Energy Management at CERN

Motivation and mandate
Present energy usage at CERN
Projects
Policy recommendations

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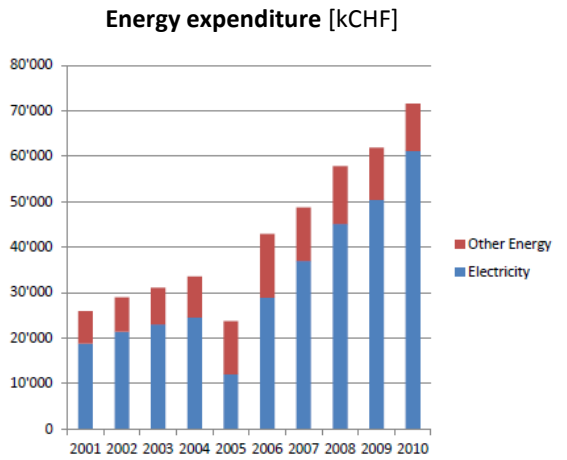
Motivation

- **Responsibility for society**

- **Economical reasons**
  - Electricity prices in France are 30-40 % lower then in most other European countries
  - "*Commission de la régulation de l'énergie*" expects electricity prices to increase in France by 6%/year, i.e. 30% by 2016
  - Reduce consumption/cost for gas for heating

- **Foster progress in energy technology**
  - For science
  - For every day life



Energy Coordinator

CERN has nominated end 2011 an Energy Coordinator with the mandate:

- Make a **technical audit** of all forms of (input) energies used at CERN
- Investigate possibilities for **energy saving**
- Study re-use of **thermal "waste" energy**
- Proposals for use of **renewable energy**
- **Liaison** with public bodies, companies, and research institutes

Work has proceeded in 3 areas:

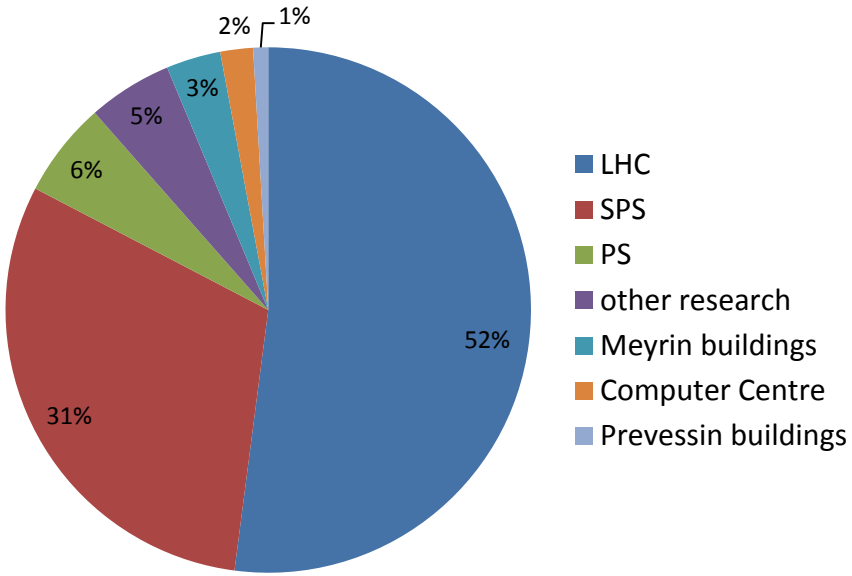
- CERN campus
- Accelerators and experiments
- Re-use of waste heat

Electricity consumption

Power demand:

- Full operation : 220 MW
- Shutdown: 50 MW

Annual consumption: 1.2 TWh

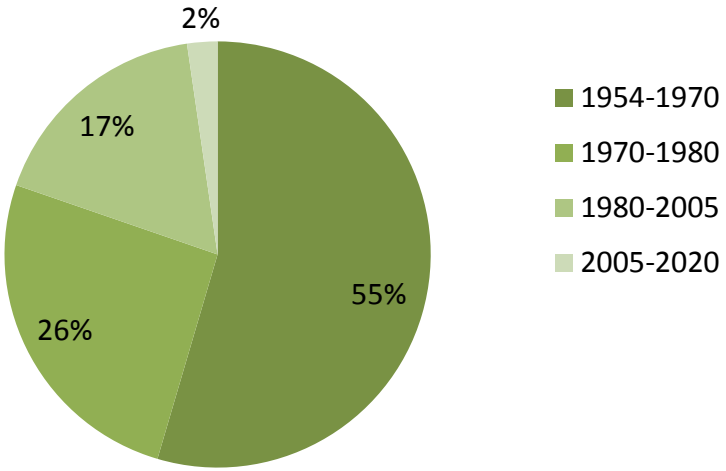


CERN Campus

CERN buildings 600.000 m^2 total

- 360.000 m^2 Meyrin site
- 130.000 m^2 Prevessin site
- Surface buildings of accelerators

