Building CERN’s Future Circular Collider

An estimation of its impact on value added and employment

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Why and what?

Huge price tag for Future Circular Collider:
- 12-20 bn CHF (construction, operation; 2019 estimate)
- has to be borne by member countries
- „FCC“ also has to be sold to member countries....... on its scientific merit; but also on economic merit...?

Multi-dimensional ex-ante examinations of FCC-impact on
- scientific progress
- technological development
- individual (academic) career opportunities
- **economic linkages – job opportunities**
  - short term effects -> jobs needed to build and run the FCC
  - long term effects (effects on know-how and productivity of involved firms) dealt with in a different study
Important:
- costs for FCC do not evaporate -> constitute earning opportunities for potential suppliers of goods and services required in the construction and operation of the FCC
- Someone's got to get the money

we will present an estimation as to who this someone might be, and where they might be located.
- not individual firms, but economic industries in the CERN member states (and beyond).
The project – the Future Circular Collider FCC

- Chronology and costs of the project:

  estimate economic effects of these spending volumes
  in terms of employment (and value added)
  taking into account regional and sectoral aspects („where and who“)

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<thead>
<tr>
<th></th>
<th>Investment Volume [mn CHF]</th>
<th>annualised Volume [mn CHF/a]</th>
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<tbody>
<tr>
<td><strong>FCC-related Investment</strong></td>
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<td>12,097</td>
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<td>Core Phase</td>
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<td>Experiment Phase</td>
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<tr>
<td>Wind&amp;PV capacity</td>
<td>644</td>
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<td><strong>FCC-related Operation</strong></td>
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Widely used impact simulation tool: multi-regional **Input-Output models**
- divide economy into different sectors/industries in different countries and estimate the flows between them.

Based on **Input-Output tables**: describe „technology“ of each of these industries:
- vector of **inputs** (commodities = materials, services) is combined with **labour** and **capital** to produce **output**: 
  \[ \text{Output } Q = f(L,K,M,S) \]

Various links to „rest of the economy“:
- this vector of **inputs** represents goods and services purchased from firms from same/other sectors, domestic source or imported from abroad)
  - \( \rightarrow \) **upstream linkages**
- **Labour** and **capital** owners get their share of Value added (wages, profits)
  - \( \rightarrow \) feeds into **final demand** (consumption, investment)
  - again, this constitutes demand for domestic/imported commodities.

Multi-regional IO table describes **consistent** flows between all sectors in all regions
- imports of some country = exports of some other country
- output of some firm = input of some other firm or final demand
ADAGIO – a multi-regional Input-Output model

- 43 countries (EU27 & major economies)
- 65 industries/commodities
- fully endogenous sector and trade linkages
- allow to ex-ante simulate effects from „demand shock“
  - new demand – e.g. from construction of FCC – translates into production of (and employment in) firms from various sectors and regions

Simulation setup:

- we include all **production-related** effects into our estimate
- direct effects on suppliers to the FCC
- indirect effects on the suppliers of these suppliers etc.
- depreciation-related investment effects (capital replacement)
The project – the Future Circular Collider FCC

- ADAGIO is a tool to answer the central questions of this analysis:
  - how much value added is linked to the construction and operation of the FCC?
  - How much employment opportunities might be generated?

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FCC-related investment

CAPEx - core & upgrade investment phases
renewable capacity

FCC operation

FCC direct effects
OPEX – operational expenditure
Cost-of-Living of resident personnel and users
Visitors to construction site and FCC
In detail: The investment phase, 2031-40/2041-50

- **Total:** ~12 bn CHF
- **technical assets:**
  
<table>
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<th>FCC section</th>
<th>[mn CHF]</th>
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<tr>
<td>Civil Engineering (Tunnel)</td>
<td>5,250</td>
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<tr>
<td>Accelerator</td>
<td>4,342</td>
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<tr>
<td>Infrastructure</td>
<td>1,805</td>
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<tr>
<td>Experiment</td>
<td>700</td>
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- derive investment demand for commodities
  - translate technical assets into economic classification for ADAGIO
- Sourcing of investment goods: necessary to rely on assumptions
  - ideally proportional to CERN contributions
  - not fully reflected in the past
  - two scenarios – „fair share“ vs. „observed share“
  - commodity structure by country to reflect relative strengths/specialisation
Results – Value added and employment:

- Investment Volume of 12 bn CHF translates into
  - 14.1 bn CHF of world-wide Value added over 20 year construction
  - linked to 230 kPY (Person-Years) of employment
    - annual average of almost 12,000 jobs over 20 year construction period

- largest effects in DEU/GBR/FRA/ITA/ESP
  - 57% of VA effects
  - 45% of employment effects
  - to be expected: these 5 are also largest contributors to CERN

- But: CHN <1% of contracts, but
  - 4.4% of VA effects
  - 10% of employment effects
  - CHN has an important position within GLOBAL Value Chains!

