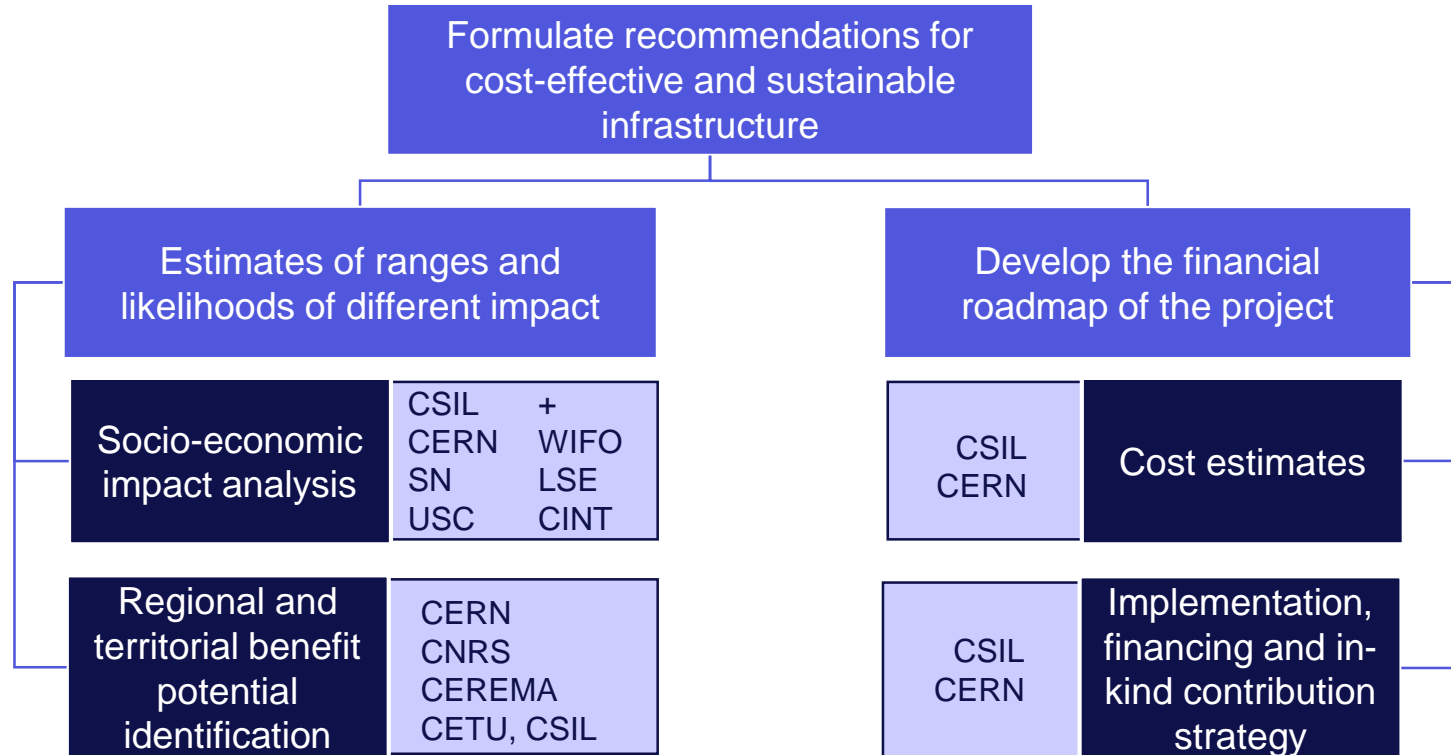




WP4 IMPACT & SUSTAINABILITY OVERVIEW

UPDATE OF THE PROGRESS MADE UP TO NOVEMBER 2022

WP4 structure: objective, tasks, team



WP4 deliverables

Official deliverable or milestone	Responsible	Due date	Status
D4.1. Plan for research infrastructure socio-economic impact analysis	CSIL	01/10/2022	Submitted
M4.1 Structure for cost estimates and funding needs	CERN	01/05/2022	Submitted
D4.3. Regional benefits and territorial development opportunities in a global	CNRS	01/11/2023	Started
D4.4. Implementation, financing and in-kind contribution strategy	CERN	01/01/2024	Not started yet
D4.2. Socio-economic impacts of the lepton collider-based research infrastructure	CSIL	01/07/2024	Expected by end of 2023

