EPFL

Design Project Presentation

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Introduction / Methodology

- Aim to compare daily emissions caused by EPFL main campus during the lockdown imposed by Covid-19 and before the lockdown

- Emissions are broken down into 5 emitting categories:
  - - Commuting
  - - Professional Transport
  - - Food
  - - IT
  - - Energy

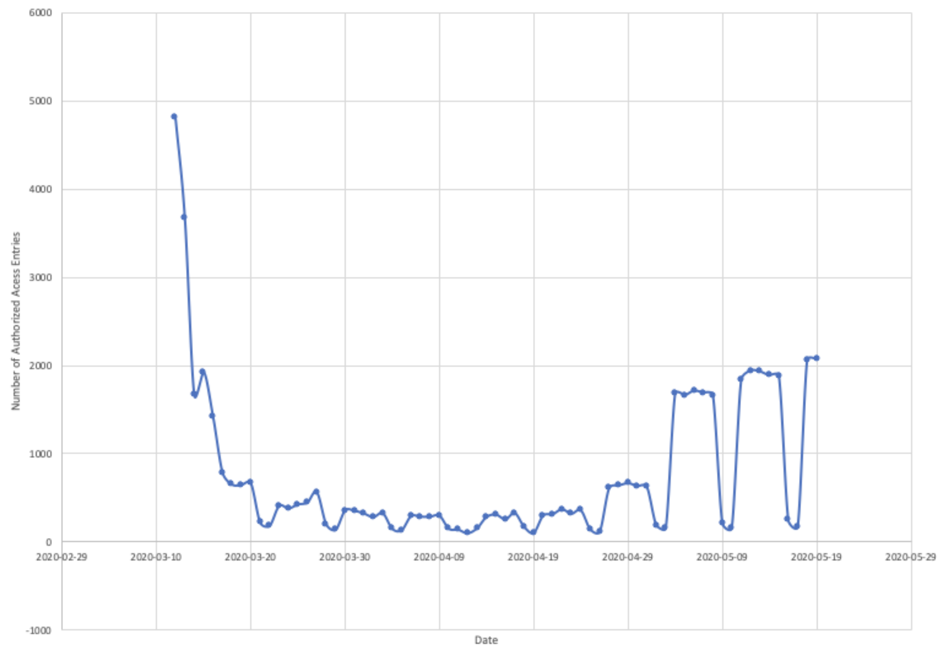


Figure 1: Entries of personnel onto EPFL main Campus during the lockdown

Commuting

- Based off the FORS 2019 EPFL study on commuting
- Considered dominant commuting methods & travel distances of different person categories
- Emission factors of transportation methods provided by Mobitool
- Compared to average daily 2019 values

FORS
explore.understand.share.

mobitool

Distances traveled per trip	By foot [km]	Bike [km]	Public Transport [km]	Car / Motorcycle [km]
Admin & Tech Collab	2.28	6.42	26.3	26.3
Scientifique Collab	2.05	4.90	27.5	32.8

Table 1: Commuting habits in terms of distances traveled by transportation method of the two person categories who frequented the campus during the lockdown

