



# Energy activities at CERN

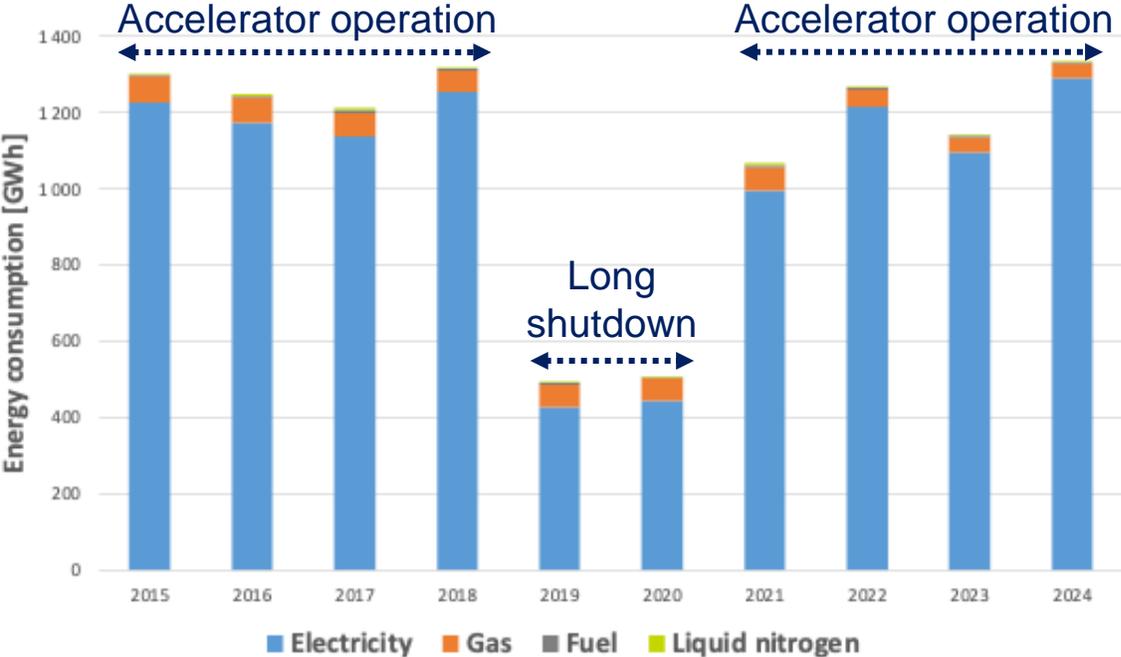
Nikolaos Sapountzoglou (Energy Engineer), on behalf of Nicolas Bellegarde (Energy Coordinator) and CERN's energy management team

ESI at CERN – Discovery Day  
21 October 2025

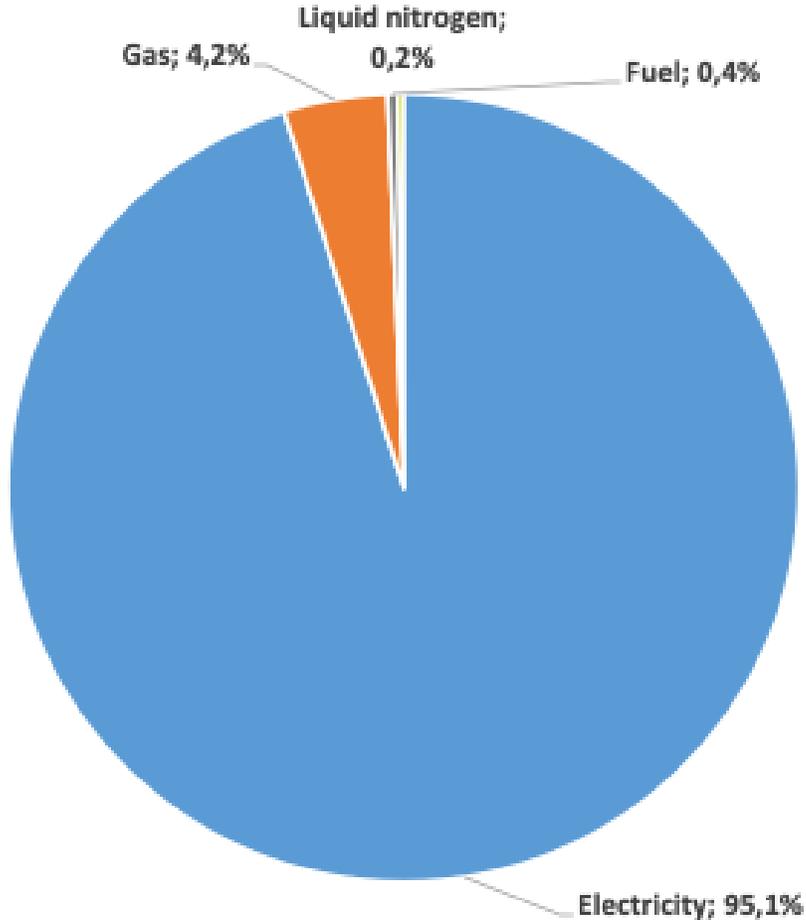
<https://indico.cern.ch/event/1545584/>

# CERN's energy consumption

- 4 sources of energy used at CERN:
  - Electricity (for most uses)
  - Gas (heating)
  - Fuel (car fleet, diesel generators and heating back-up)
  - Liquid nitrogen (helium cooling in the LHC)