Cost estimates

Timeline



Methodology and main assumptions

- **Methodology:** StR-ESFRI "Guidelines on cost estimation of research infrastructures" (2019) and the European Commission's "Guide to Cost-Benefit Analysis of Investment Projects" (2014).
- **Time profile:** from 2021 (assumed year of start of feasibility studies) until 2057 (assumed last year of exploitation of the FCC-ee results) – total of 37 years
- **Unit of measure:** CHF, in real terms at 2021 prices.
- **Who bears the costs:** CERN and all other institutes
- **Residual value:** At the end of its lifetime, the FCC-ee infrastructure could be partly re-used for subsequent projects. Therefore, no costs of FCC-ee dismantling and infrastructure adaptation at the end of its lifetime have been included in the cost estimates. A residual value is instead estimated.

Cost structure

- **Investment costs:**
 - Pre-investments
 - Accelerator systems
 - Infrastructure systems
 - Civil engineering works
- **Operating costs:**
 - Labour costs (67% of total)
 - Maintenance and repair
 - Utilities and services (e.g. electricity, water)
 - Consumables (e.g. cryogenics)
 - Management and administration
 - Others

Socio-economic impact analysis

MAIN IMPACT PATHWAYS (global and territorial)

Scientific
production

Education
and training

Industrial
effects

Cultural
effects

Public good
value

ICT and data
spillovers

Others

Overall approach

- Long-time perspective, covering the entire life time of the FCC-ee
- Mix of methods: resulting KPI structured according to the RIPATHS framework
- Where possible, benefits are translated into monetary terms → Quantification of the minimum likely expected socio-economic return
- Probabilistic model, building on historical data and expert opinion
- Distinction between:
 - global and territorial impacts
 - directly caused and wider benefits

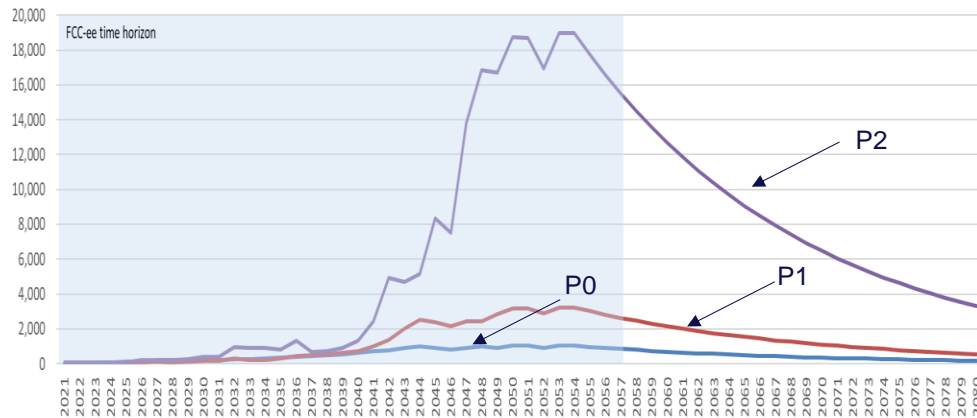
Scientific production

Timeline



Method

- **Scientific products:** Articles in peer-reviewed journals; Working papers/not peer-reviewed articles in document servers, notes, reports, PhD theses; Pre-prints; Conference proceedings; Books for academic use; Chapters in edited books
- **Number of FCC scientific products** estimated based on historical curve of LHC, LEP and Tevatron
- Economic value proxied by the **production opportunity cost:** the scientist's annual gross salary divided by the number of hours worked can be taken as a proxy of the value for society of his/her time.



