Yarding with a tethered balloon, a new start in the French Alps

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Linz, FORMEC 2015

Context in French Alps

- Demand for extra wood mobilization

- High expectations toward:
  - Environment protection (soil, water, bio-diversity)
  - Reduction of fuel consumption and carbon emissions

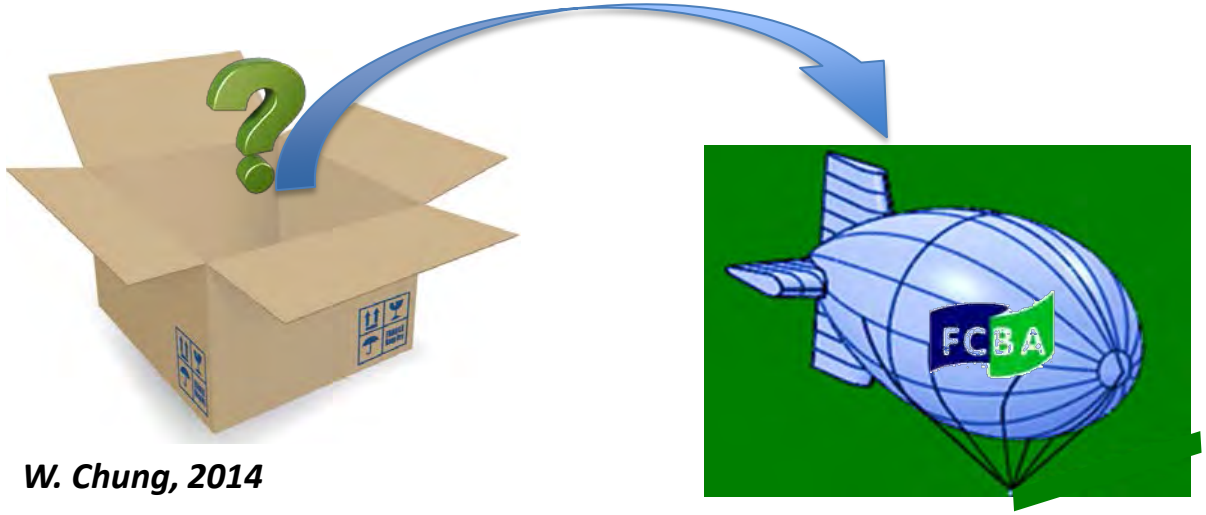
- High cost of wood mobilization:
  - Road constructions and maintenance
  - Helicopter or cable yarding

Innovating system?

2013: IUFRO conference in Norway:

"Steep terrain: push up the boundaries"

2014: FEC - FORMEC in Gerardmer (France)



W. Chung, 2014

⇨ Would that be feasible ?

Thinking outside the box

A french consortium

A small logging company

- Weathered know-how about logging in mountainous conditions
- An old dream for forest protection

A balloon manufacturer

- Knowledge in aerospace and aerial constraints

airstar International

FCBA, technology institute of the forest-based industry

- Description of technical specifications
- Project manager
- Test and measurements planning, data processing
- Economic simulation

