EN Engineering Department

# Electricity supply contracts

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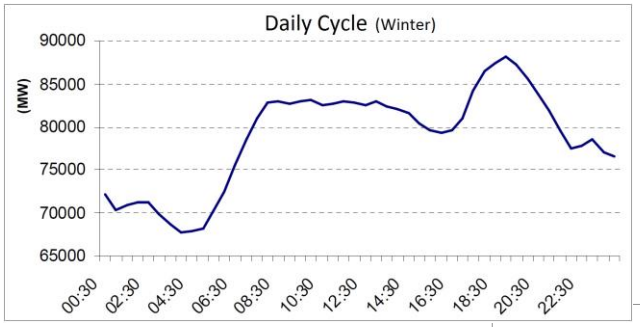
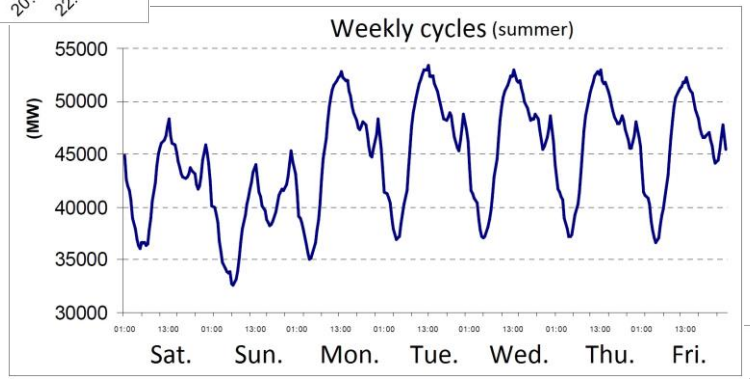
# Table of contents


- Power consumption
- Power production
- Quality
- Tariffs
- Energy Price
- Power production and "smart grid"
- Accelerator Labs

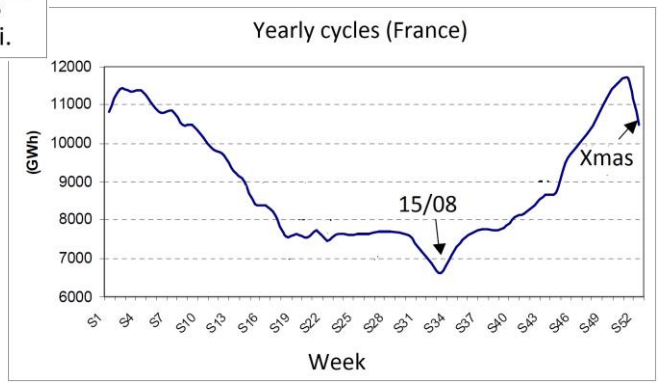
# Power consumption

- Daily, Weekly & seasonal cycles




- Factors:
  - **Day light**
  - **Daylight saving time**
  - **Temperature**
  - **Home/work**
  - **Economic activities**
  - **Tariffs**
  - **Events (football on TV!)**



# Power production

- Baseline (Nuclear power plant, Coal, Gas, oil)
- Additional capacity (Hydro plant, Solar, Wind, cogeneration)
- Adapting capacity (Gas plant, pumped storage hydro plant, Diesel generator)

The challenge for the management of grids is to adapt the production to the Power demand despite the increasing part of the fluctuating production (Solar, wind, cogeneration)

# Energy quality

The characteristics of the «signal» delivered by the grid is far from perfect; The usual tolerances are :

Frequency (~ 50 hz +- 1%)

Unbalanced voltages (~2% max)

Harmonics (~< 3%)

Voltage (Un +- 5 to 10%)

These tolerances are taken into account and usually don't have any effect on the lab systems