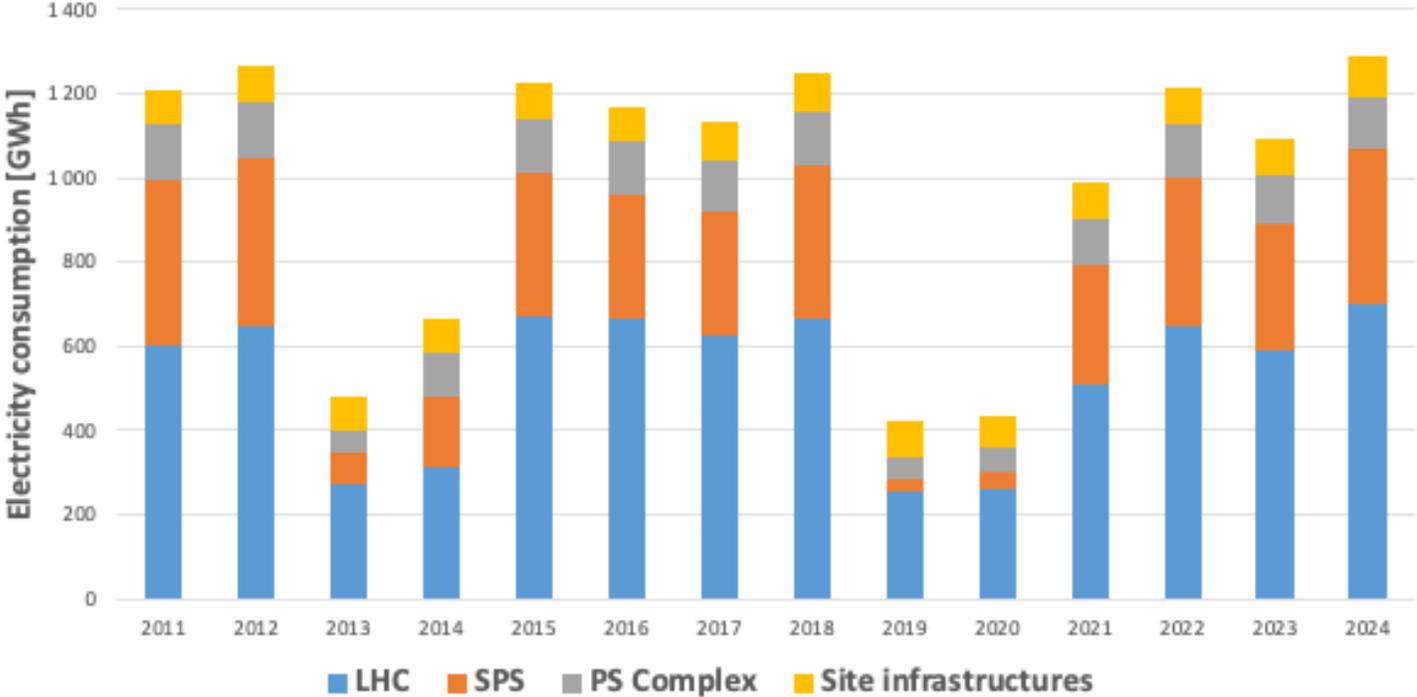
CERN's energy consumption breakdown  
Run2+Run3 average – Total : 1'260 GWh



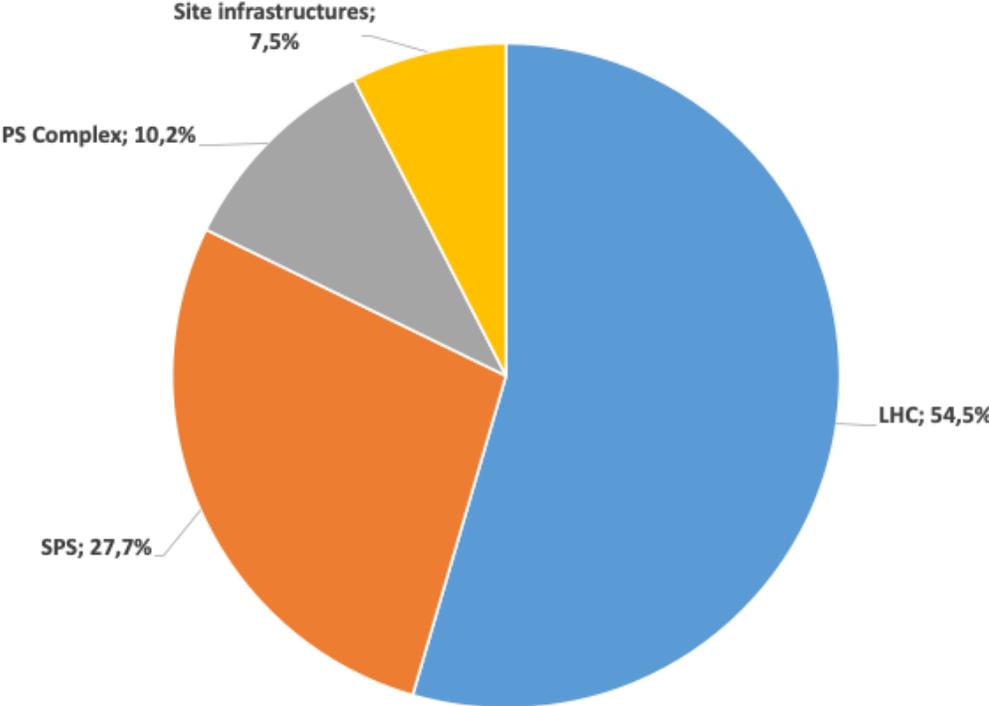
Energy procurement currently represents 5 to 10% of CERN's annual budget when the accelerators are running