FCBA

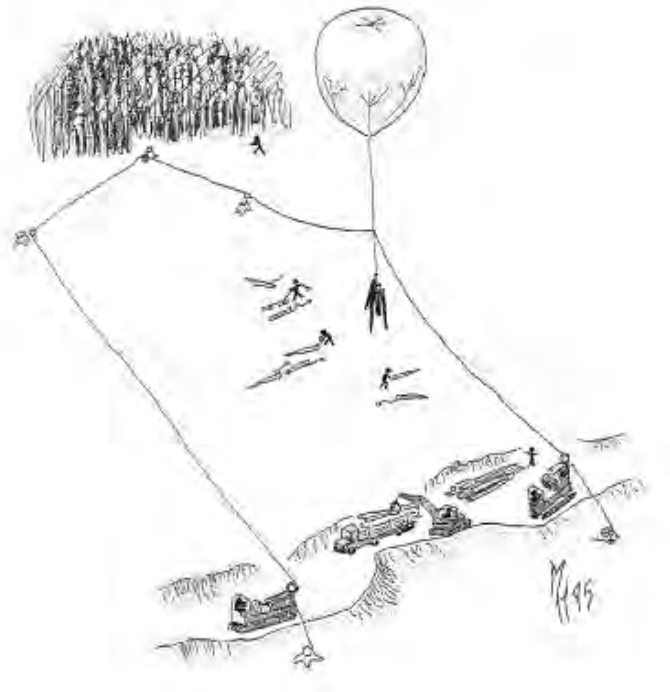
Yarding with balloon

An old technique

- Tested in few countries (USA 1967, FA0 1996)
- Big steel cable and fuel-dependent winches
- Many operators
  - ⇨**stopped for economical reaso**

Technological improvements

- New textiles for the envelope
- Synthetic ropes lighter than steel
- Batteries and electric winches
- Better knowledge on aerodynamics



Baloon logging
Canadian system
1995

Pre-feasability

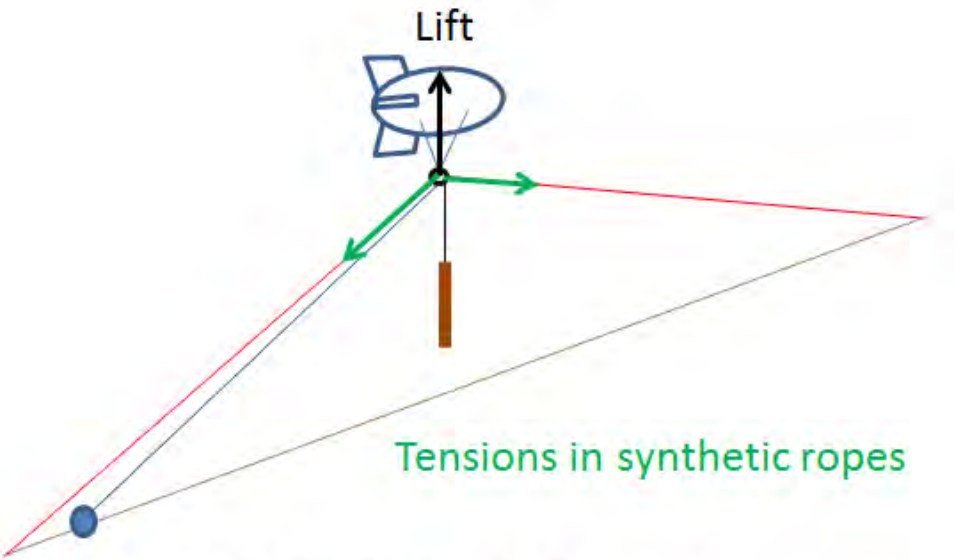
Aerial weather conditions:

- Balloon constructor requirement: wind velocity < 40 km/h
- Analysis in French alps: more than 220 days/year

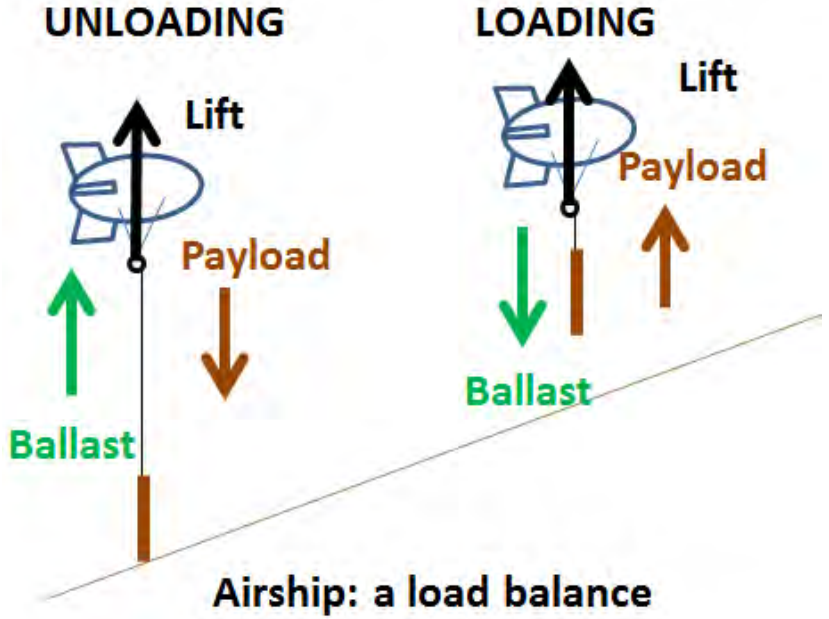
⇨**enough for annual workplan with balloon**

