# ESFOR Energy Storage System For Ropeways

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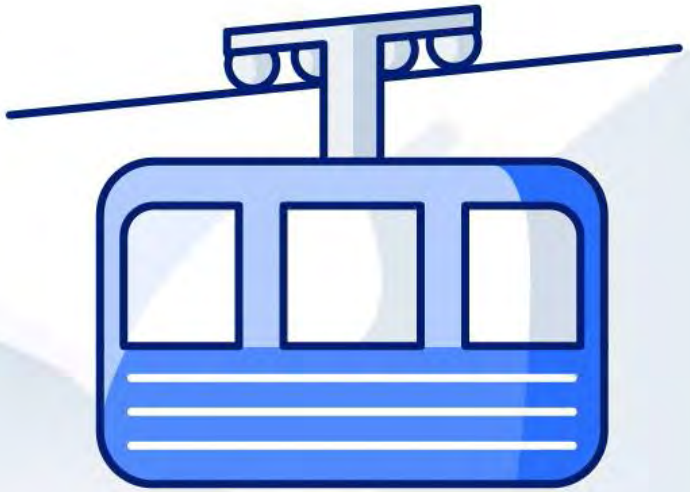
# ESFOR

## Energy Storage system FOr Ropeways



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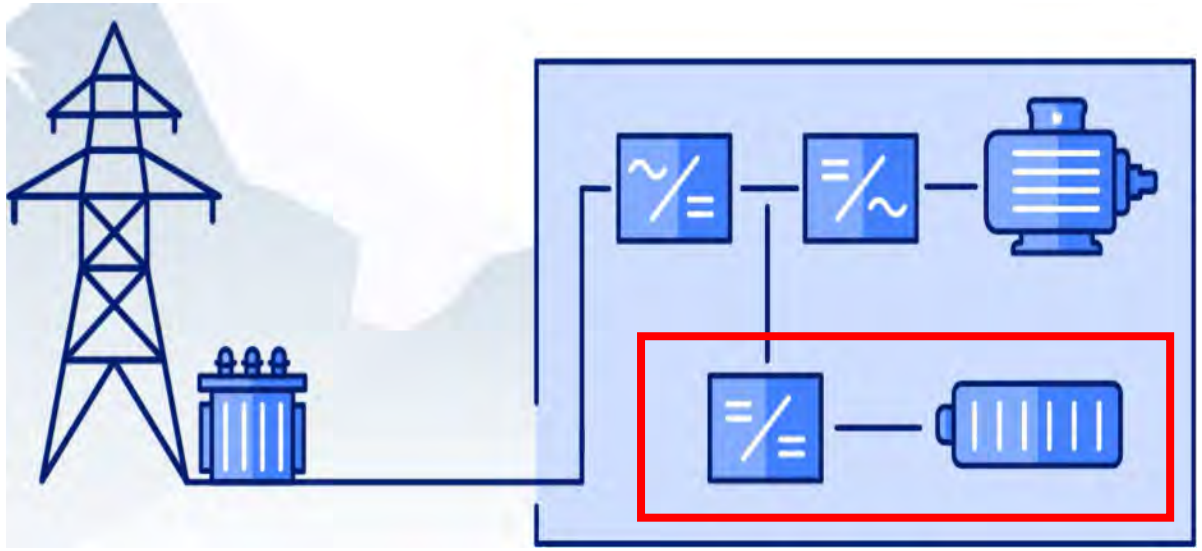
# ESFOR

## Design

- Battery storage feeds directly into the DC link of the drive system
- ESFOR consists of particularly safe and durable high-performance batteries
- Battery modules were originally developed for railroad applications
- Storage size is modular and can be increased in 20 kWh steps



# Main components

## ABB Traction battery modules

- produced by ABB in Baden (CH)
- for railroads, electric buses and ships
- based on Toshiba LTO (Lithium Titanate Oxide) cells
- water-cooled to ensure an optimum operating temperature

➢ high performance battery

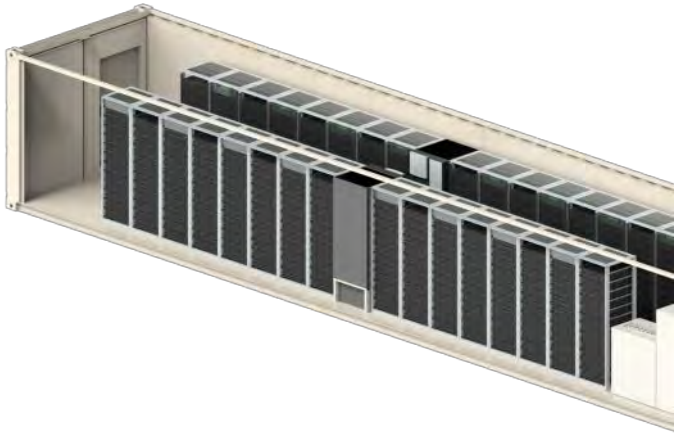
## ABB DC-DC converter, ACS880

- implemented in large numbers as frequency converters for many ropeways
- well known and extremely reliable and robust
- energy storage is directly integrated into the ropeway system