Commuting - Results

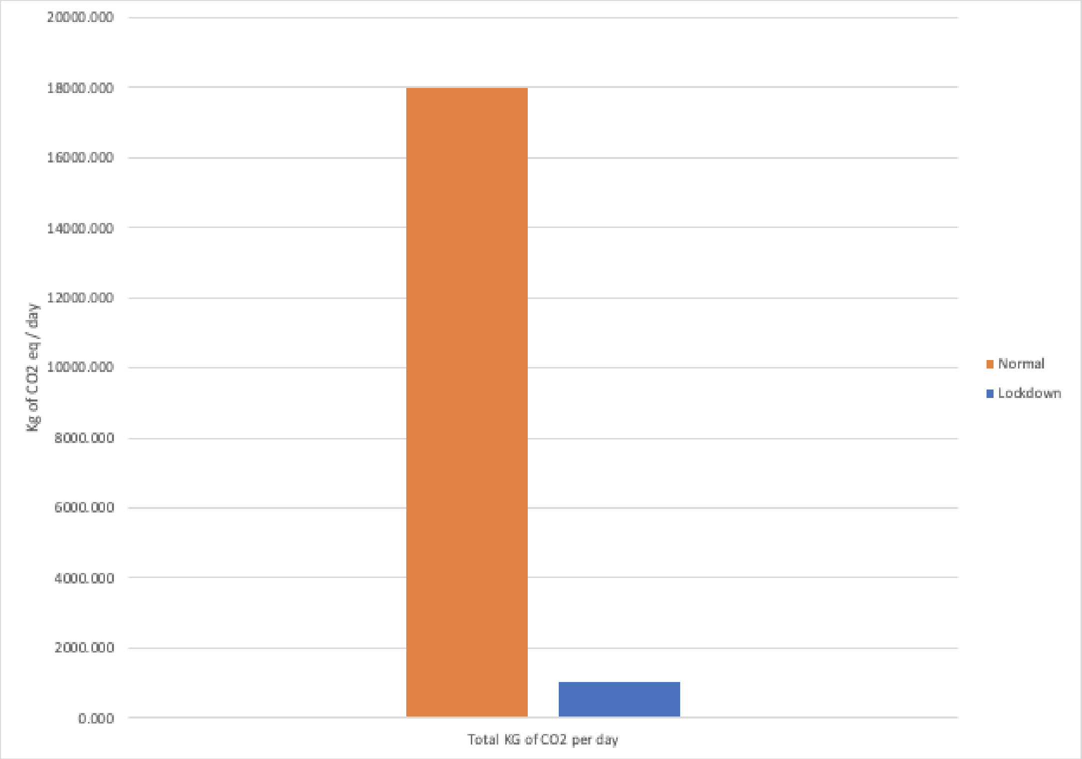


Figure 2: Comparison of emissions in Kg of CO_2 eq per day, between the Lockdown and Normal scenario

Total decrease of **92.4%** or **16.9 metric tonnes** of CO_2 eq

Professional Transport

- Professional transport is the biggest CO_2 emitting section
- Based on EPFL Sustainability data
- For aviation, not the totality of the flights (only the ones booked via CWT)
- Aviation represents 88% of kilometers travelled and is responsible of 98% of the CO_2 emissions
- Decrease of the professional transport emissions by 2.8% from 2018 to 2019

Professional Transport - Scenario Comparison

- Assumption : no professional transport during the lockdown period
- Lockdown period : from the 13th March to the 11th May

Table 2 : CO2 emissions saved during the lockdown

Lockdown Period	CO_2 spared (real data) [tCO_2]	CO_2 spared (redressed data) [tCO_2]	Percentage of the yearly emissions [%]
2018	1'259	1'499	14.98
2019	1'222	1'472	15.10

- During this period, we have spared 15 % of the annual emissions due to professional flights

Professional Transport - Way to reduce emissions

- To become carbon neutral, EPFL must reduce the CO2 emissions caused by flights

- Ways to reduce these emissions :
  - Replacing all first and business class seats by economy class seats could save about 15 % of the yearly emissions
  - Applying a distance restriction : if the distance to travel is under 1’000 km, the travel is done by train. Leads to a decrease of 7.5 % of the emissions
  - Replacing all indirect flights by direct flights could spare up 8.6 % of the yearly emissions
  - Most efficient way : home-working and online conferencing. Permits almost no CO2 emission leading to an important decrease of the annual emissions

Food - emissions at EPFL vs Home

1. CO_2-eq emissions from cooking
   - “best- and worst-case” scenario
2. Type of Food
   - Differences between vegetarian and non-vegetarien food
   - Meat consumption at EPFL versus home (swiss average)
3. Estimation of total CO_2-eq emissions for food
   - Normal (open) Campus
   - 15%-19% more vegetarian meals at home
   - “best- and worst-case” for cooking emission