- largest effects by industry:
  - construction, metal products, machinery, electronics

In detail: The investment phase, 2031-50

1) 1 Person-Year = amount of labour provided by 1 employee in a 1 year period. allows to add up employment over the years
FCC-related investment

- CAPEX - core & upgrade investment phases
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FCC operation

- FCC direct effects
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In detail: Electricity procurement, 2031-40

- large demand for electricity
  - annually: 1.25-1.95 TWh
- large ecological footprint (and large electricity bill)
- CERN plans to contract out electricity supply to new capacity of renewables (wind, PV)
  - peak demand incl. reserve ~ 500 MW
  - would leave ~20 TWh of off-CERN-peak power over 15 years to be fed into general grid.
  - est. total installation costs (ass. 60 wind : 40 PV): 640 mn CHF
  - location of capacity as yet unspecified ("somewhere in Europe")
- in all, 630 mn CHF of value added and close to 12,000 PY of employment linked to renewables (of which 500 mn CHF and 7,000 PY in Europe)
**FCC-related investment**

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**FCC operation**

- FCC direct effects
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In detail: Direct FCC-related CERN effects, 2041-57

- **Annual Total:**
  - ~ 200 mn CHF of material inputs (intermediate goods and services)
  - plus 450 mn CHF of wages for resident personnel and users

- **various aspects:**
  1. *direct* effects of FCC operation -> VA, employment at CERN
  2. *direct & indirect* effects of input demand -> VA, employment at suppliers of inputs
  3. *direct & indirect* effects of consumption by CERN employees -> VA, employment at suppliers of consumption goods
  4. tourist expenditures by CERN visitors
FCC-related investment
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FCC operation
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- Visitors to construction site and FCC
1 direct FCC-related VA and employment at CERN:
- 8,000 jobs on average 2028-2057
- 450 mn CHF of value added
  (180 mn CHF of wages + 270 mn CHF depreciation)

2 direct & indirect effects of consumption by resident personnel & users:
- ~ 450 mn CHF wages per year (for resident personnel and users)
- -> 310 mn CHF of consumption expenditure
- -> in all, this consumption expenditure is linked to > 600 mn CHF of Value added supporting >8,000 jobs (of which almost 5,000 in CHE/FRA)
- sectoral effects dominated by „consumption-related“ industries (trade, real estate, personal services)
FCC-related investment
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FCC operation
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3 direct&indirect effects of input demand - OPEX

-> VA, employment at suppliers of inputs
  ■ ~ 200 mn CHF of OPEX supplies per year
  ■ again assumptions about sourcing of these supplies
  ■ -> in all, linked to 230 mn CHF of Value added supporting 3,400 jobs (of which 2,400 in Europe)

4 Visitors to construction site & FCC

■ pre-pandemic: ~150k visitors to CERN per year; will rise to 300k for the FCC
■ boost to regional tourism industry: Canton of Geneva records 1.6 mn arrivals and 3.2 mn overnight stays
■ especially visitor groups: stay for avg 4 nights, spend around 800 CHF per person (disregard non-group visitors)
■ 180 mn CHF of VA per year, 2,700 jobs;
■ main benefits to accommodation/restaurants, trade, transportation, cultural sectors
■ in France and Switzerland
**FCC-related investment**
- CAPEX - core & upgrade investment phases
- renewable capacity

**FCC operation**
- FCC direct effects
- Cost-of-Living of resident personnel and users
- OPEX – operational expenditure
- Visitors to construction site and FCC
### Summary—the Future Circular Collider FCC

#### Summary of economic effects by project phase:
- Construction & operation of FCC directly and indirectly linked to around 50 bn CHF of Value added over its initial 30 year period, offering job opportunities amounting to 800 th Person-years.

- **Annualised effects over 30 years:**
  - 1.7 bn CHF of Value Added
  - Linked to 27,000 jobs

<table>
<thead>
<tr>
<th>FCC-related Investment</th>
<th>Investment / Consumption Volume</th>
<th>annualised invest/cons. volume+</th>
<th>direct</th>
<th>indirect</th>
<th>total Type1</th>
<th>Type2</th>
<th>Sum Total</th>
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<td><strong>540</strong></td>
<td><strong>250</strong></td>
<td><strong>800</strong></td>
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#### cumulated Value Added effects
- [mio CHF]
  - FCC-related investment
  - FCC-Operation
  - Total

#### cum. Employment effects
- [1000 Personyears]
  - FCC-related investment
  - FCC-Operation
  - Total
The project – the Future Circular Collider FCC

- Chronology of jobs linked to construction & operation of FCC:

**Worldwide:**

- Visitors
- Cost-of-living – resident personnel
- FCC-related personnel
- FCC-OPEX
- Renewables capacity
- FCC-construction
The project – the Future Circular Collider FCC

Chronology of jobs linked to construction & operation of FCC:

France & Switzerland:

- Including at least 1,600 local* jobs in construction of the infrastructure.
- Including at least 600 local* jobs due to consumption of FCC-related residents and visitors who spend in the territory.

*Local means Ain and Haute-Savoie departments and Canton de Genève.
The project – the Future Circular Collider FCC

Economic sectors of employment:

**Investment phase**
- MANUFACTURING: 36%
- CONSTRUCTION: 17%
- WHOLESALE AND RETAIL TRADE: 13%
- TRANSPORTATION AND STORAGE: 5%
- PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES: 7%
- ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES: 6%
- OTHERS: 16%

**Operation phase**
- AGRICULTURE, FORESTRY AND FISHING: 22%
- MANUFACTURING: 19%
- CONSTRUCTION: 8%
- WHOLESALE AND RETAIL TRADE: 15%
- TRANSPORTATION AND STORAGE: 8%
- ACCOMMODATION AND FOOD SERVICE ACTIVITIES: 8%
- PUBLIC & OTHER SERVICES: 13%
- OTHERS: 7%
Thanks a million!

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