due to the international nature of the field. ***The environmental impact of particle physics activities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

Conclusions

- CERN's carbon accounting methodology is regularly revised. The accounting will be extended according to needs and international approaches
- A recent event between the eight European EIROforum organisations and the seventeen NLDC laboratories in the United States on climate issues demonstrated the need to exchange on carbon accountings in research facilities and to share experiences on reduction actions (https://www.eiroforum.org/news/uniting-science-to-address-climate-change/)
- For potential future large research facilities, such as FCC, carbon accounting is part of the process, as local impact assessments in many other environmental domains


CERN