Food - cooking emissions

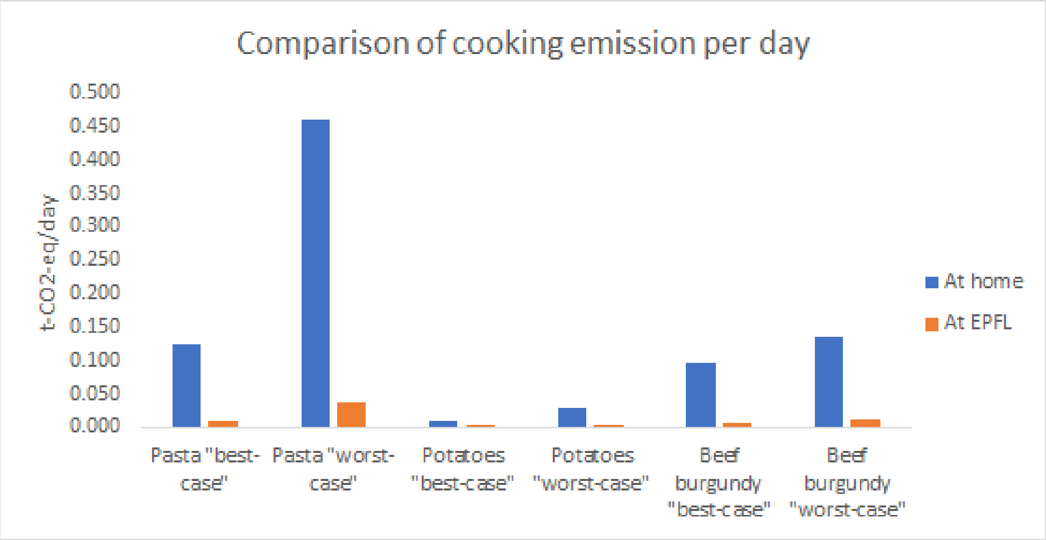


Figure 3: Comparison for CO_2-eq emissions of cooking at home and at EPFL

Method:

- Best-case as optimized cooking process (e.g. cooking with lid)
- CO_2-eq emissions for cooking the average number of meals sold per day at EPFL (data from 2019)

Limitations:

- Does not consider higher efficiency when cooking in larger quantities.
- Only difference due to the **type of electricity** between EPFL (renewable) and home (swiss average)

Food - total emissions

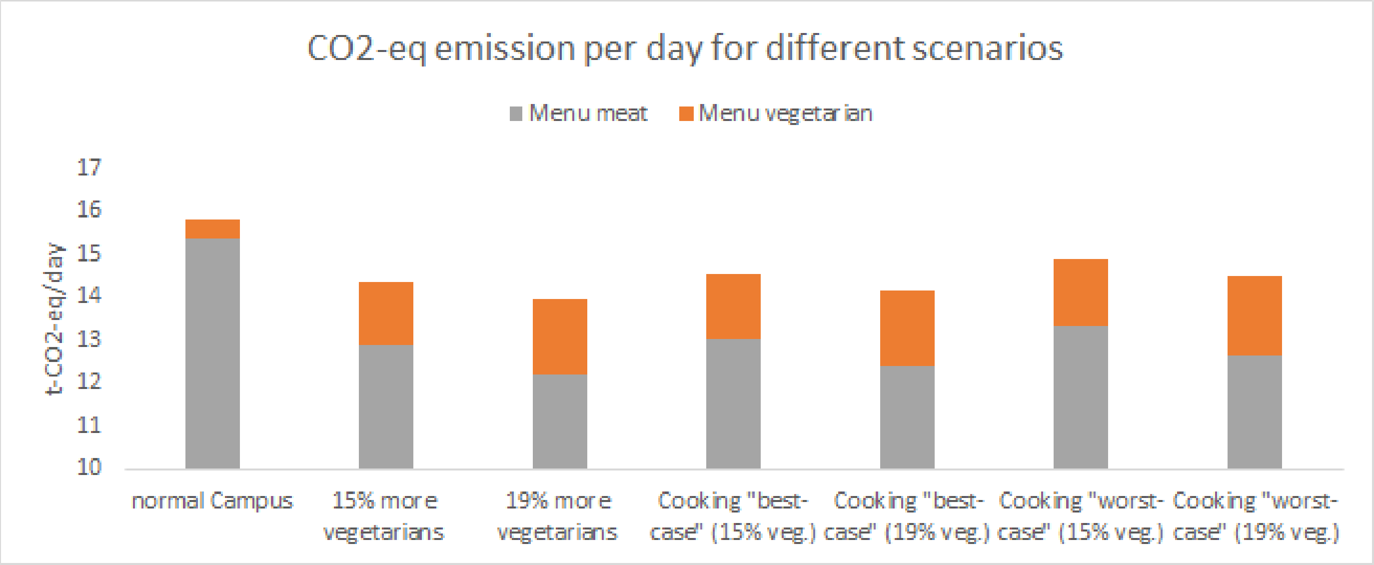


Figure 4: CO_2-eq emissions for normal and shutdown scenarios

More vegetarian food eaten at home (swiss average is 15-19% higher than at EPFL campus)