# CERN's electricity consumption

- Electricity consumption breakdown



CERN's electricity consumption breakdown  
Run2+Run3 average – Total : 1'196 GWh

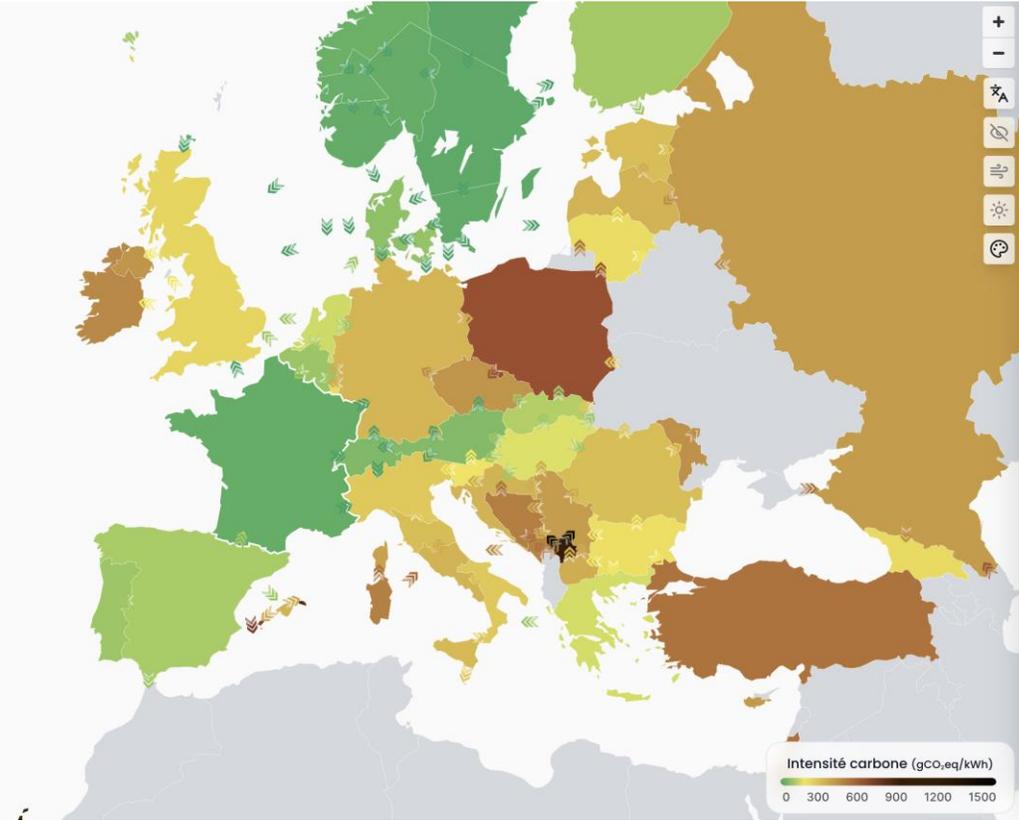


Electricity consumption monitored through 300+ measuring devices

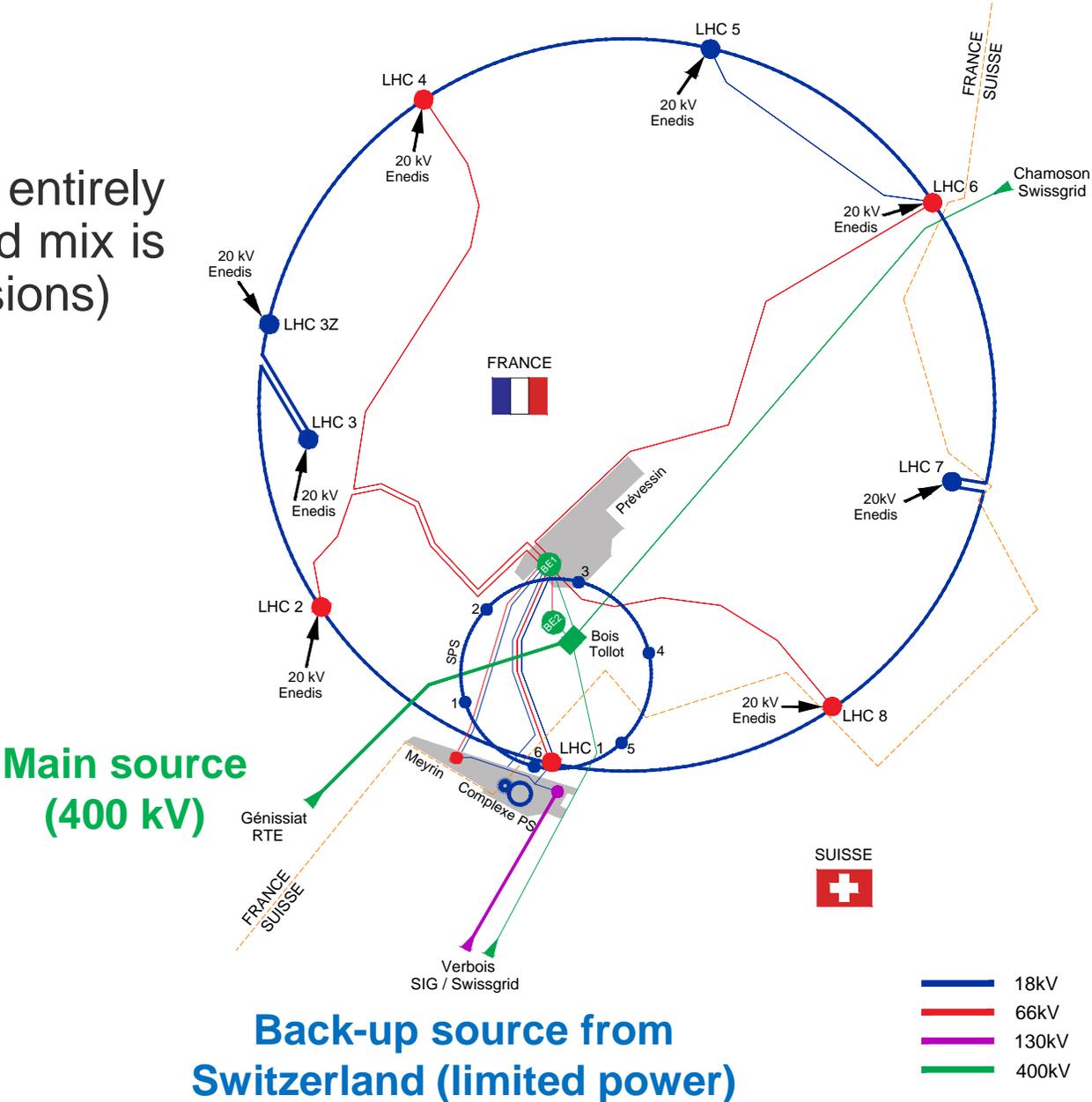
Measurements available on **WebEnergy tool**, developed internally and also used for short and long-term forecasting (see [energy.cern.ch](http://energy.cern.ch), available to everyone with a CERN account)