Construction date Meyrin site



80 % of buildings are older than 30 years

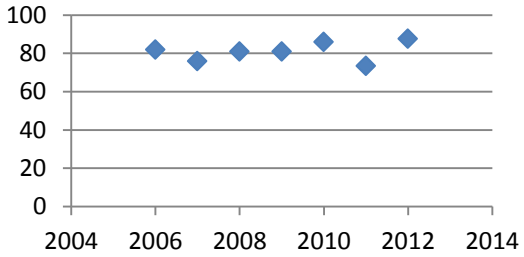
- High energy consumption
- General refurbishment needed

Heating system

District heating networks
Boilers fired with natural gas

- Meyrin: 3 x 15 MW
- Prevessin: 3 x 4.7 MW

Gas Consumption [GWh]



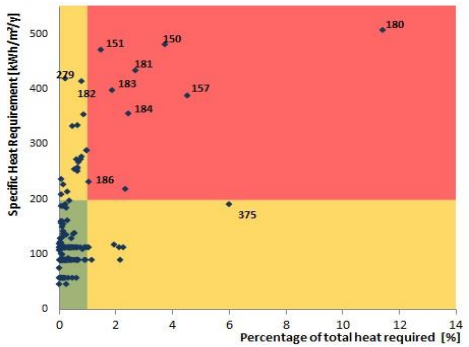
Air conditioning

- Office buildings constructed before 2000 had originally no air conditioning
- For some offices AC has been added afterwards (usually individual “split” systems)
- New buildings should not have full AC, but the temperature limited to 27°C

Projects Campus

- **Study heating energy needed by buildings of Meyrin site,** see L.Scibile in session B3
  - Simulate need of heating energy for each building
    - Type, age, size
    - Constrain by total energy measured

  ➔ **Prioritization of renovation**



- **Refurbishment and extension of computer centre,** see W.Salter, A3
  - Improve air flow management
  - Use free cooling
  - Increase temperature

  ➔ **substantial savings**

- **Hot water preparation for restaurant 2**
  - 50 m^2 thermal solar panels

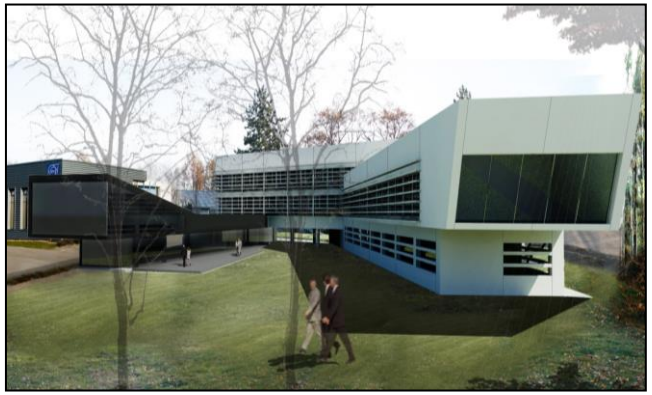
  ➔ **save 50% of energy**

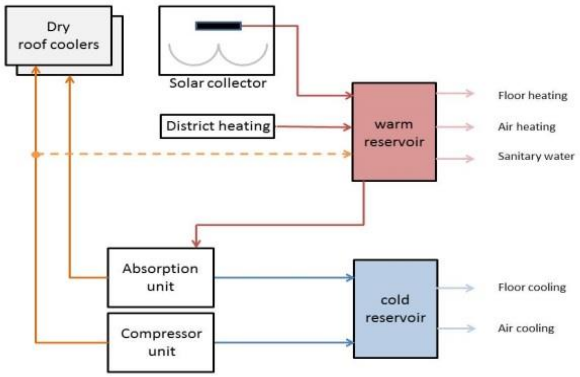
Projects Campus *contd.*

- **New building at Prevessin site**
  - Integrated design of heating and cooling system
    - Re-use of "waste" heat
  - 90 kW absorption machine for cooling and "rafraichissement
  - 250 m^2 solar field (collectors are CERN spin-off) for cooling and heating

L.Scibile, B3

C.Benvenuti, B4





- **New building for surface treatment**
  - Heat pump air-water

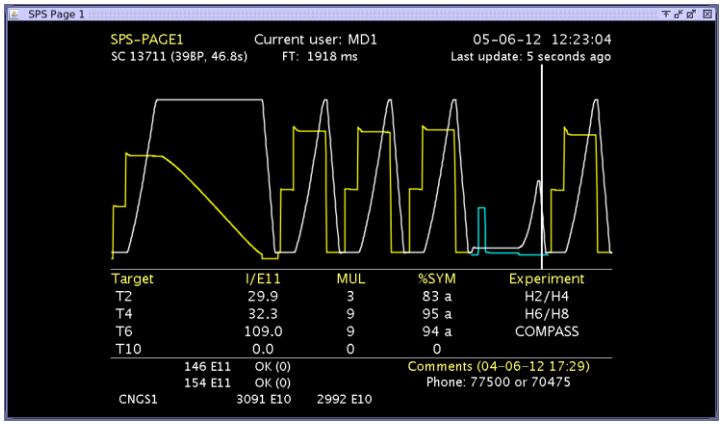
- **New building at LHC point 5**
  - Heat pump air-water
  - Option water-water to use "waste" heat
  - Solar collectors for hot water