- Lower CO_2-eq emission at home, even by adding additional cooking emissions for cooking at home
- **Vegetarian meals could be made more attractive to save CO_2-eq emissions on the Campus!**

IT

- Based on Vice Presidency for Information Systems (VPSI) data
- Consumption of INJ, MA, BM, MC, CB and CM data centers: incomplete but majoritary part at EPFL scale
- Study ranges from 2nd of March (before shutdown) to 23th of April (after shutdown) => direct effects of COVID-19 should be noticeable
- Results: stable with slight increase since the beginning of the confinement
- Several explanations: recording of online lectures, use of VPN,...
- Number of data centers rapidly growing => need new methods to increase energy efficiency and decrease costs

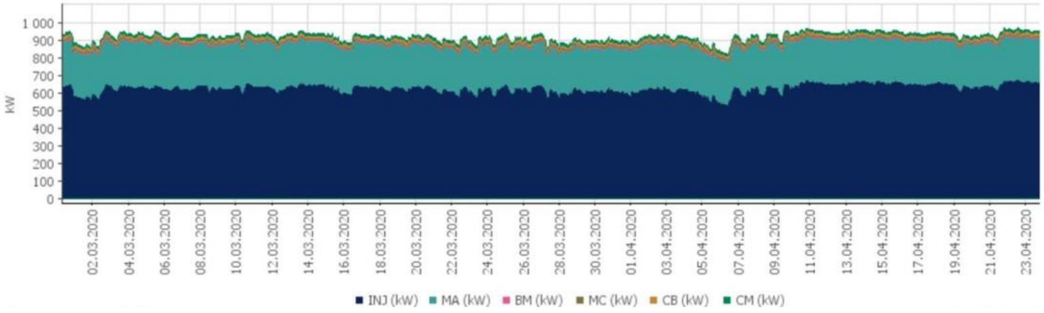


Figure 5: Energy consumption between 2nd of March and 23th of April [AAA]

IT - Alternatives

Thin Clients

- Resources stored on central server
- Electricity consumption cut by more than 50 [%] and lifecycle CO_2-eq emissions by 54 [%]
- Environmental + economical benefits:
  - EPFL: ~ 4500 PCs => 2215 [t] CO_2-eq saved over five years lifecycle
  - Replacement of 75 [%] of PCs at EPFL by Thin Clients => saving of 2.4 mio [CHF]

Data center waste heat

- Main concern, especially in Nordic countries
- Study led in Aalto (Finland): ~ 20 [%] of total district heating production could originate from data centers
- Two main barriers:
  - Heat demand requires local demand (heat cannot be distributed long distances)
  - Lack of business models: difficult to optimize => need to consider worst-case scenario

Energy

Equation :

Q(t) = Ath * [kth * (Tint - Text(t)) - ksun * Irr(t) - Qpeople(t)] - Qel(t)

Assumption:

- People heat
- Electronic devices heat

Calculations:

- Solar heat (coef)
- Thermal losses (coef)

Bias:

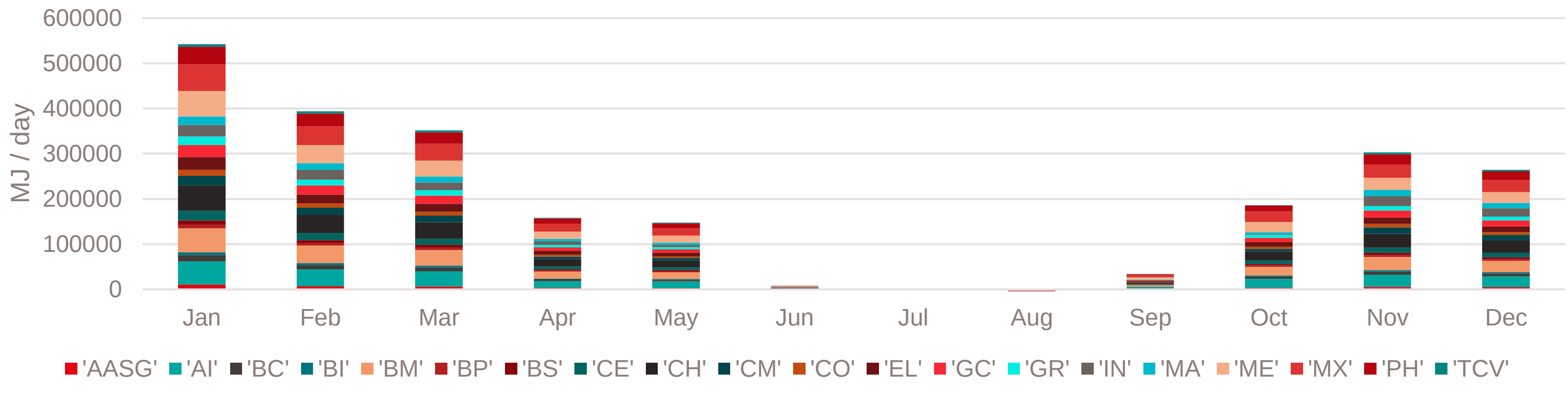
- Ventilation
- Certains Buildings

Comparison with Enregostat (real)

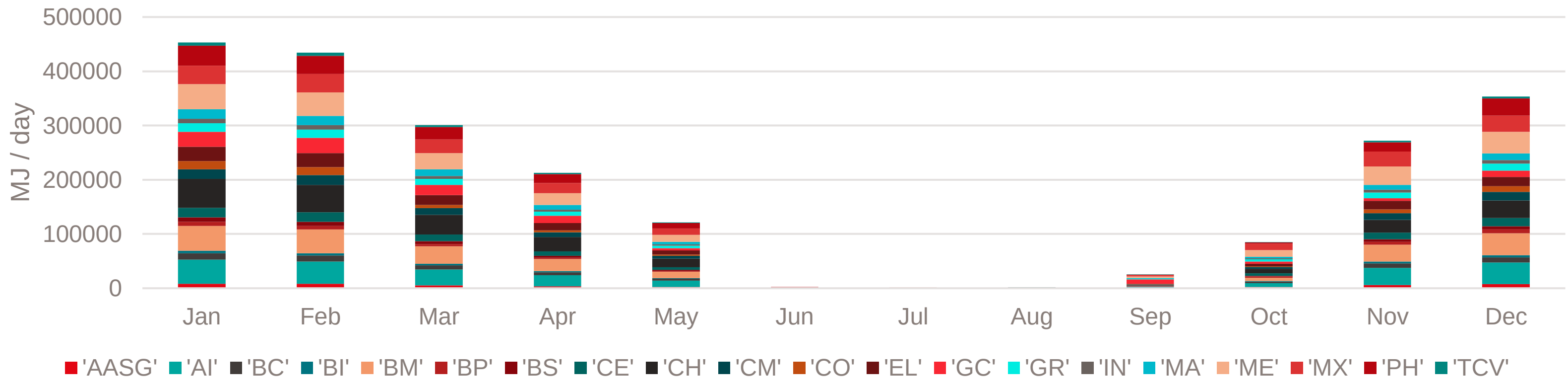
Calculation 2020 (confined period)