# CERN's electricity supply

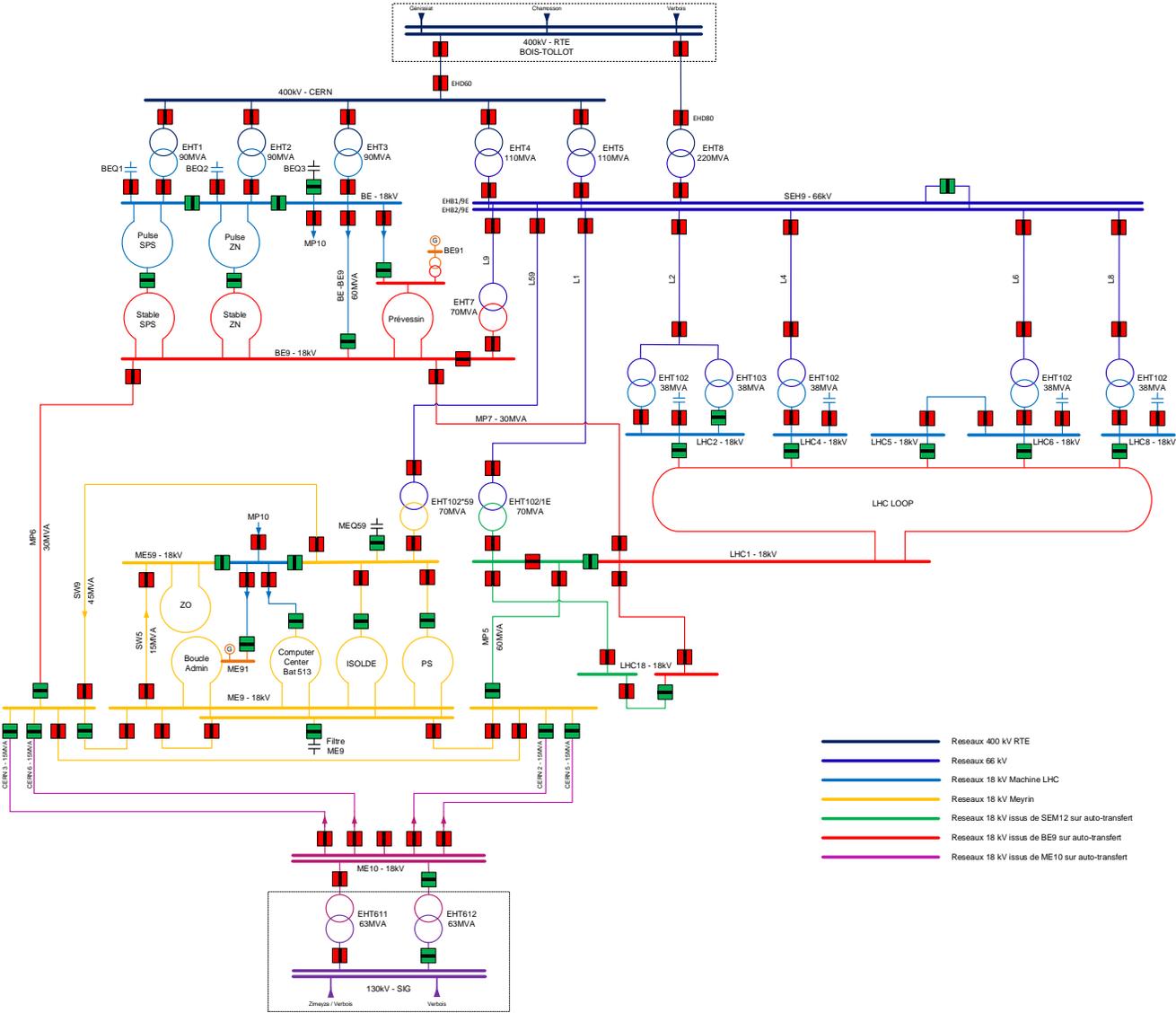
- Under normal circumstances, electricity is entirely procured from France, where the energy grid mix is **more than 90% low-carbon** (scope 2 emissions)



<https://app.electricitymaps.com/zone/FR>



# CERN's electrical network



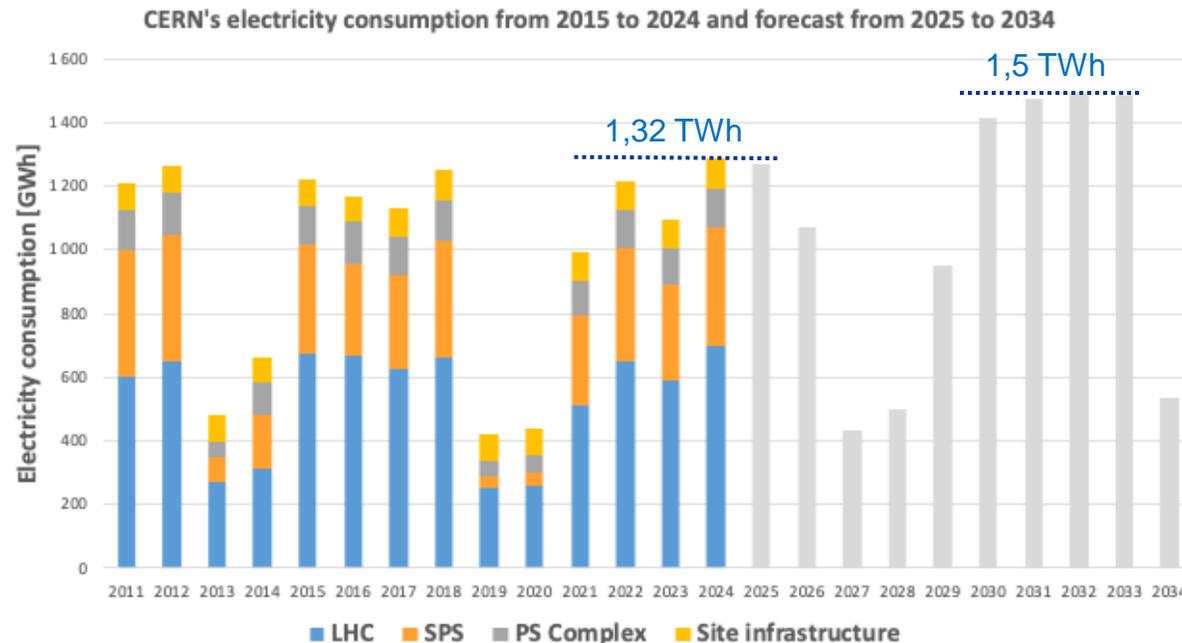
- Separation of loads per type (general services, machine and secured networks)
- Equipment quantities
  - 100+ substations
  - 500+ km of HV cables
  - 350+ HV transformers
  - 50 000+ LV feeders
  - 300+ UPS systems

# CERN's 2025 and 2030 objectives on energy

## 2025 energy objectives

- Limit the increase of electricity consumption to **5% up to the end of Run 3** compared to the 2018 baseline year