Why tethered instead of airship?

- Spread the elevating forces in cables seems to be more efficient than compensate with ballast in every cycle



Forces in tethered balloon



Airship: a load balance

Adjusted objectives

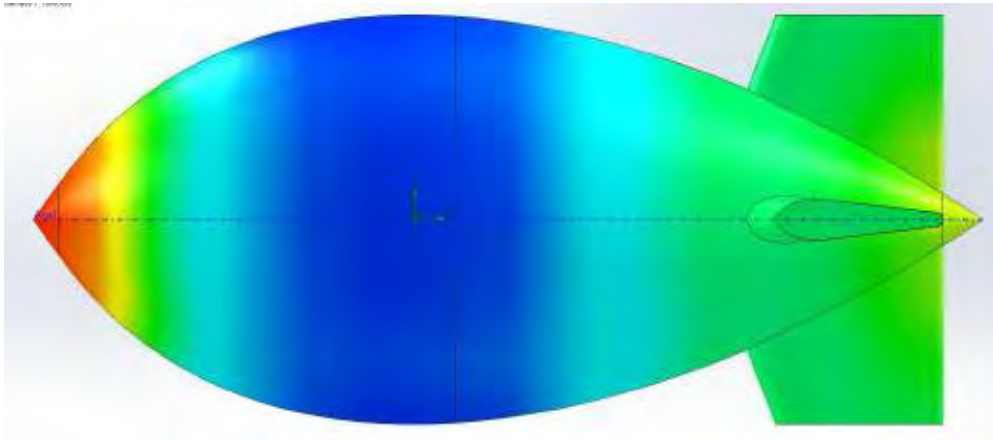
A compromise between payload, speed, dimensions and manufacturing costs:

- Balloon: 4000 m3 Helium, 50 m length, , 17 m diameter
- Speed 10 m/s
- Payload: 2 tons
- Logging cost close to the usual performance of cable crane

Reducing the energy consumption when:

- Using the lift from helium as the elevating force
- Reduce the tension in cable and the used forces when moving a static object (balloon + payload)