## Chiller

- ensures optimum operating temperature of the batteries
- ensures the high performance and service life of the batteries

# Technology comparison



**Commercial storage**

++ very high energy density

- low discharge power (0.5 - 1C)

- 3'000 - 5'000 full load cycles

+ cost/kWh

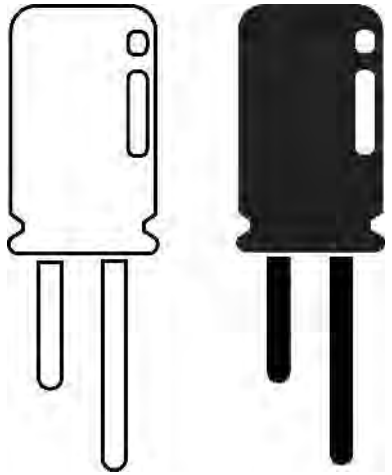
**ESFOR**

+ high energy density

+ high discharge power (6 - 8C)

+ >20'000 full load cycles

- cost/kWh



**Supercaps**

-- low energy density

++ very high discharge power (10 - 50C)

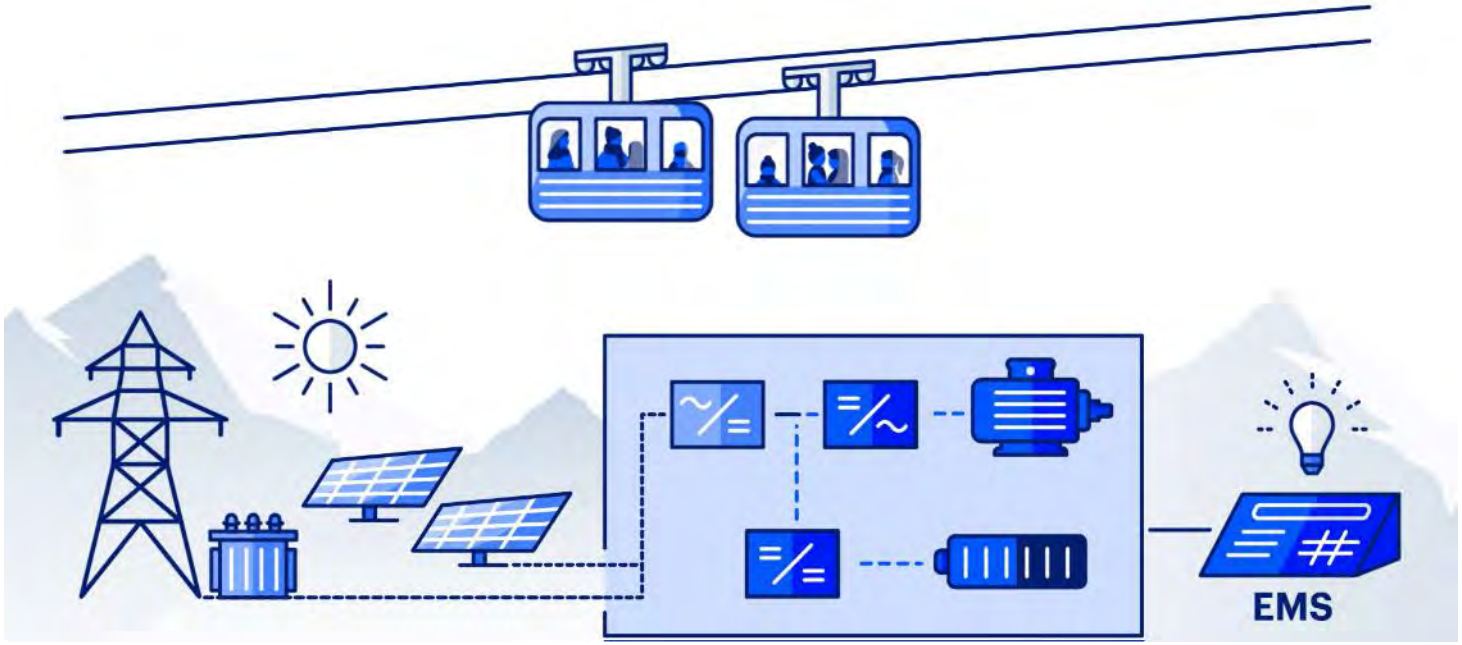
++ <1'000'000

-- cost/kWh

# Applications

**Temporary storage of locally generated energy**

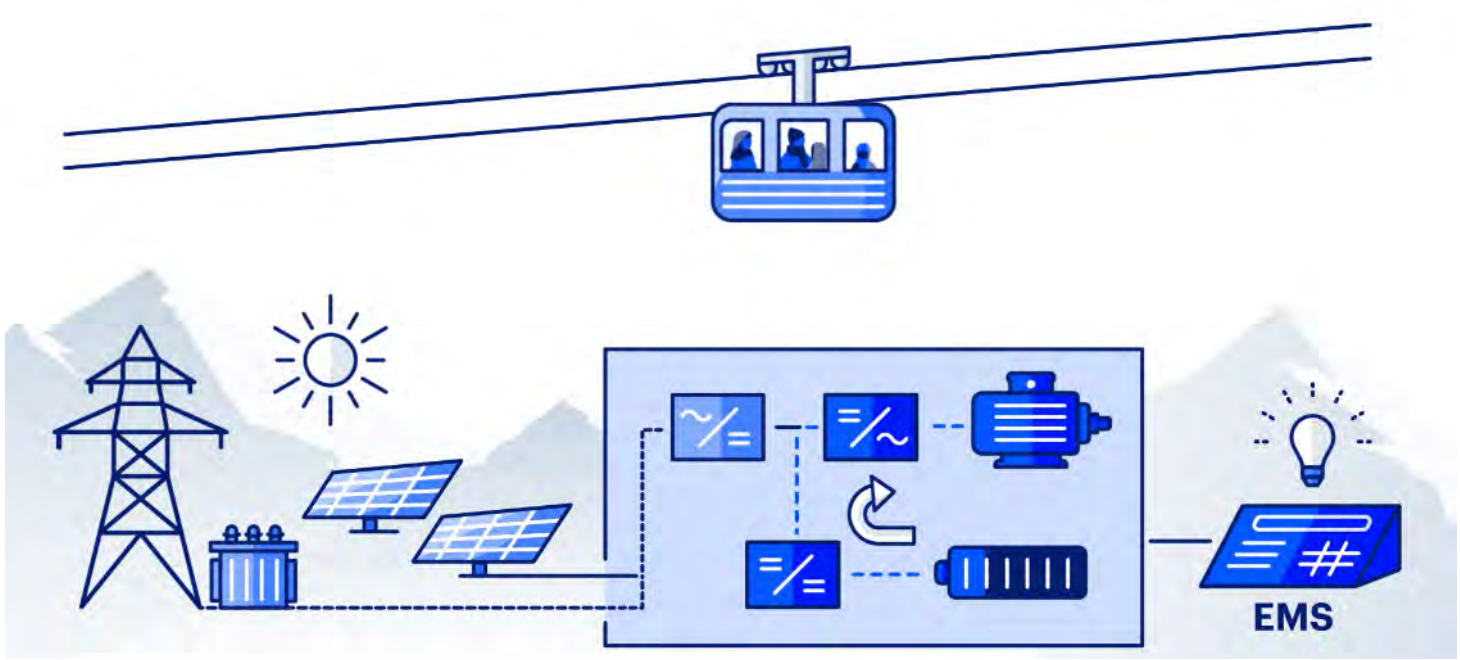
- PV, but also wind, water, fuel cell, etc.
- Surplus energy is stored and used later in a targeted manner
- Increase of autonomy / self-consumption




# Applications

## Utilization of brake energy

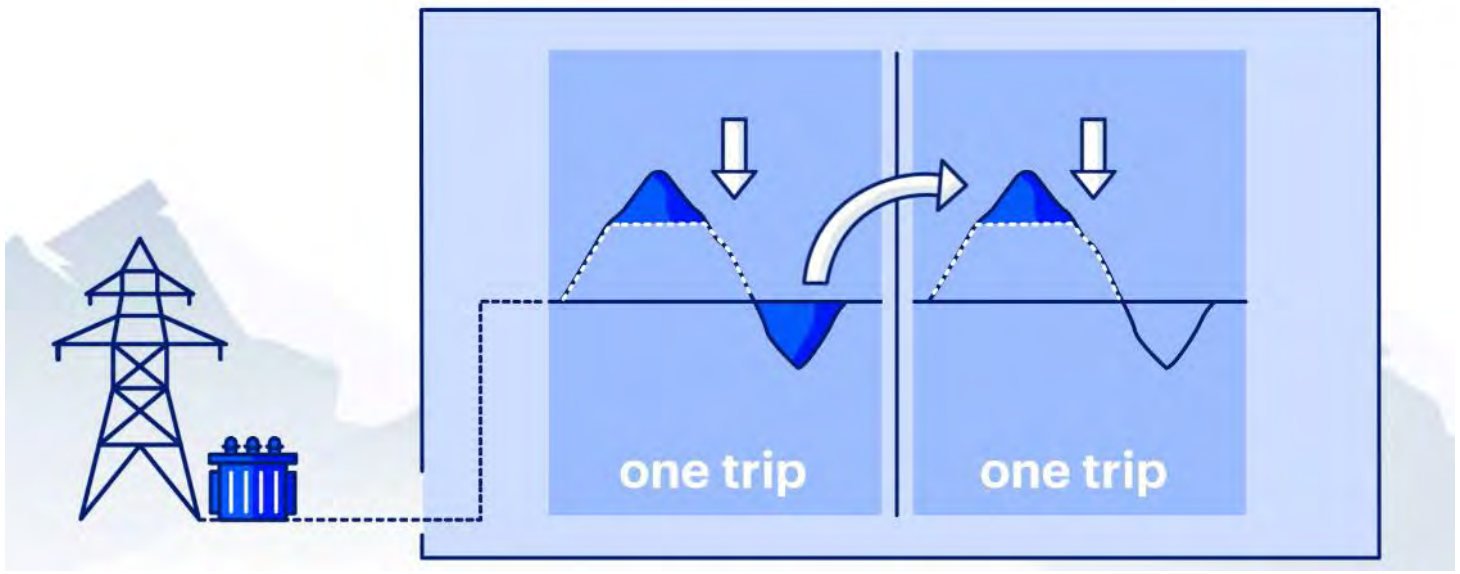
- Recuperate braking energy and store it in ESFOR
- Use energy on the next trip to reduce power peaks and power consumption