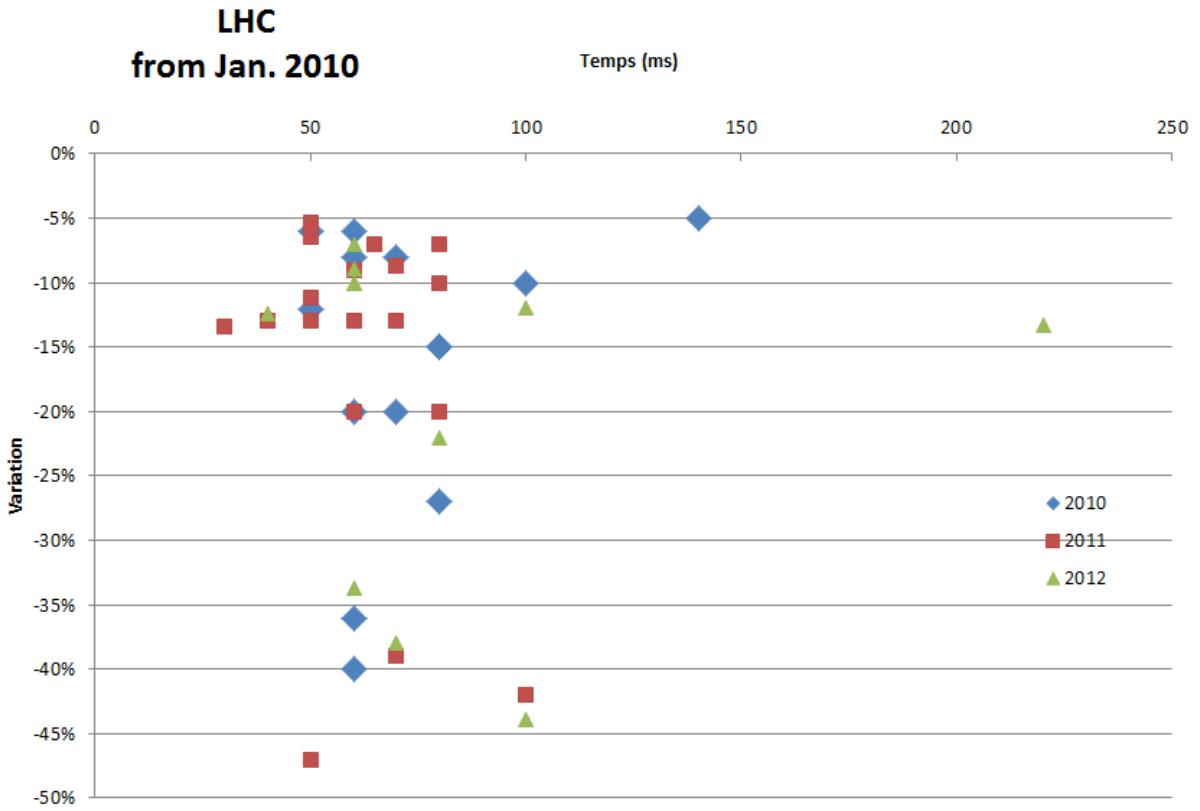
But…

# Energy quality

Any event on the network (lightning, short circuit, trip on power lines are seen as voltage drops of typically 50 to 300 mS (time for circuit breakers to intervene)

The Voltage drops are typically from 10 to 60% depending on the distance from the event location.

The number of events depends also on the «density» of the local network



# Energy quality

- These voltage drops cannot be avoided on the grid side.
- UPS, Diesel gensets or powerful filters can be used to «filter» them (e. g. ESRF). These solutions can be implemented only on low power distribution (a few MW).
- Dealing with the necessary power to run CERN, All systems must be designed to withstand such a perturbation. (economical compromise)
- Despite the efforts made in hardening the infrastructure, Cern suffer (less!) interruptions due to grid voltage drops

# Tariffs

Utilities are using incitative means to slightly adapt the consumption.

They are based on power prices different from a peak period to a low consumption period of time.

They are based on price differences on Subscription and/or consumption:

# Tariffs

- Lower subscription but deterrent consumption price leading to load shedding during peak periods; Peak periods are announced by the utility with ~ 1 hour of anticipation.

- The max. power for a subscription period has to be declared with an anticipation time prior to the consumption period; Over limit fees are more than expensive and lead to load shedding .

- Daily, weekly and seasonal periods are defined in the tariff corresponding to peaks (high prices) and valleys (low prices)