⇨ **electric energy could be used**



Logging cycle

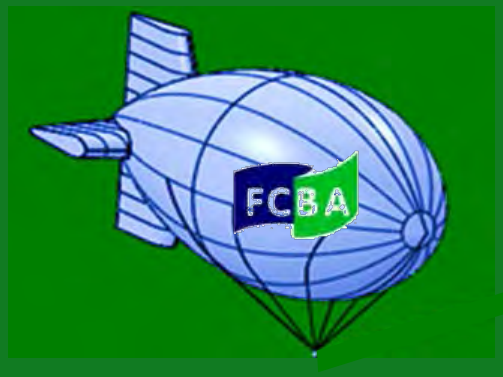
cycle

Natural lift

chokering

yarding

unhooking



Electric winch

A small-scale system

- 17 m length
- 6 m diameter
- 273 m^3 Helium
- Payload 100 kg

Field tests in July 2014

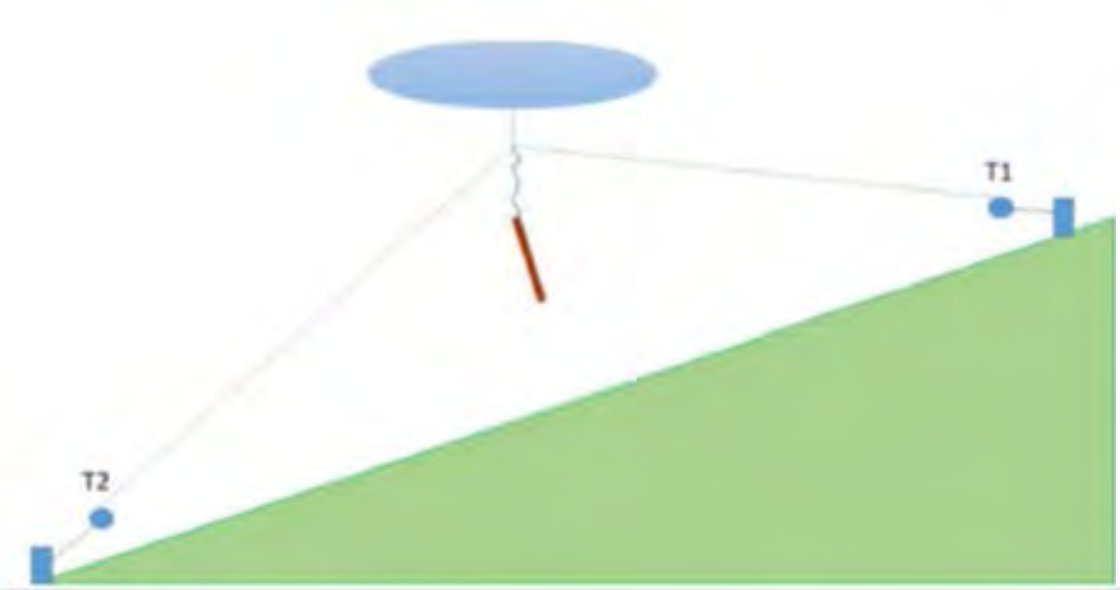
- Anchorage configurations of the system
- Tensions and forces measurements in the ropes

Alternative configurations of the system

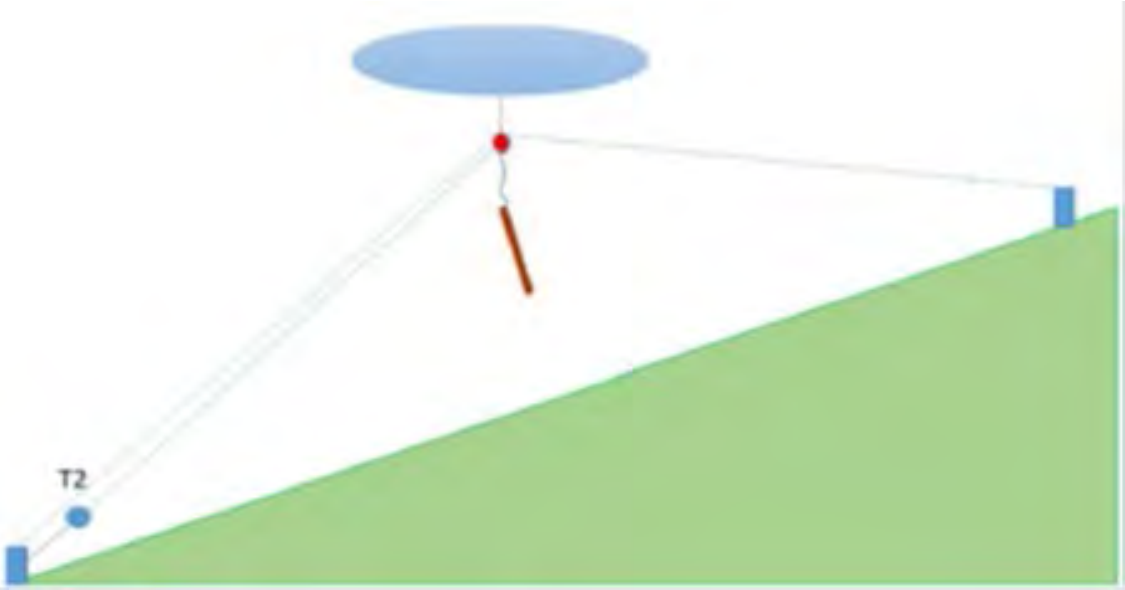
2 configurations were tested to measure:

- The tensions on the ropes at the anchorages
- The power required for the winches
- Aerial moves of the balloon

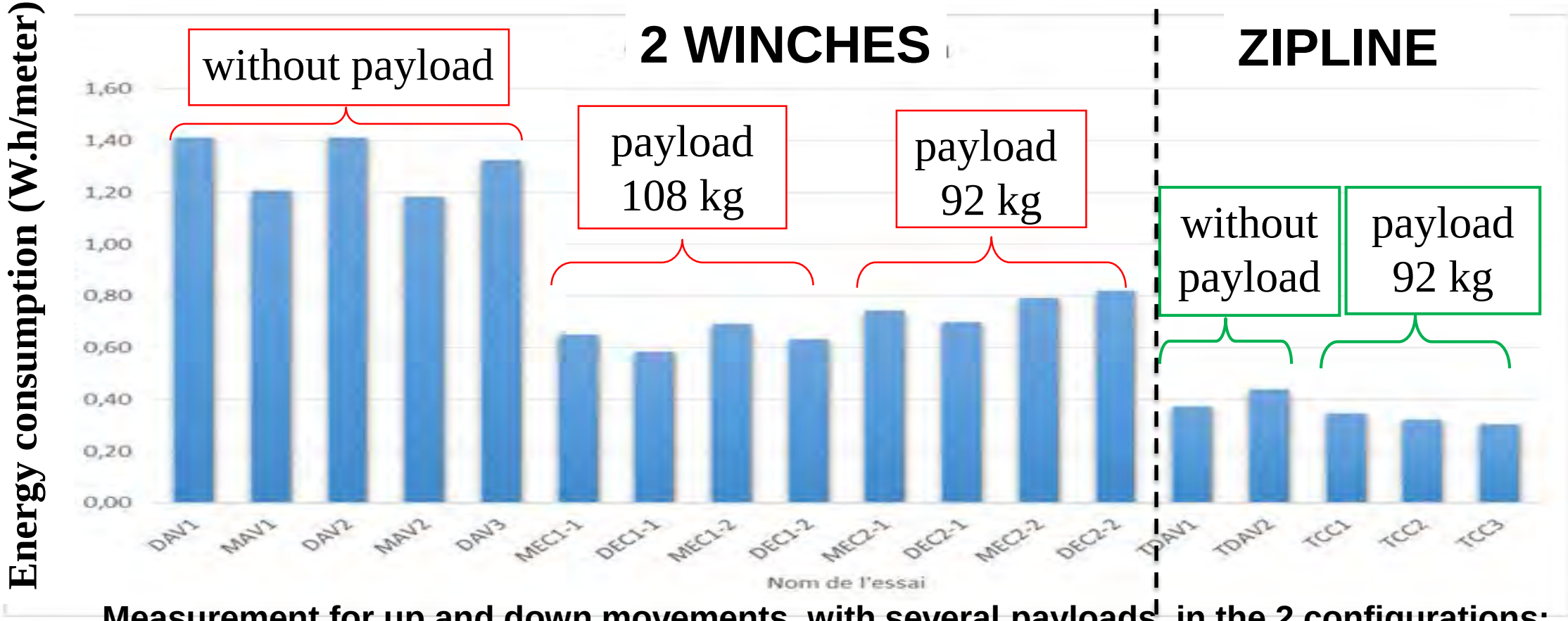
The balloon is attached at 2 winches, up and down



The balloon is attached at a pulley, moving on a zipline by a bottom winch



Energy consumption



Measurement for up and down movements, with several payloads in the 2 configurations:

The best configuration for tensions, energy consumption and aerial reaction: the zipline

Engine power required: 60 kw (simulation for 2 tons)