# Applications

## Limited power supply

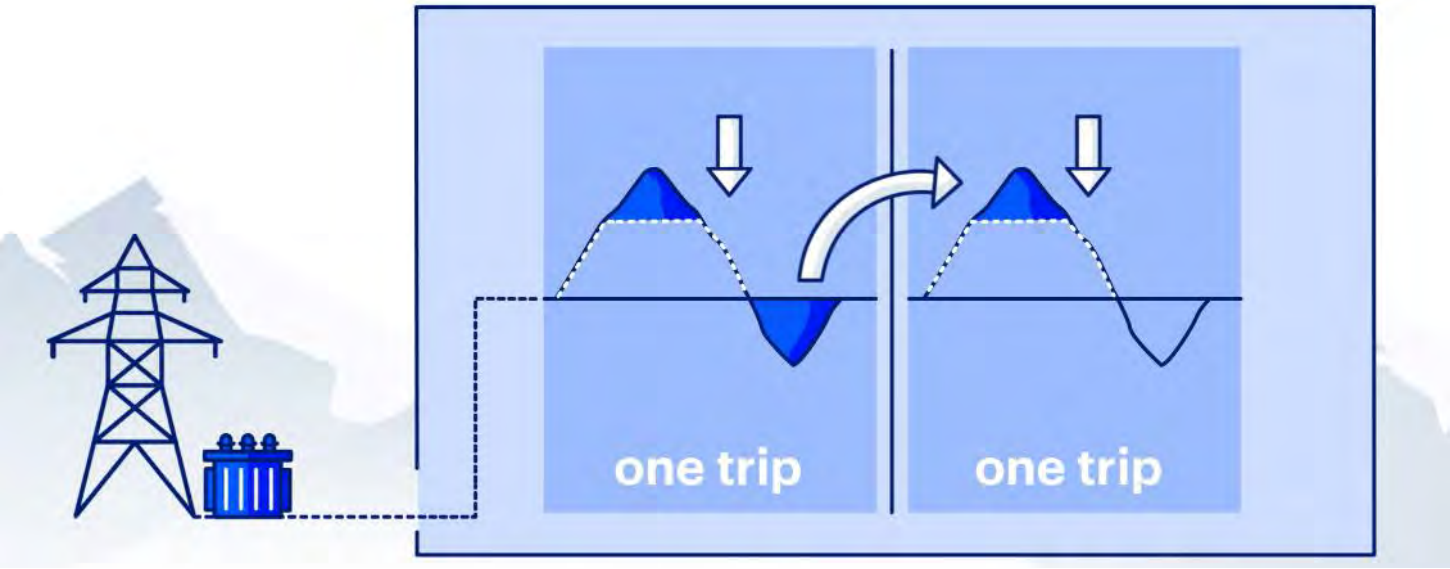
- Limit maximum power demand from the power grid
- Positive as well as negative (regeneration)
- Prevent/minimize possible expansion of the power grid (voltage stability)

