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# CAHIER D'ACTEUR

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# Le point de vue de Montanuniversität Leoben

Montanuniversität Leoben (MUL) is Austria's university for resources, materials and mining engineering. Through its research centre Zentrum am Berg (ZaB), MUL develops resource-efficient tunnelling and technologies for the reuse of excavated materials. MUL is a partner of the EU project iRIS (Horizon Europe, Grant Agreement No. 101275935) and represents excavated-materials and land-use topics for the Einstein Telescope preparatory phase (ET-PP).

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## EN BREF.

**From the perspective of resource management and the circular economy, the FCC is more than a physics instrument: it is an opportunity to demonstrate, how a major European infrastructure can be built while turning one of its environmental liabilities, excavated materials, into a resource. Today, reuse rates for excavated and construction materials in Europe are only around 30%, largely because conventional laboratory characterisation takes days and prevents on-site decisions (Hale et al., Sustainability 13(11), 6083, 2021). Within the Horizon Europe project iRIS, MUL and its partners are developing AI-supported real-time characterisation of excavated materials and processes to reconstitute functional soil from excavation and demolition streams. These technologies are being piloted with sample materials from CERN and from Einstein Telescope candidate sites, with the explicit aim of being available for FCC construction. Studies indicate that circular management of FCC excavation materials could reduce related costs substantially while restoring degraded land and creating skills, jobs and transferable know-how for the wider construction and recycling sectors. We therefore consider the FCC, if realised with such an approach, a credible driver of the circular economy in the region and in Europe, and we recommend that circular-economy be anchored in the project from the design stage.**

## 1. Why a resources university takes a position on the FCC

MUL has decades of experience in underground construction and in the management of excavated materials, including EU projects on resource-efficient tunnelling (Galler, Geomechanics and Tunnelling 8(4), 2015) and current research on AI-based strategies for the reuse of tunnel excavation material (Hauzinger, Schneider & Galler, World Tunnel Congress, 2025). As a partner in the iRIS project and as the representative of excavated-materials topics for the Einstein Telescope preparatory phase, MUL works directly on the question that the FCC raises at unprecedented scale: what happens to the rock and soil that a 90.7 km tunnel produces, and who can benefit from it?

## 2. Excavated material is a resource, not a waste

Across Europe, only about 30% of excavated and construction materials are currently reused, the rest is largely landfilled. The obstacle is not technology but decision-making: laboratory analysis of material quality takes days, so material must be transported and deposited before its reuse potential is known (Hale et al., 2021; Cherrey et al., World Tunnel Congress, 2023, on the Lyon-Turin base tunnel).

The iRIS project addresses exactly this bottleneck. It develops a field-deployable appliance that characterises material on the conveyor in real time, combining laser spectroscopy (LIBS), X-ray transmission and optical sensors (VIS/NIR) with AI models. It targets are conveyor speeds of 2 m/s and classification accuracy of at least 85% under field conditions, cutting analysis time from days to seconds and allocating materials to a valorisation path by matching characteristic properties to predefined thresholds. The goal is to raise reuse rates from 30% to 60% and to reduce landfill volumes by up to 40%. The FCC would be the first infrastructure of its scale able to apply such technology from the first metre of excavation, serving as a practical example for EU-wide deployment at scale.

## 3. From excavated rock to functional soil

A second pillar is soil reconstitution: producing functional soil from excavated mineral material blended with organic streams, to help restoring degraded or sealed land. Soil is classified by the European Commission as a non-renewable resource, and its restoration is a core objective of the EU Soil Strategy for 2030 and the Green Deal. Within a dedicated EU project, soil reconstitution is developed and demonstrated as a cooperative effort of CERN, MUL, BOKU, BRGM, UCLouvain and further academic and industrial partners.

The socio-economic case is significant. A first study on the socio-economic impact potentials estimates that circular management of FCC excavation materials, including soil reconstitution, could reduce related costs from an estimated 698 million CHF to 448 million CHF, a reduction of roughly 35% (DOI: 10.5281/zenodo.15421975, 2025). Beyond costs, re-constituted soil sequesters carbon, supports biodiversity recovery and can return land to agricultural or ecological use after construction. Demonstrated regulatory compliance through traceable, data-based material classification can additionally accelerate permitting.

## 4. Socio-economic benefits for the territory and for Europe

From our perspective, the relevant socio-economic effects of an FCC built on circular principles include:

- **Local value creation:** a regional circular-economy value chain around excavation, processing, reuse and land restoration, involving local construction firms, hauliers, recyclers and agricultural actors rather than long-distance disposal;
- **Technology transfer:** the FCC would act as a lead case for real-time characterisation and soil-reconstitution technologies, opening markets for European SMEs in tunnelling, infrastructure, demolition-waste sorting, recycling and land remediation, strengthening their competitiveness at global level;
- **Skills and education:** large research infrastructures train engineers, data scientists and environmental specialists; the iRIS EU project explicitly couples its pilots with training programmes;
- **Replication:** methods proven at FCC scale can become references for other European projects, including the Einstein Telescope, railway and hydropower schemes.

These effects are not automatic. They depend on decisions taken now, in the design and procurement phase, which is precisely why this public debate matters.

## 5. Our position and recommendations

MUL views the FCC project positively, provided that circularity is treated as an inherent project design requirement and not as an accessory. We recommend that:

- reuse and valorisation ambitions for excavated materials be included in the project baseline and in construction tenders;
- real-time material characterisation and on-site sorting be foreseen at the worksites;
- soil reconstitution and land-restoration schemes be co-developed with local and regional stakeholders and the support of authorities in France and Switzerland;
- monitoring data on material flows be made transparently available during construction, supporting public trust and regulatory oversight;
- training and employment opportunities linked to these activities be anchored regionally.

Under these conditions, the FCC can demonstrate that frontier science and responsible resource management reinforce each other and leave the territory not with spoil heaps, but restore land, create new skills and serve as an internationally visible model of circular construction.

## Sources

iRIS — intelligent Research Infrastructure Sustainability, Horizon Europe GA No. 101275935 (Part B). · Socio-economic impacts of the lepton collider-based research infrastructure, 2025, DOI: 10.5281/zenodo.15421975. · Hale, S. et al., Sustainability 13(11), 6083, 2021, DOI: 10.3390/su13116083. · Cherrey, A. et al., Proc. WTC 2023, DOI: 10.1201/9781003348030-30. · Galler, R., Geomechanics and Tunnelling 8(4), 2015, DOI: 10.1002/geot.201500017. · Hauzinger, E., Schneider, D., Galler, R., WTC 2025, Stockholm. · EU Soil Strategy for 2030, COM(2021) 699 final.