Education and training

Timeline

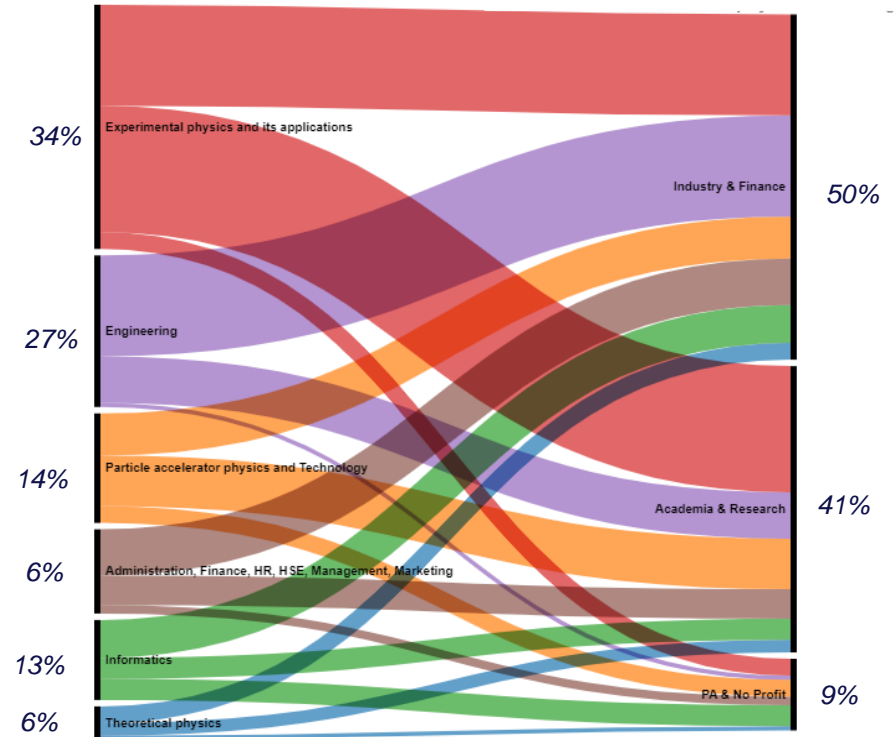


Method

- **Beneficiaries:** PhD students, post docs, technical students, young fellows that spent a period of job at CERN
- The benefit is estimated as the **incremental salary premium** they gain as compared to their peers (without such job experience)
- **On-line survey** to former researchers at CERN, now in the labour market: about 400 valid responses
- **Econometric analysis** to estimate the impact of CERN on salary:
 - salary premium = 3% (2-4%) for each year spent at CERN
 - salary premium = 6% (2-10%) for the average duration of stay at CERN (3.8 years)

Domain of activity while staying at CERN

Sector of employment after leaving CERN



Industrial impacts

Timeline



Approach 1 (CSIL)

- **Spillover effects for supplier companies** due to innovation, learning and reputation gains
- Procurement cost and degree of innovativeness (high-tech and low-tech)
- **Profit/sales multiplier for CERN suppliers** based on past surveys and analysis of balance sheets data: 3.11 for high-tech procurement

Approach 2 (WIFO)

- **Direct, Indirect and wider effects on value added** due to the investment and operation expenditure of FCC
- Effects computed on the basis of a macroeconomic model for all European countries (**input/output tables**)

Approach 3 (LSE)

- **Indirect territorial effects on employment** of FCC procurement on one illustrative firm
- How far the employment benefits diffuse to other sectors and outside the company (municipality and region)?
- Counterfactual evaluation to estimate the **net causal** effect (synthetic control group)

ICT and data spillovers

Timeline



Virtual repository (Zenodo)

- **Data storage** benefit: value estimated based on market price of a similar tool (Dryad)
- **Online usage**: monetary value of the time spent by unique visitors on the repository website
- **Downloads**: monetary value of the time spent by unique visitors to
- **Net benefit**: Total benefit - cost

Web collaborative service (Indico)

- Price for a “**synthetic Indico-like system**” based on prices of alternative systems covering all Indico functionalities
- Hypothetical Willingness to Pay, estimated with an **on-line survey** to Indico users (private sector companies with more than 50 computers using Indico for conference, workshop, and meeting management): 2100 respondents

ICT start ups and spinoffs

- **Number of companies** created by people who leave CERN or CERN employees
- Estimation of the **economic value** produced by these companies over their lifetime