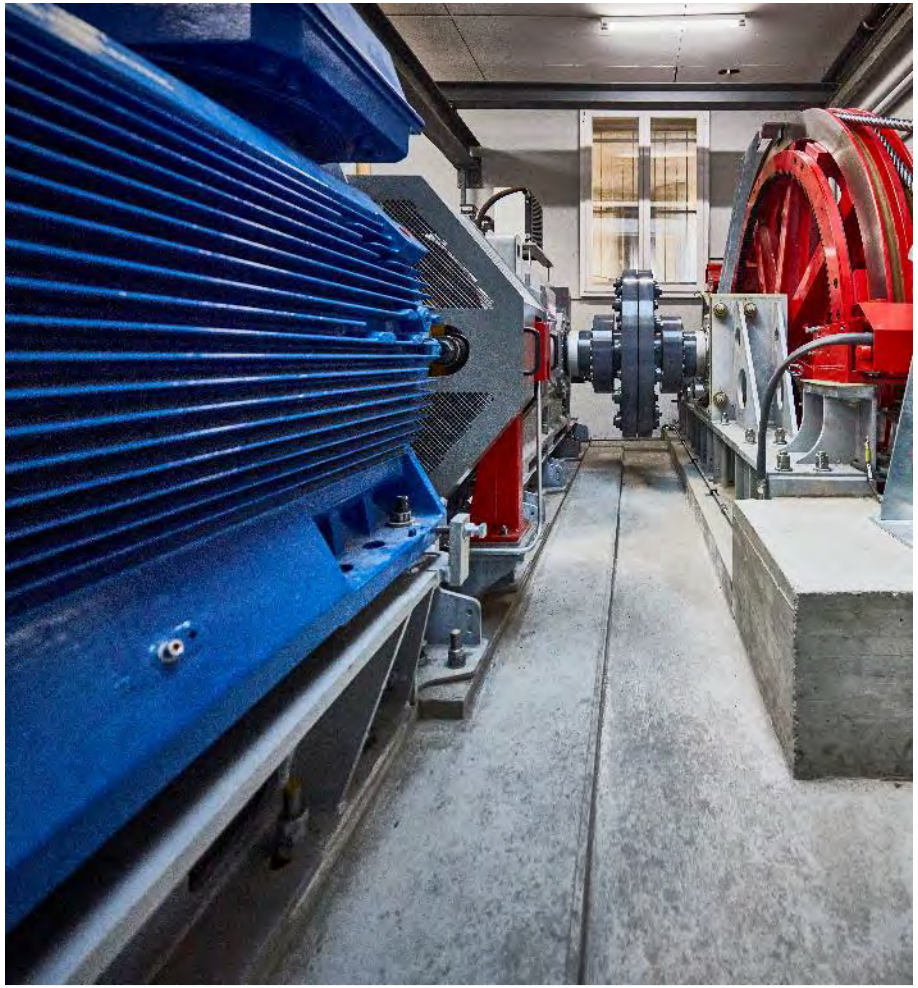



# Applications

## Peak-Shaving

- Specific reduction of power peaks
- Reduction of the 1/4h power average possible depending on the situation