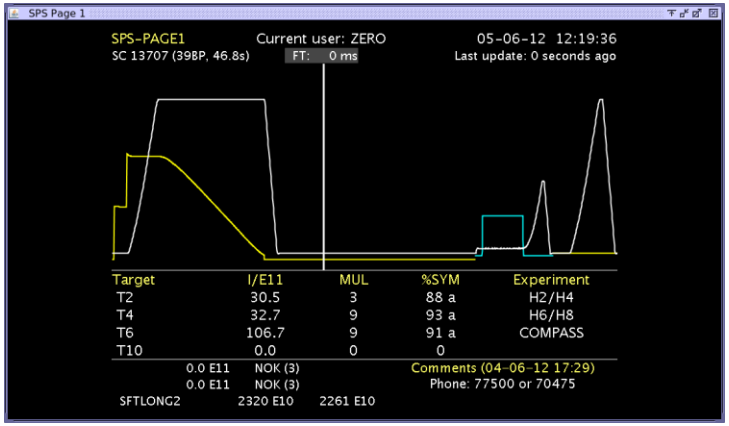
Projects accelerators

- **Further optimisation of cycles (drop, shorten, down-size)**
  - HW upgrade: e.g. precise B-field measuring and control
  - SW upgrade: e.g. additional control procedures
  - Trigger: either operator-driven or automatic

  ➔ Some savings

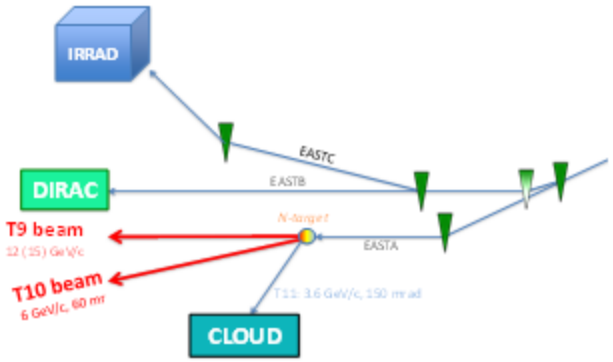
  ➔ Increased flexibility





Projects accelerators *contd.*

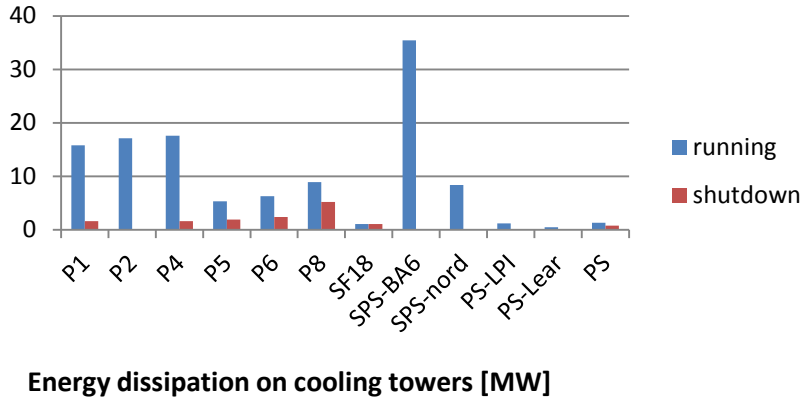
- **Pulsing magnets for fixed target area East hall,** see K.Papastergiou, B2
  - Investment: replace magnet yokes and power converters
  - Enormous energy saving (90%)



- **Studies for upgrades and future accelerators**
  - High temperature SC cables, see A.Ballarino, B4
  - Recuperate (waste) RF energy
    - Thermal
    - Electrical

Projects “waste” heat

80% of electricity used in accelerators is dissipated in cooling towers



Energy dissipation on cooling towers [MW]

CERN’s waste energy

- Intermittent (shutdown)
- Limited life time (LHC)
- out of phase with need (LHC runs in summer)
- low temperature (generally < 30°C)

… complete operational independence needed ➔ back-up solution on provider and consumer side

Projects studied

- Heat apartment blocks in Meyrin (shortage of investment)
- Heat new halls of airport (airport time scale 2016+)
- Heat new buildings of St.Genis (distance problems)
- Heat new CERN buildings (ongoing)

Energy policy recommendations

- **Buildings**
  - New: integrated energy concept (combine hot/cold streams, use waste heat, solar energy)
  - Existing: “complete” renovation (energetic, structural, functional, aesthetic)
  - Consider long-term evolution/usage (Masterplan)
- **Projects**
  - Life time assessment of energy usage
  - Optimize investment-operation
- **Accelerator/experiments**
  - Optimize operations (machine cycles, coherent operation of all elements of the accelerator chain)
  - Pulse transfer and fixed target beam line
  - Stop equipment when not needed (needs often HW or SW investment)
- **Managerial**
  - Incentive for energy savings (account for energy, let saver benefit)
  - Each project (infrastructure, accelerator, experiment) should include energy planning
  - Make it an work objective (individuals, groups, departments)
  - Re-adapt operations schedule to (new) energy tariff
  - Make good use of Energy Coordinator