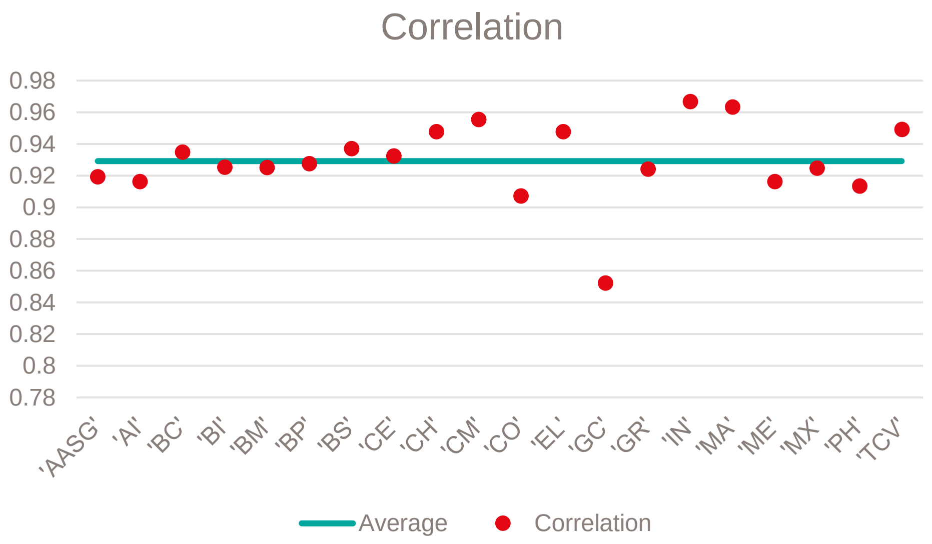
EPFL

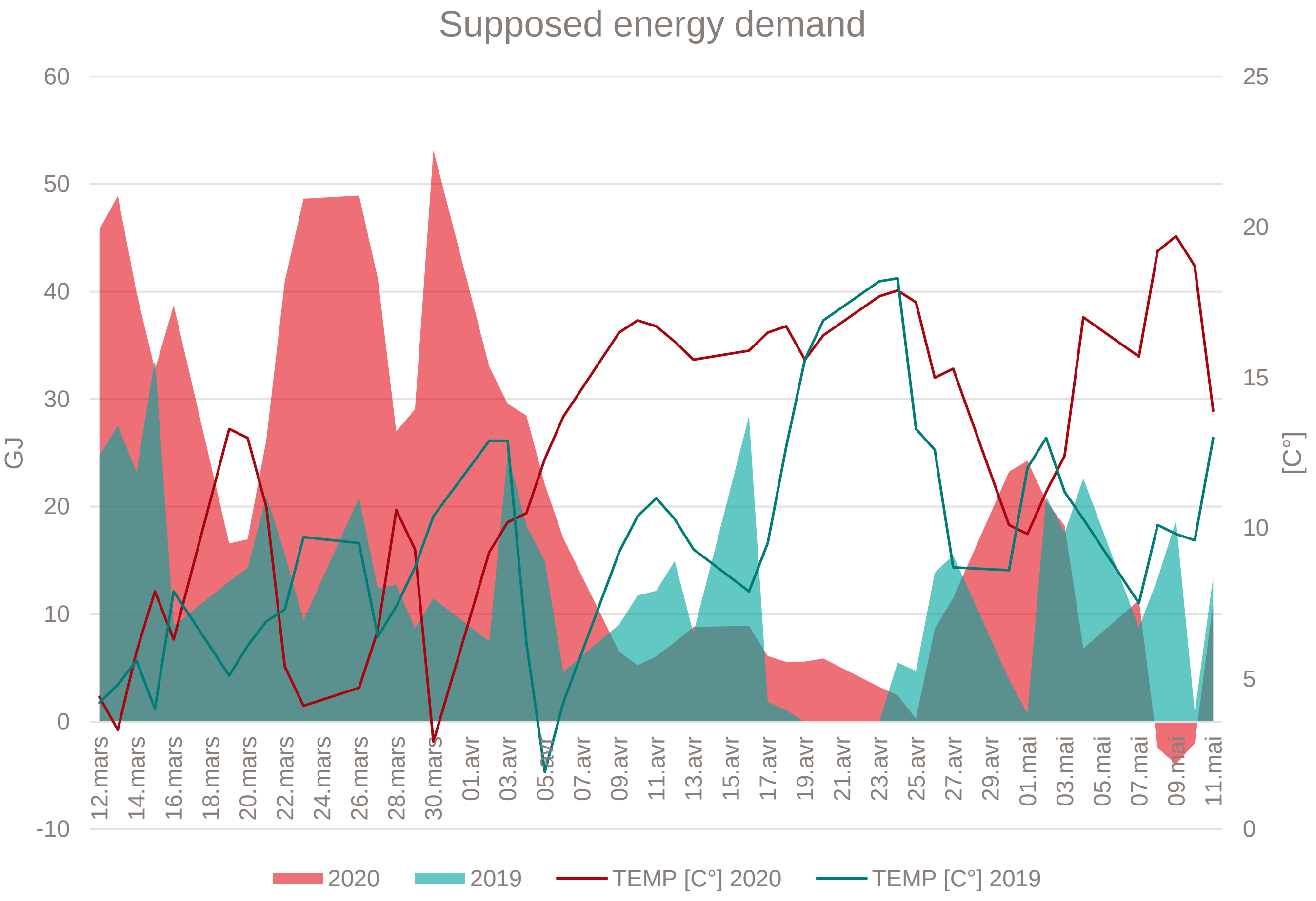
EPFL Heat load / Prog



EPFL Heat load / energo




Correlation
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
0.78
'AASG' 'AI' 'BC' 'BI' 'BM' 'BP' 'BS' 'CE' 'CH' 'CM' 'CO' 'EL' 'GC' 'GR' 'IN' 'MA' 'ME' 'MX' 'PH' 'TCV'
Average
Correlation