Cultural effects

Timeline



Onsite visitors

- Forecasted **number of visitors**
- Socio-economic value: **travel cost + value of travel time + on-site expenditure**
- Results based on a **survey** launched in 2018-2019 collecting information from 892 visitors
- **Total expenditure per visitor** (in group or individual): 550-640 CHF (4 day visit on average)
- Around 50%: benefit from visitors for the local territories

Online visitors

- Forecasted number of visitors of social media and websites
- Socio-economic value: **value of time** spent in viewing and interacting



Regional and territorial benefits

Timeline



Estimate of jobs indirectly linked to the visitors at CERN

Method:

- Number of visitors at CERN distinguishing groups and individuals. Only the groups are kept for this estimate.
- Estimate of the **jobs in tourism induced by the expenditures of the visitors**.
- Estimate of the **geographical distribution** of the jobs.

Results:

- Over 30 years (FCC-ee programme timescale: construction + operation), **1 700 jobs in average per year**, can be linked to the expenditures of CERN's visitors.

Geographical distribution of jobs:



■ France ■ Suisse

Reference:

A report and an infographic presenting the results are coming soon.

An estimate of the indirect and induced jobs linked to the expenditures of the FCC-ee programme participants in the territory is ongoing.

Regional and territorial benefits

Timeline



Estimate of the economic effect due to the local spending of resident persons

Method:

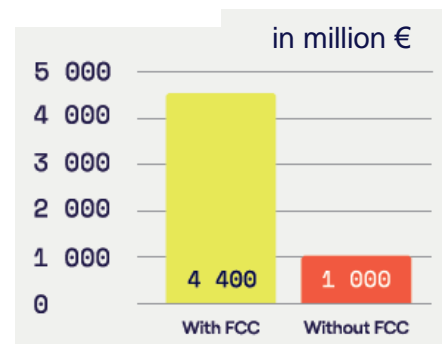
- Estimate of the **number of people participating** in the FCC-ee programme and **living in the territory** = residents (Canton de Genève, Ain and Haute-Savoie departments).
- Estimate of the **household consumption expenditures** according to the status and the wages of the residents.
- **Total estimate of the consumer spending over 30 years** as part of all CERN's research activities, including the FCC-ee programme.
- Estimate of the **geographical distribution** of the consumption expenditures.

Reference:

A report and an infographic presenting the results are coming soon.

Results:

- Over 30 years (FCC-ee programme timescale: construction + operation), **4.4 billion euros** could be spent in the local territory through consumer expenditures of residents. **Of which 3.4 billion euros can be attributed directly to the FCC-ee programme.**



Geographical distribution:

(FCC-ee programme only)

 2.3 billion euros

 1.1 billion euros

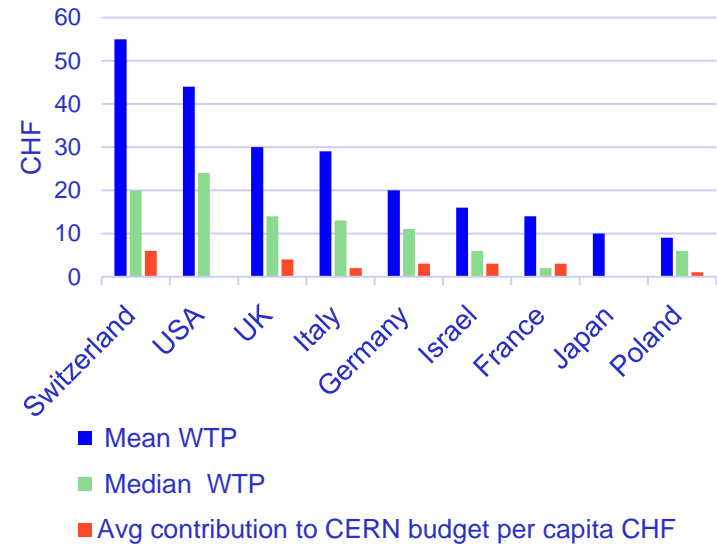
Public good value: the general public attitudes