→ **Maximum target of 1.32 TWh/year**

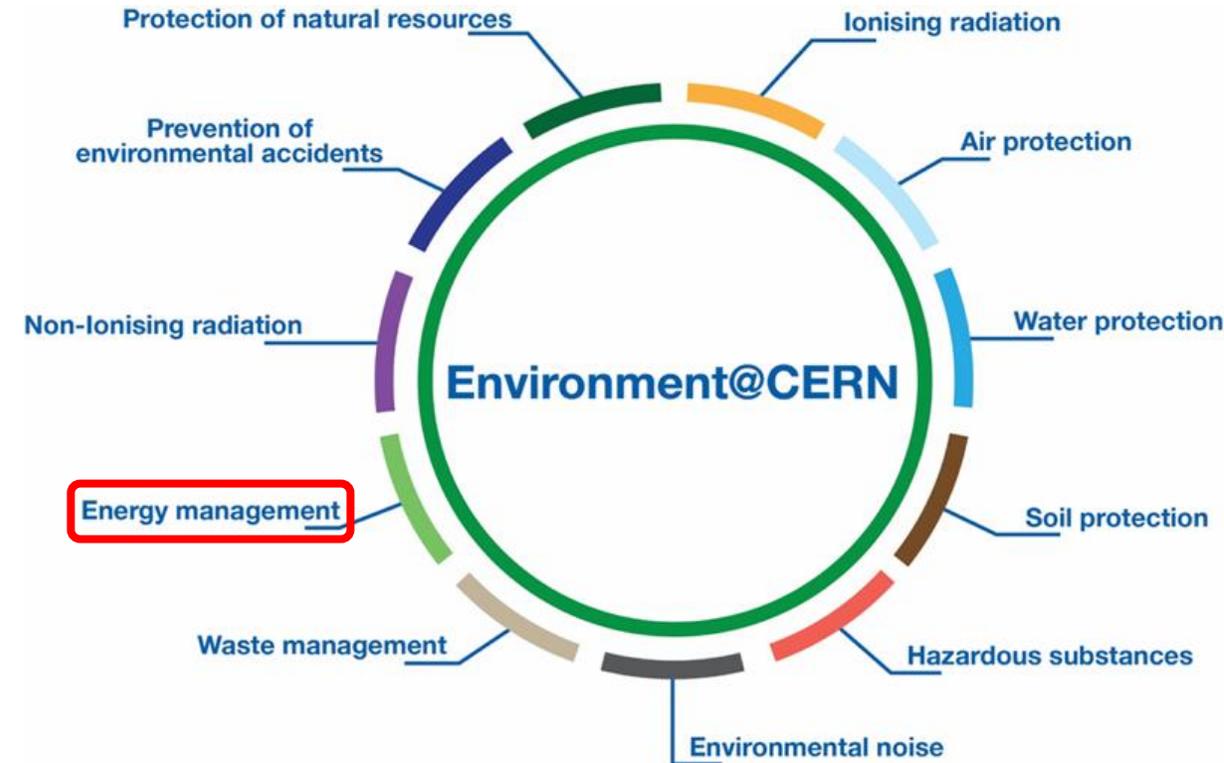


## 2030 energy objectives

- Limit the electricity consumption to **1.5 TWh/year** up to the end of Run 4 (HL-LHC operation)
- Reduce the gas consumption by **60%** compared to the 2018 baseline year (weather-normalised)
- Cover the electricity needs by **10% renewable Power Purchase Agreements** and 90% French electricity mix

# Energy management at CERN

- In place for over 10 years with well-established governance (and reinforced in 2022 in the context of ISO 50001)
  - Dedicated team (part of it full-time)
  - Energy Management Panel
  - CERN Environmental Protection Steering Board



Main objectives: keep the energy required to a minimum, improve energy efficiency, recover waste energy

# Energy management and ISO 50001

- **ISO 50001: main international energy certification standard**
  - Primary goal is to strengthen corporate environmental responsibility
  - Awarded to CERN in February 2023
  - Continuous evaluation of energy performance improvement of organisations through regular audits (two per year)



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 on the environment. 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 funding and personnel, needed to meet its Energy Policy objectives.

In particular, the Organization:

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

### 2.1 Continuous improvement

The Organization is committed to the continuous improvement of its energy performance by means of :

- defining, monitoring and updating strategic energy guidelines and associated objectives and indicators. These guidelines, objectives and indicators are based on energy use measurements, best practices and feedback and are documented in the Organization's energy performance plan;
- an Energy Management System (EMS) compliant with the ISO 50001 standard;
- training the relevant personnel and raising their awareness of the Organization's energy performance and usage;
- monitoring trends, regulatory developments and best practices in energy performance.

## CERN is awarded the ISO 50001 energy certification

8 FEBRUARY, 2023



The CERN Meyrin site in 2020 (Image: CERN)

As part of CERN's commitment to responsible energy management, the Organization began the [ISO 50001](#) certification process in 2022. The certification was officially awarded on 2 February 2023 for a period of three years, i.e. until 1 February 2026.

## Managing energy responsibly: CERN passes ISO 50001 audit

CERN is one of the first scientific laboratories to have obtained ISO 50001 certification for energy management. Following our first surveillance audit, find out how we can all play a role in improving energy management