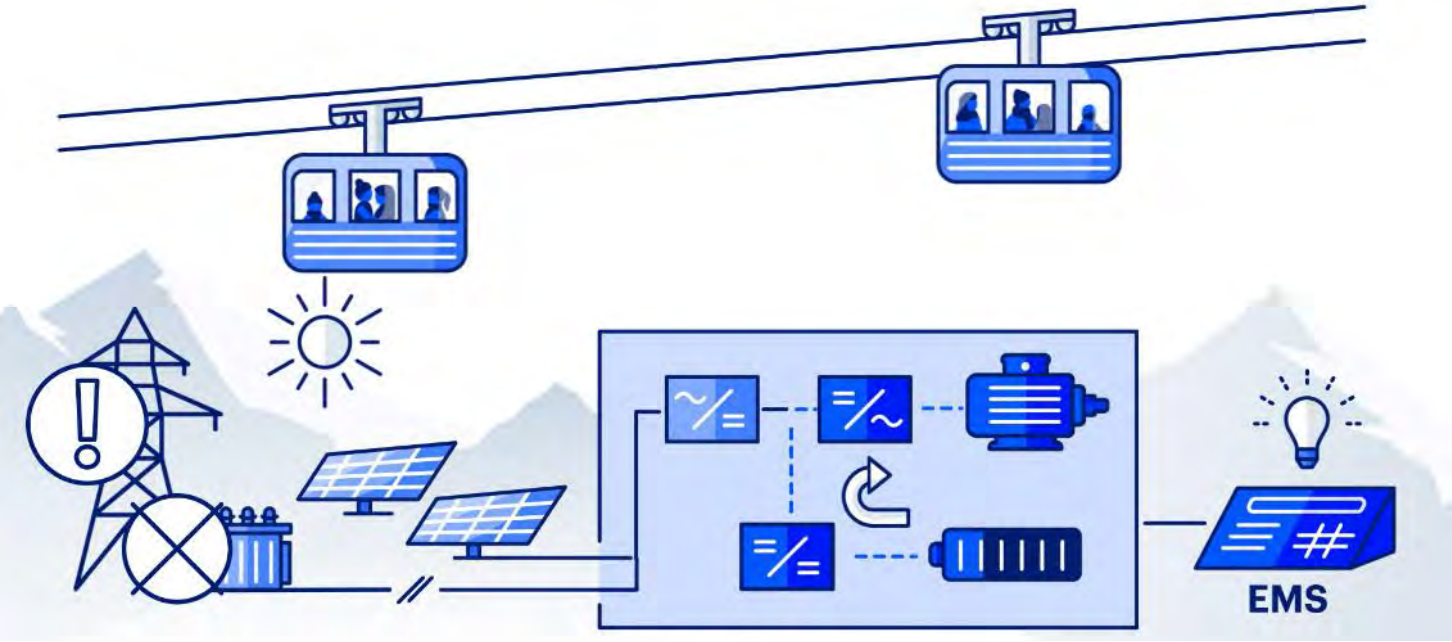


# Applications

## Recovery of the ropeway

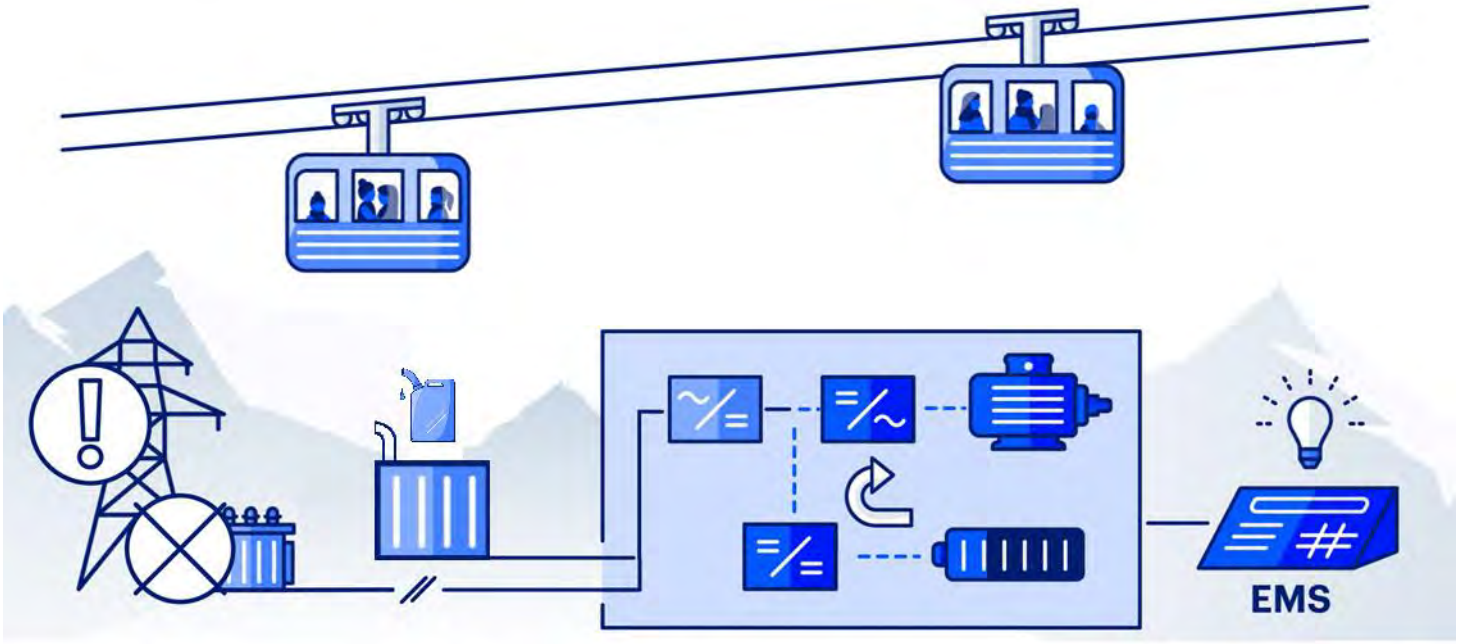
- Recovery with ESFOR and main drive in case of main power supply failure.
- Recovery with backup evacuation drive from main power supply in case of main drive failure.




# Applications

## Mains backup operation

- For mountain station evacuation, the emergency power system (diesel generator) can be dimensioned smaller thanks to ESFOR
- The emergency power system only has to provide constant power
- Volatile deviations (e.g. power peaks) are covered by ESFOR




# Potential

**For all ropeways with pendulum operation**

- with volatile and high power demand
- with existing or planned PV plant
- if it is not possible to feed the braking energy back into the power grid
- if a ropeway operator aims to generate a large part of his required energy himself
- if there are government subsidies for new renewable energy projects in a country
- if a ropeway operator has to pay high electricity prices
- especially in case of winch ropeways (only one vehicle). if a completely new ropeway is being built
- if a modification is planned
- if a completely new ropeway is being built.