Timeline



Method

- **On-line surveys** to representative samples of population in Germany, Israel, Italy, Japan, Poland, UK, USA
- **10,448 total respondents**
 - **8,443 respondents** from the 2022 survey
 - **2,005 respondents** from FR and CH during the previous surveys in 2017 and 2018
- **Information about:**
 - General interest and opinions about scientific research
 - Knowledge of CERN
 - Value attached to continuation of CERN research with a new machine: how much CERN's future research is worth to a person
 - Demographic characteristics



Three examples of additional benefits

Timeline



Production of electricity from renewable sources and overcapacities

- **Construction and operating FCC-ee with renewable energies** sources via long-term procured resources can be both **economically attractive** and permit, due to allocation of overcapacities, **making available electricity for other institutional/societal consumers** at attractive prices.
- Sourcing from renewable energy sources can lead to the **replacement of fossile energy sources**, contribute to the energy transition, thus resulting in a **reduction of greenhouse gases** in Europe.

Excavation materials societal benefits

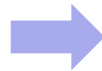
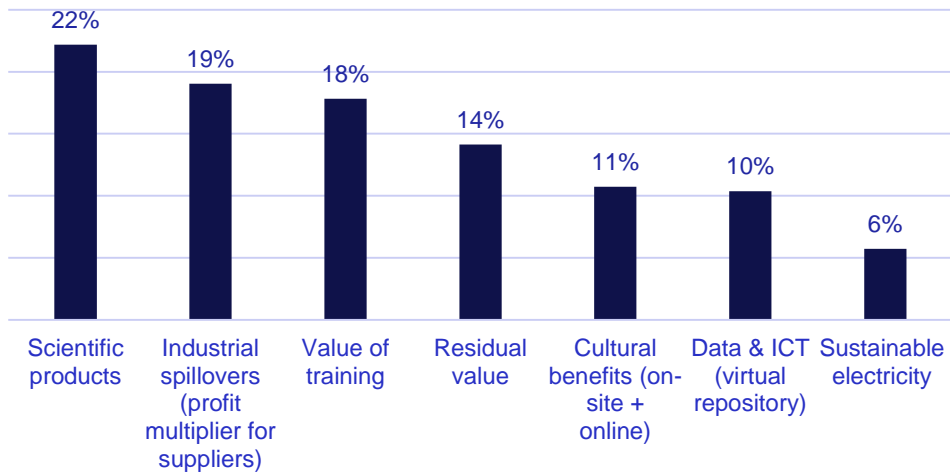
- Locally innovative approach leads to **avoided costs from transporting and depositing** the excavation materials in distant quarries and mines in FR and CH
- The **quality of existing agricultural spaces can be improved** and **forests can be made climate-change fit**.
- Ongoing estimation of quantities of excavation materials in different locations.
- Re-useable quantities range from 10% to 60%.

Waste heat recovery and supply

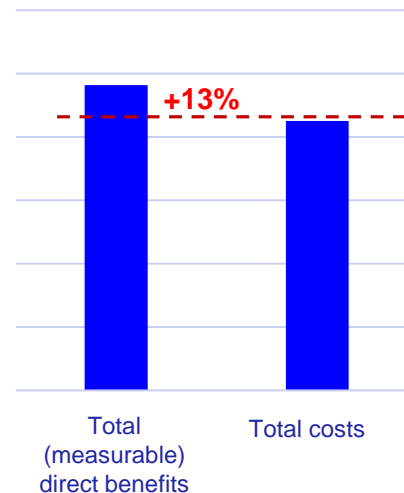
- Conservative low-end estimate of 20 GWh of low-grade waste heat recovered at each of the eight sites permits providing the heat to consumers in the vicinity at attractive price via district-heating network operators.
- **Inventory of potential consumers** is being built (LAPP)
- Socio-economic value estimate as compared to traditional heating sources is ongoing (CSIL)

A preview of results of the quantitative model

Share of measurable socio-economic benefits directly attributed to FCC-ee (preliminary)



Benefit vs costs (preliminary)



Benefits and costs are discounted at a Social Discount Rate of 2%.



Thank you
for your attention