14 MAY, 2024 | By HSE unit

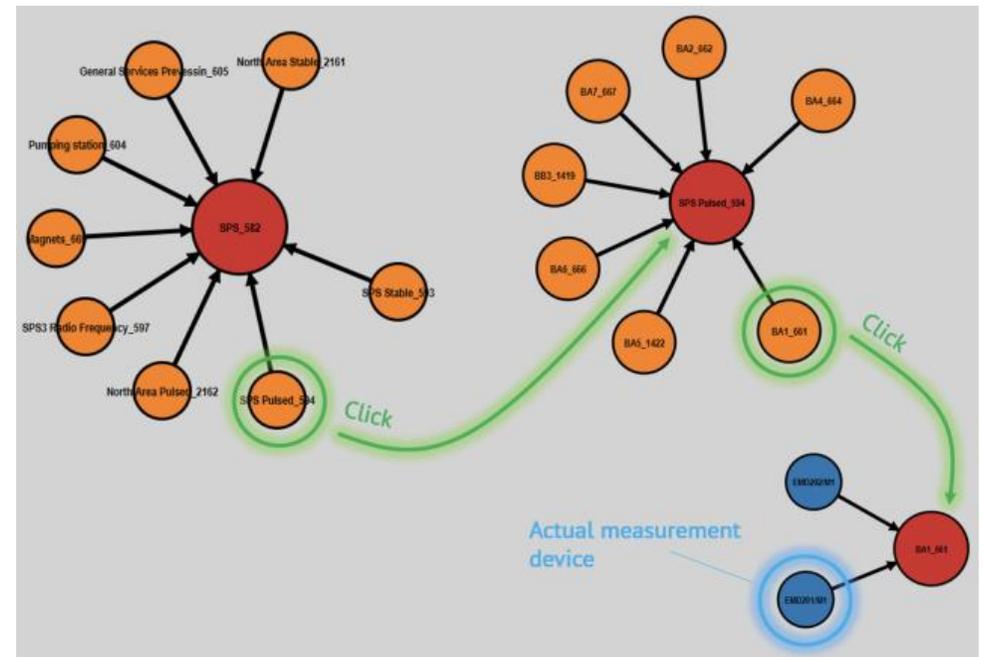


The CERN Meyrin site. Continual improvement of energy management is one of the key pillars of the Organization's strategy to minimise its impact on the environment. (Image: CERN)

# Energy management tools

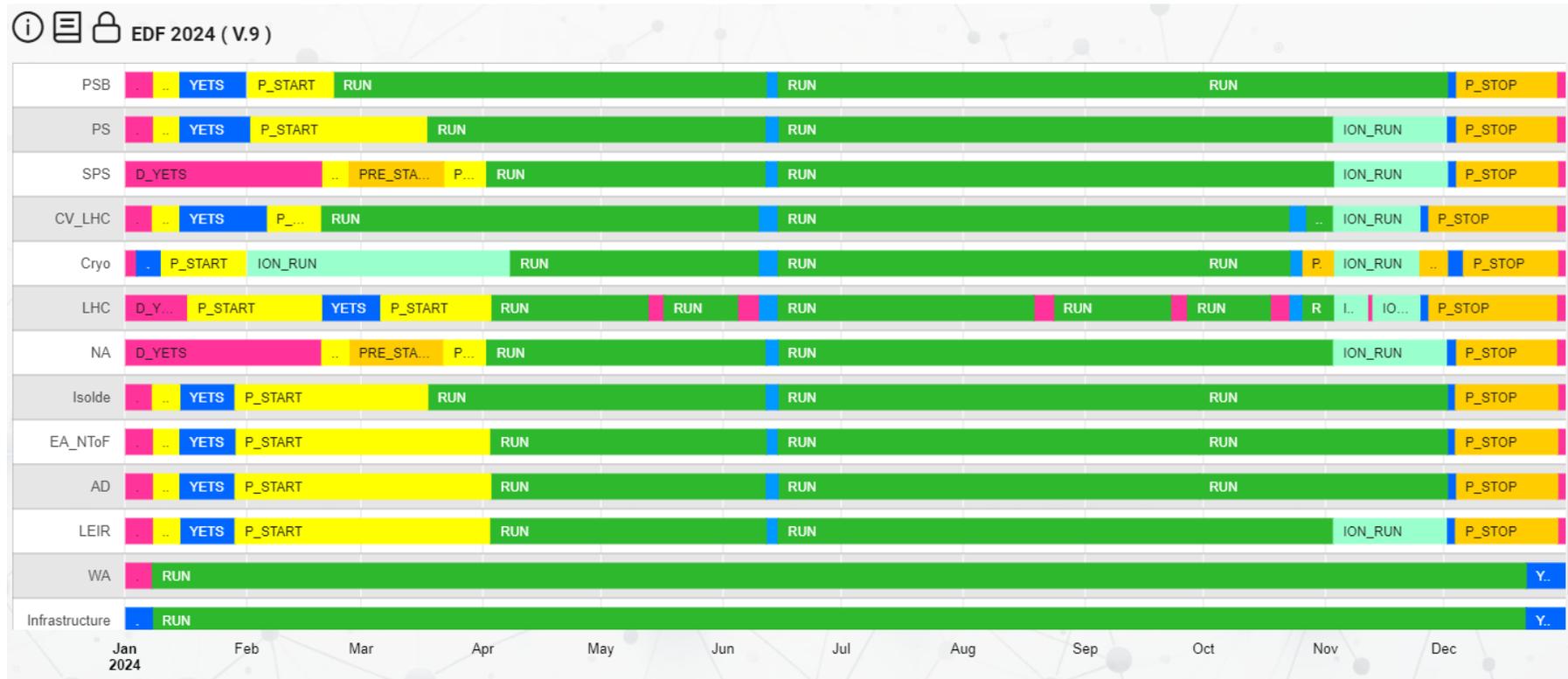
## ■ Monitoring via WebEnergy

- Measurements on 300+ high-voltage devices used
- Global accuracy better than 1% compared to the main counters on the 400 kV network
- Bonuses almost always obtained from main electricity provider for good forecast
- Further improvement of monitoring ongoing with an additional 200+ high voltage devices to be incorporated in coming years

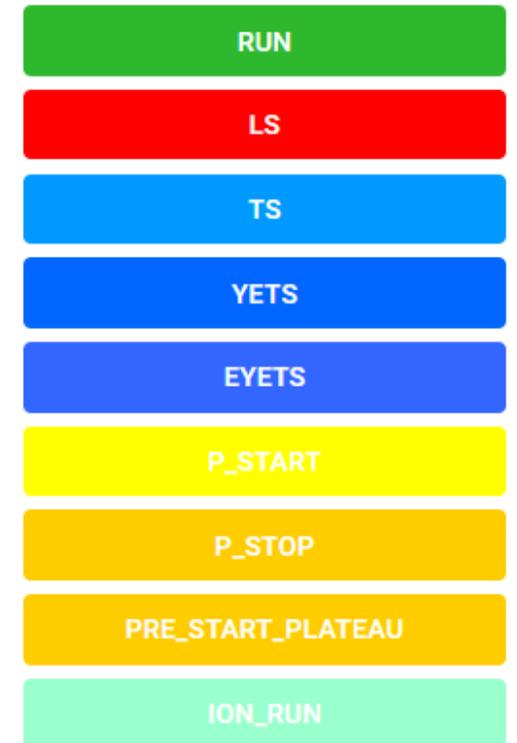


# Energy management tools

- Forecasting via WebENergy – From accelerator schedule to long-term consumption forecast (10-year forecast)