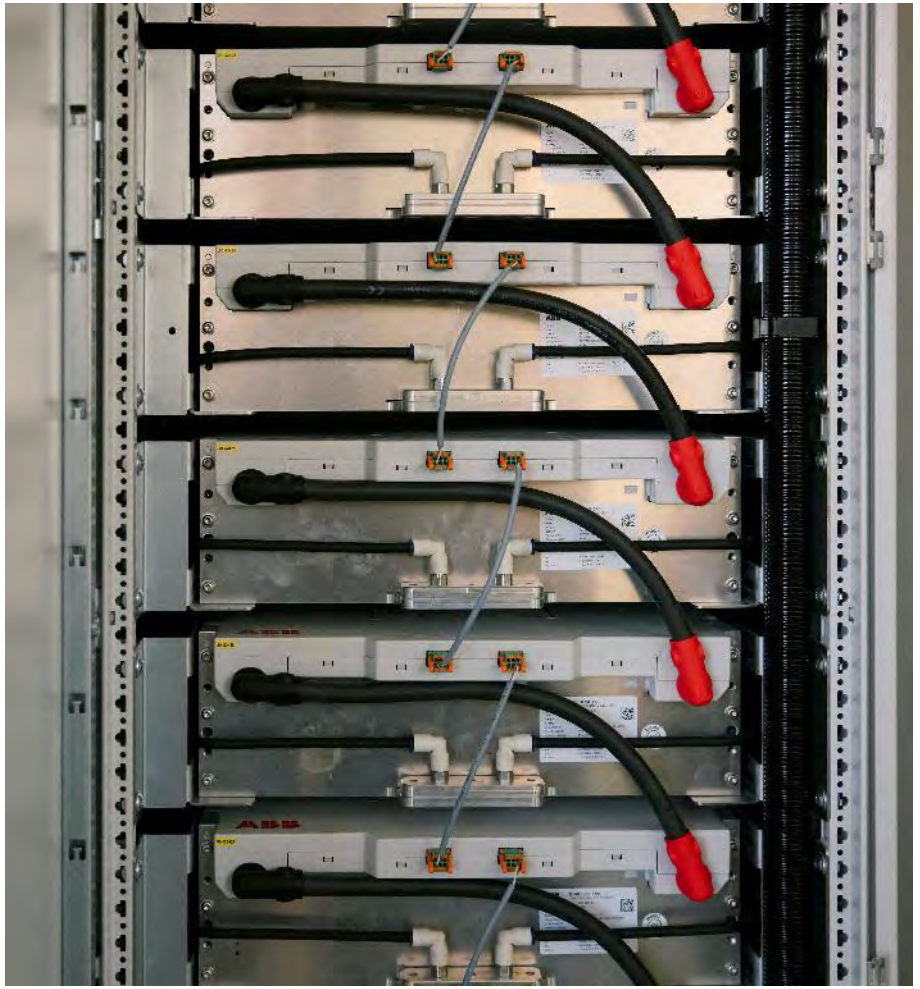
# SMC Funicular in Switzerland

# SMC Funicular in Switzerland

**New construction / reconstruction**

- Storage and reuse of braking energy
- Installation of a PV system on the station roof
- Peak shaving

➢ ESFOR reduces the energy demand from the grid by approx. 25% to 50% per year



# SMC Funicular in Switzerland

- Recovery concept:
  - From battery storage in case of main power supply failure
  - Recovery with backup evacuation drive in case of main drive failure
- Ropeway could be realised without combustion engine
- Considerable reduction of investment costs

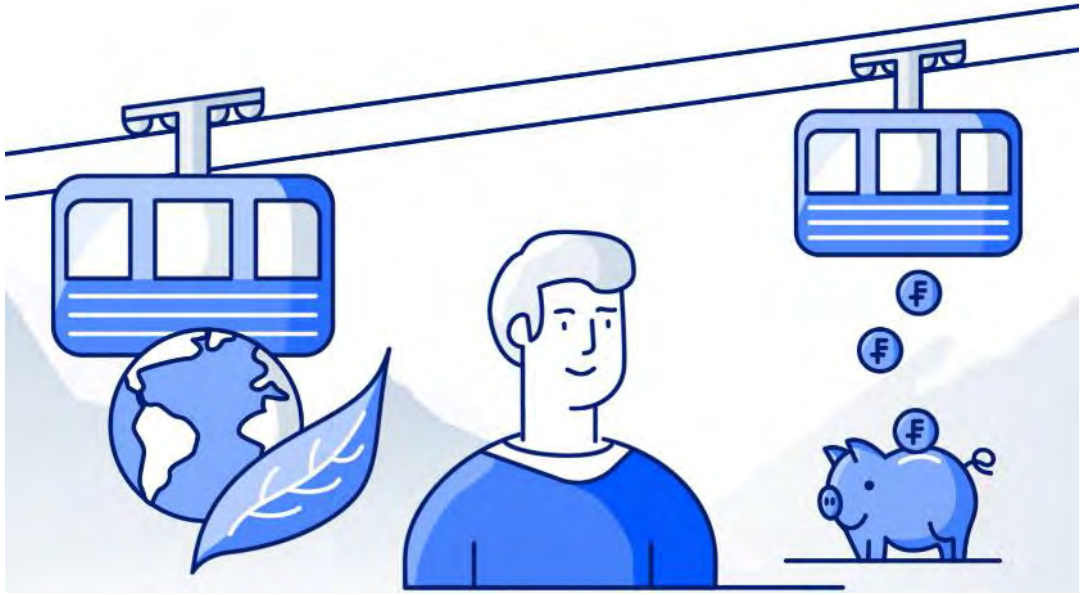
# Evaluation of ROI

**Financial aspects:**

- ROI is given by the specific ESFOR applications that can be implemented
  - the more applications combined, the better ROI
- In general ROI is approx. 7 – 10 years