Supposed energy demand
60
50
40
30
20
10
0
-10
GJ
25
20
15
10
5
0
[C°]
12.mars
14.mars
16.mars
18.mars
20.mars
22.mars
24.mars
26.mars
28.mars
30.mars
01.avr
03.avr
05.avr
07.avr
09.avr
11.avr
13.avr
15.avr
17.avr
19.avr
21.avr
23.avr
25.avr
27.avr
29.avr
01.mai
03.mai
05.mai
07.mai
09.mai
11.mai
2020
2019
TEMP [C°] 2020
TEMP [C°] 2019

Overall Results

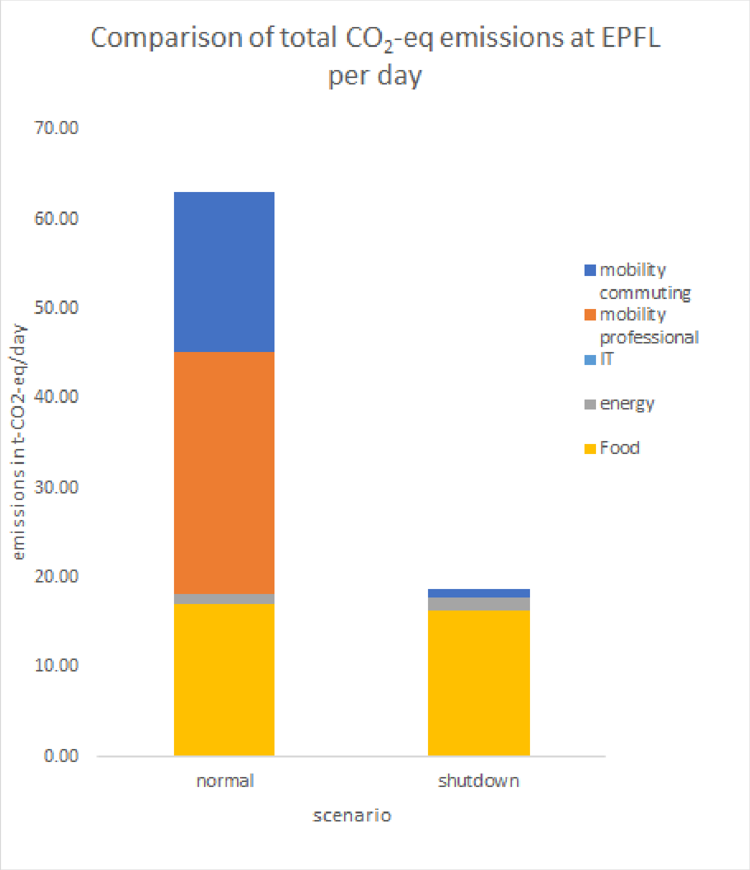


Figure10: Total CO_2-eq emissions for normal and shutdown scenario

Results

- Largest decrease in mobility
- Food, IT and energy have similar emissions
- Total decrease of 70 % for the shutdown scenario

Discussion

- We consider only 74.4% of the CO_2-eq emissions estimated by the EPFL sustainability team
- Other universities (ETHZ, UZH) have similar emissions for mobility
- Some estimations (e.g. Food) are strongly depending to initial assumption.

Conclusion

- Mobility sectors mainly affected by reduction in volume of people:
  - Professional: - 100 [%]
  - Commuting: - 94.2 [%]

- Other sectors less impacted: even small increase for energy

- Other measures are needed to achieve 2030’s goals:
  - Moving some courses to online realm
  - Promote professional mobility using train (or car): only 12 [%] now
  - Better and cheaper vegetarian offer

- However, lack of knowledge remains:
  - What areas of pedagogy could be moved online?
  - To what extent the campus population can be reduced?
  - What impact for other sectors: solid waste,...?

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