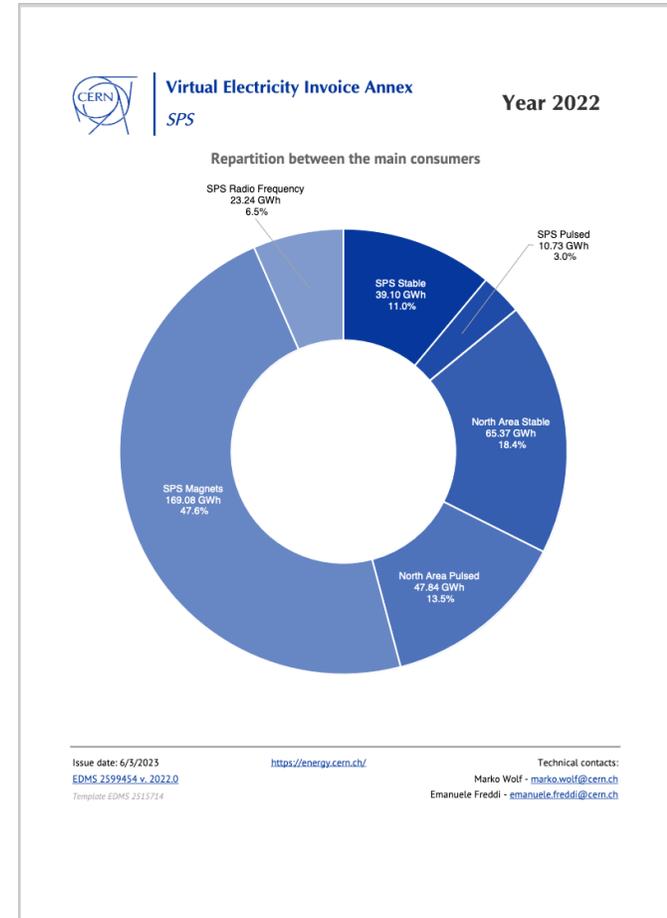
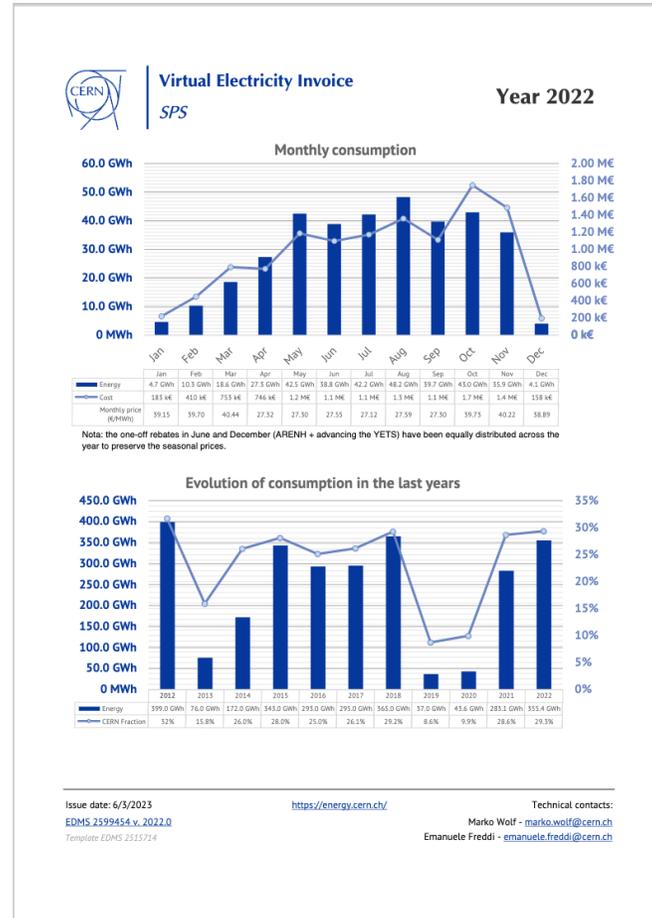
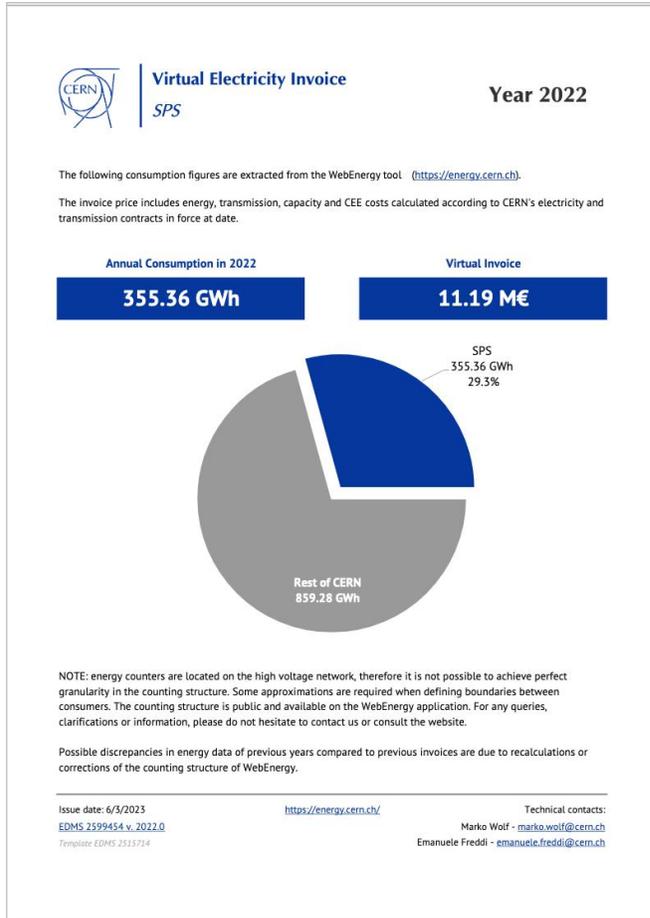


## Schedule legend



# Energy management tools

- Virtual invoices, sent every year to management and main users to raise awareness