**Ecological aspects:**

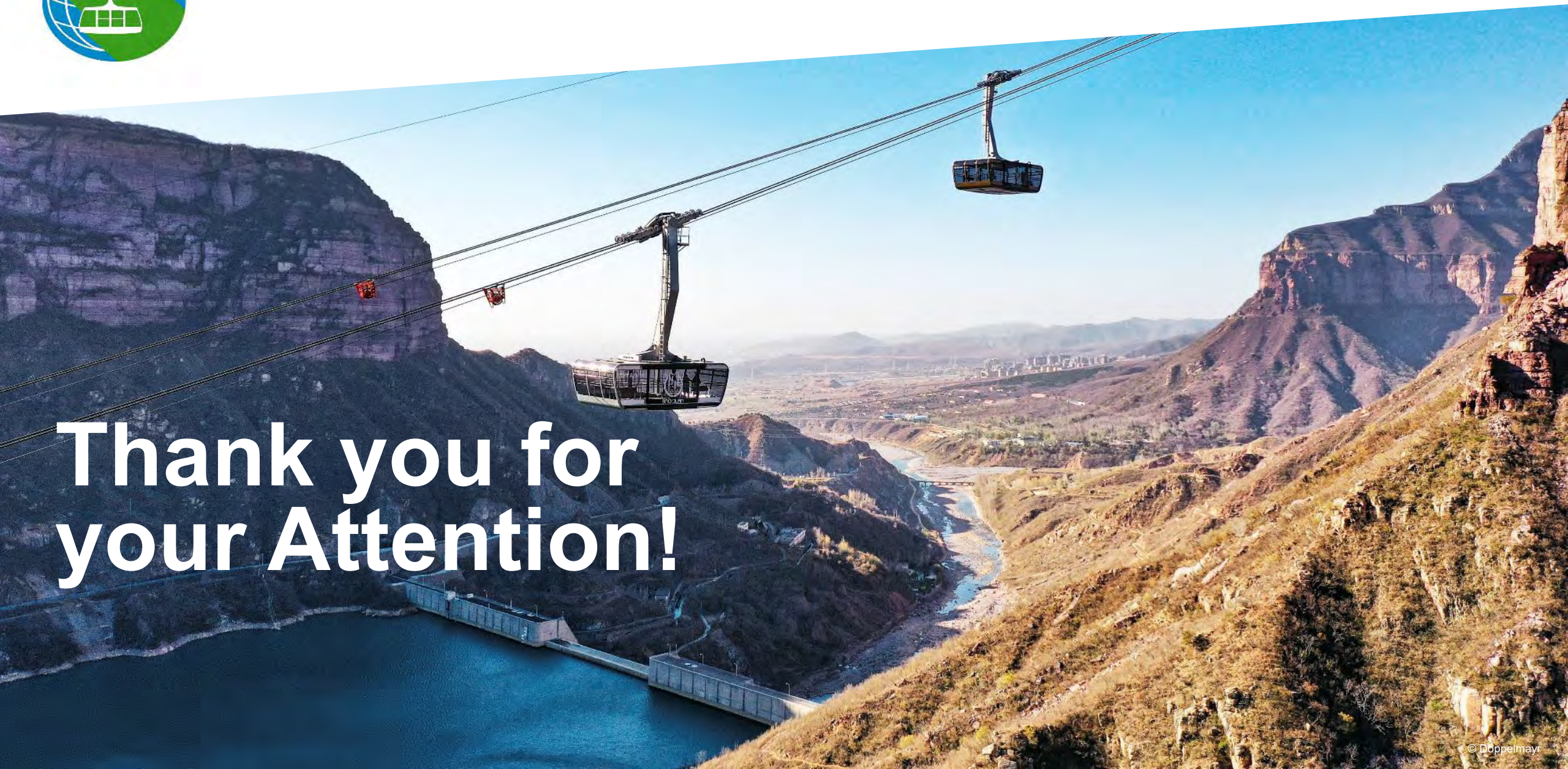
- EU CSRD (Corporate Sutainability Reporting Directive)
- Public founding possibilities for sustainable projects



# ROI

## Frey Stans

- High expertise for consulting in energy themes
- Simulation tool to quantify ESFOR potential on a project base
  - phisics of specific ropeway
  - time table or operation data
  - PV plant or locally generated energy
  - associated consumers
  - ➢ **define the ideal ESFOR setup**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your Attention!
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