Problem: compare the environmental impact of a travel by lift to a travel by car.

1. Presentation of studied system

The resort of Vaujany is located in the massif of Oisans, about 50 km from Grenoble (Isère). The village is located on a sloping hillside. To connect the various infrastructures of the village-station, two elevators have been installed in addition to the various escalators. These lifts are made by the company Skirail (Poma group).
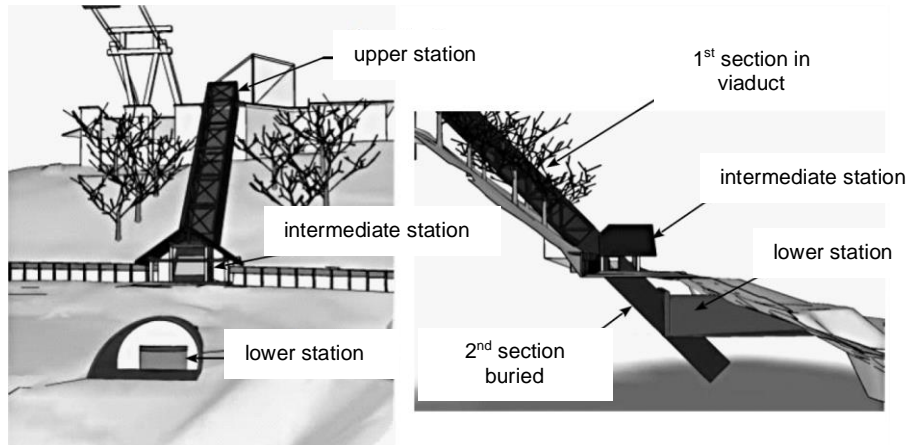

Figure 1: panoramic views of site

The system has an aerial part in a viaduct between the upper station and the intermediate station and part in a buried sheath between the intermediate station and the lower station (Figure 1).
The system consists of two independent elevators, which run in parallel. Each is connected to a counterweight. The cabins have a capacity of 18 seats.

2. Assessment of the environmental impact of the structure

The problem of parking in the heart of the village-resort, coupled with that of atmospheric pollution makes it necessary to compare the transport by motor vehicle to that by elevator.
In order to offer a quality service to users, the station has chosen to operate the system in "tandem". This makes it possible to have permanently a cabin waiting in upper station and the second in lower station. So when a cabin moving with passengers, the second cabin makes the travel in the opposite direction.
A statistical survey of return trips from both cabins was made between the upper and lower stations (Figure 2). A return trip from both cabins is two round trips from one cabin.
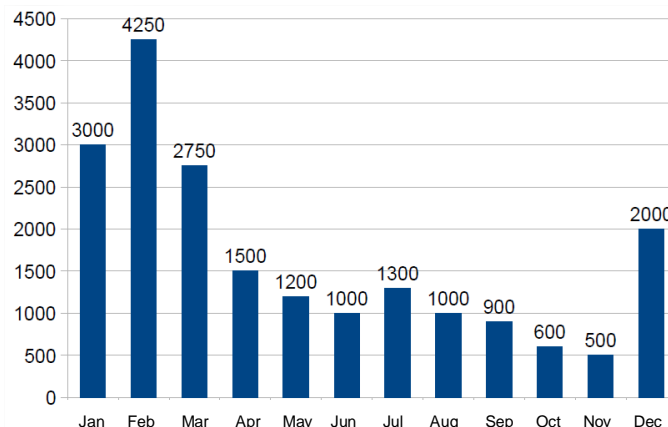

Figure 2: number of return trips from both cabins

3. Questions

Data and hypothesis:

- the road between the upper station and the lower station is 1 km long;
- the average energy consumption of the system for a return trip is 0.5 kW·h;
- the average number of passengers per year per cabin in the lift is 6 people;
- the average number of passengers per year per trip in a motor vehicle is 3;
- CO_2 emissions in France for electricity production of 1 kW·h electric is 90 g CO_2 equivalent;
- the average T_{emCO2} CO2 emission rate of a motor vehicle in France is 115 g·km^{-1}.

3.1. Question 1

Determine the number N_{r_cabin} of return cabins taken over a year based on the data provided (figure 2). **Deduce** the number $N_{passenger}$ passengers carried between the two stations (ascent or descent) by this means of transport. It is assumed that everyone who climbs to the upper station then goes down again.
Calculate the equivalent number of travel N_{travel} (single or return) from the motor vehicle.

3.2. Question 2

Calculate the mass M_{waste_car} of annual CO_2 emitted by car transport, then mass M_{waste_lift} CO_2 lift emitted by lift transport.

3.3. Question 3

Conclude, with few lines, the relevance of the installation of this lift.