# Keeping the energy required to a minimum

- Limiting the energy consumption of the accelerator complex has always been a **priority for the Organization** (e.g. extensive usage of superconductivity for LHC)
- **Total energy savings in place since 2010: 100+ GWh/year**, mainly thanks to facility upgrades (e.g. East Area new magnets and power converters), changes in operation modes (e.g. SPS magnets powering, eco-mode for cryoplants) and large building consolidation
- Additional energy savings measures in 2022/2023 in response to the energy crisis (reduced accelerator schedule, reduced gas consumption)
- **Planned savings at horizon 2030 of about 80-100 GWh/year** (e.g. consolidation of cooling and ventilation plants, heat recovery projects, building consolidation)



# Improving energy efficiency

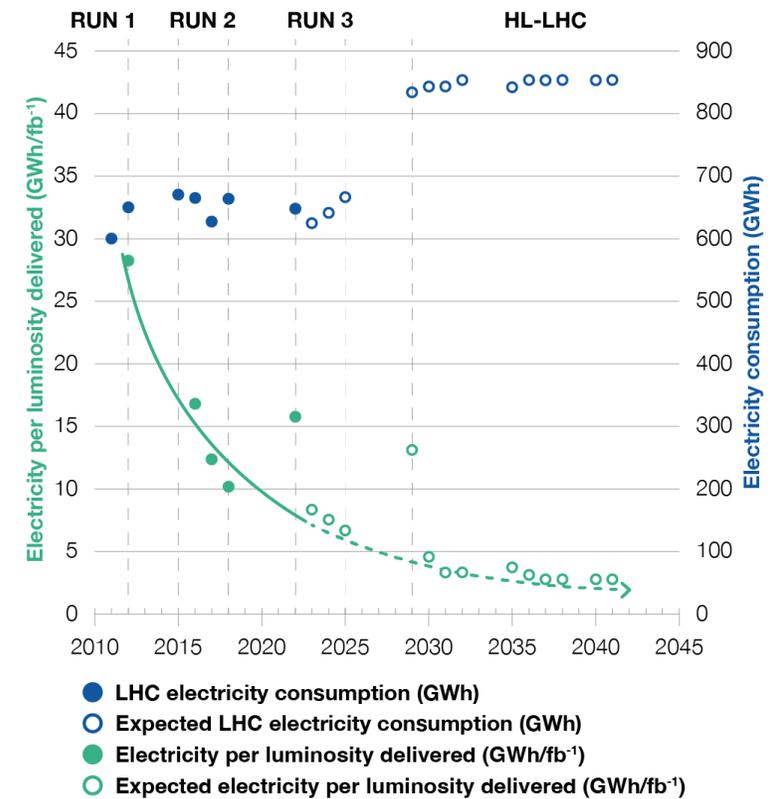
- CERN aims to increase the energy efficiency of its accelerator complex in terms of « **luminosity/intensity at injection** » delivered per « **unit of energy consumed** »

→ Energy performance indicators established for the LHC, SPS and PS complex, closely followed-up

- New Data Centres built at CERN have a « **Power Usage Effectiveness** » (PUE) target of 1.1/1.15, well below European targets (1.3/1.4)

- **Procurement guidelines** have been established for evaluating energy performance over the planned or expected operating lifetime when procuring equipment, products and services

→ Criteria (sum of all items covered by one invitation to tender):  
**power consumption > 500 kW** or  
**annual energy consumption > 5 GWh**



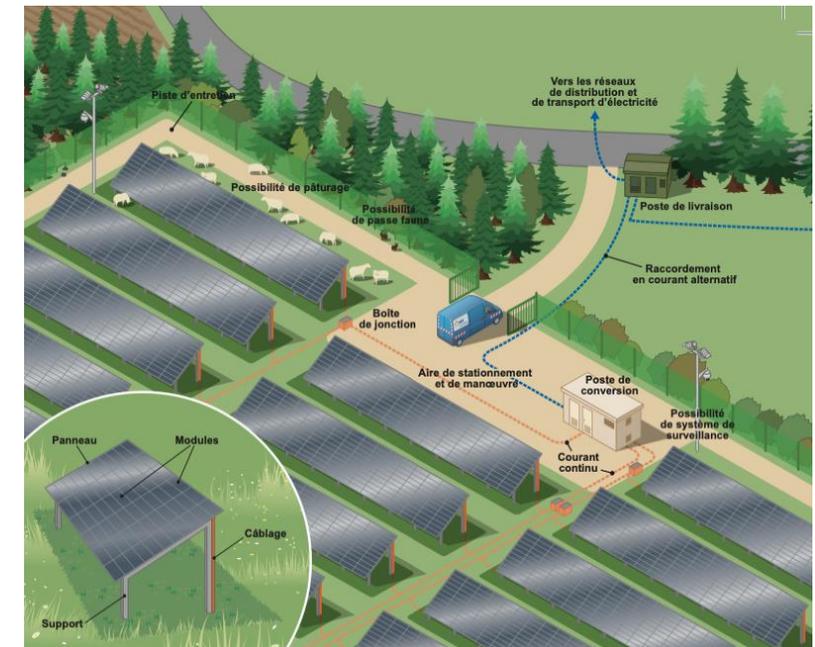
# Recovering waste energy

- **Ongoing project for external use:**
    - Recovering waste heat from LHC P8 cooling towers to heat a new ZAC in Ferney-Voltaire (8000 people) – **20 GWh/year recovered as of 2026**
  - **Ongoing projects for internal use:**
    - Recovering waste heat from new Prévessin Data Centre and LHC P1 cooling towers to heat Meyrin and Prévessin sites – **25/30 GWh/year as of 2027**
- **A major step for CERN to reduce its annual gas consumption (60% compared to 2018)**



# Renewable energy

- Three physical photovoltaic Power Purchase Agreements signed between CERN and producers in France (*mandatory as CERN is supplied from France*)
  - Total of 95 MW peak, 140 GWh/year (~ 10% of CERN's annual electricity consumption during Run periods, ~ 25% during LS periods)
  - Solar plants representing a total area of 90 ha, i.e. ~ 40 % of CERN's fenced perimeter – difficult to envisage onsite!
  - All projects are being built (estimated start of electricity supply: **between January 2026 and mid-2027**)
  - Contract duration: **15 years** from the start of electricity supply





[home.cern](http://home.cern)