Economic simulation

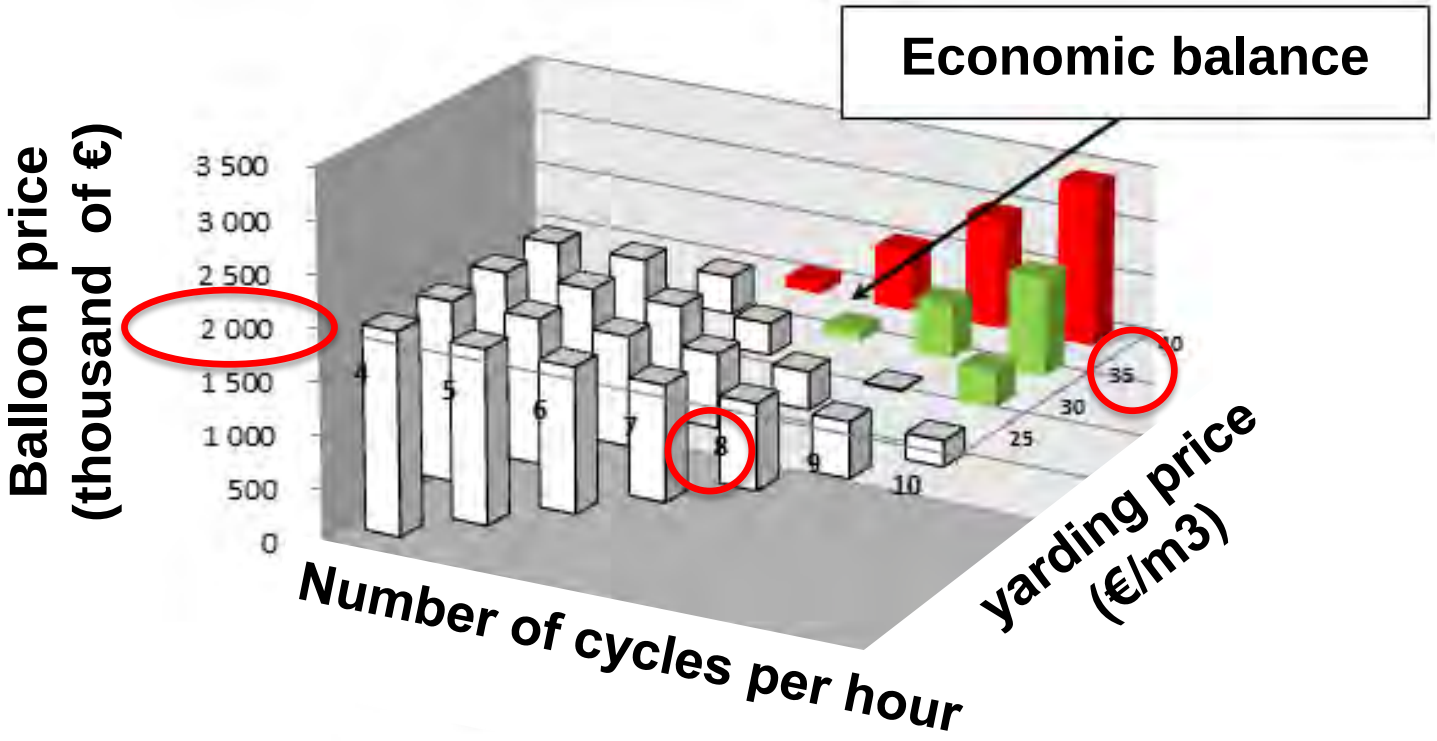
Hypothesis: - 2 tons payload, speed 10 m/s, 2000 meter line
- Cost balloon, with electric winches: 2 millions €
- 2,5 men

⇨ Expected productivity: 14,4 m^3/h, 8 cycles/hour

⇨ Logging costs close to the cable crane ones: 35 €/m^3

⇨ productivity seems to be the main parameters to decrease the logging cost, more than the balloon cost

Economic balance depending on the productivity and the cost of the balloon



Next step

Construction of balloon 4000 m^3 by 2018!

It’s impossible?
What are we waiting to do it!

Thank you for your attention