# Tariffs

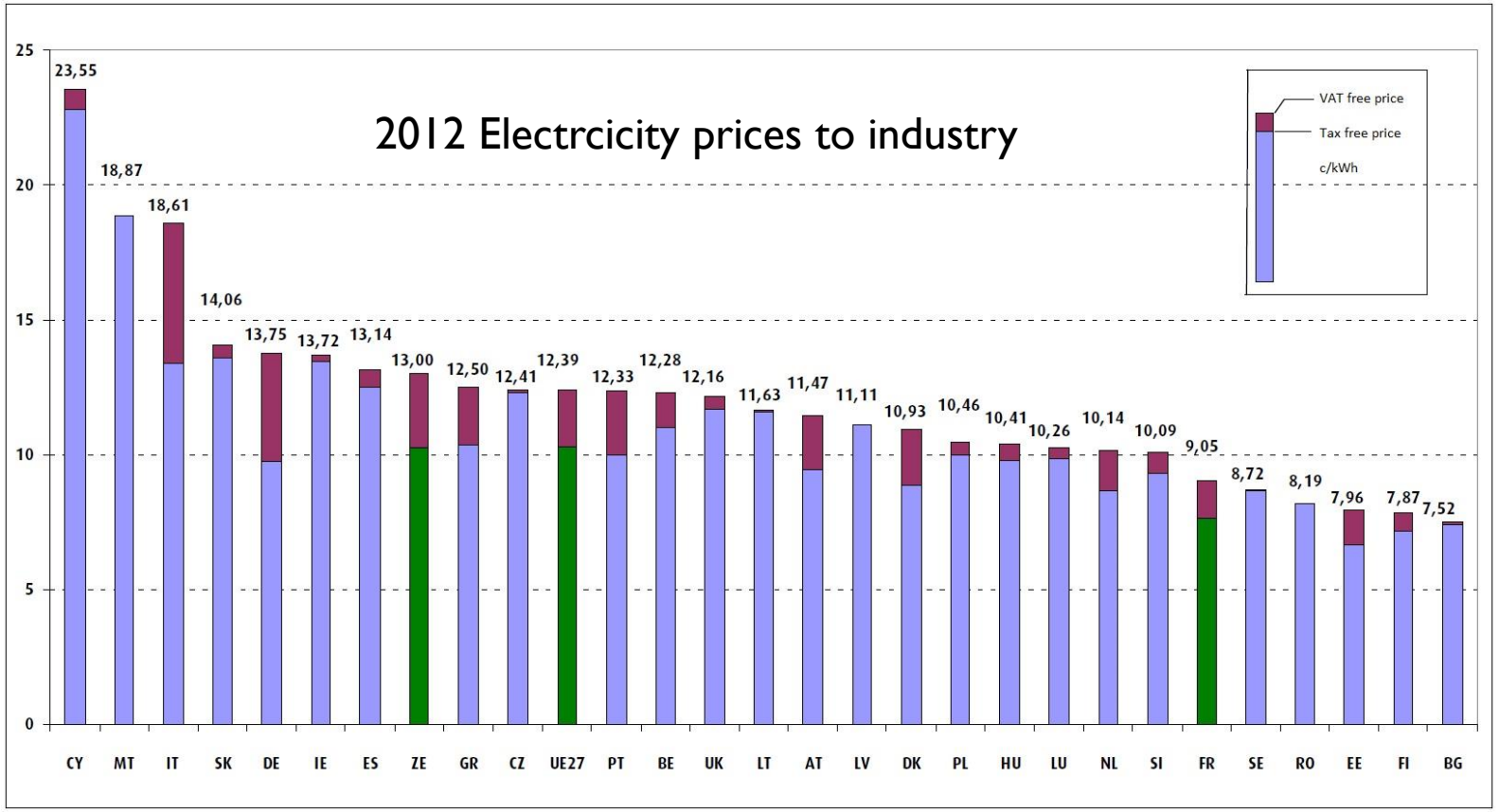
## Example: EDF (French utility)

(comsumption part of one of the industry 400 kV tariff)

**Highest price is ~7 times the lowest one**

| Season | Tariff daily period | Price (c/kWh |
|---|---|---|
| Winter (December, January & February) | Peak period: 8:00 to 10:00 and 17:00 to 19:00 | 13.966 |
| | Valley period: 22:00 à 6:00 | 4.225 |
| | Full period: 6:00 to 8:00, 10:00 to 17:00 and 19:00 to 22:00 | 8.664 |
| Middle season (March & November) | Valley period: 1:00 to 7:00 | 2.977 |
| | Full period: 0:00 to 1:00 and 7:00 to 24:00 | 4.599 |
| Summer (April, May, June, September and October) | Valley period: 0:00 to 6:00 and 22:00 to 24:00 | 2.014 |
| | Full period: 6:00 to 22:00 | 3.919 |
| July & August | Full day | 2.918 |

- Huge electricity price differences in Europe (X3)



## Forecast on the energy level of price

- Long term: A substantial price increase is expected over a 25 years horizon because of the decline of the nuclear power, the growing but expensive green solutions (wind farm, solar energy,…) and the oil & gas rarefaction.

- Short and medium term: the price level will be low (40 E/MWh) because of the low level of consumption due to the economic crisis and the progress made on energy efficiency and also because of the boom of the shale gas

# Power production and "smart grid"

A **smart grid** is an electrical grid that uses information and communication technology to gather and act on information, such as information about the behaviours of suppliers and consumers

It's a fast and accurate mean to adapt the production and distribution of electricity in order to improve the efficiency, reliability and economics.

It's more and more appropriate because of the increasing part of the fluctuating production.

# Accelerators Labs

Load shedding during peaks period and maintenance shut down during winter time are very cost effective. **The ability to quickly drop down the power have to be taken into account in new accelerator projet.** The non superconductive technology is more adapted to that.

On the other hand, superconductive technologies together with their cryogenic plants (complete cool downs and start ups are very long) do not allow short yearly shut downs and unexpected consumption drops for a few hours but the overall consumption of the magnets is very low.

Therefore, an economical compromise between construction costs, consumption (type and amount) and applicable tariffs has to be found

Be careful: **Tariff lifetime are usually much lower than the accelerator lifetime!**

Machines efficiency and heat recovery are other possible solutions to contain the energy cost.