# Frey Stans | ESFOR Energy Storage System For Ropeways

## Frey Stans

Frey Stans is a traditional ropeway control system manufacturer based in Stans, Switzerland with a significant track record with all types of ropeways and many years of experience around the globe. Since 2017, Frey Stans is part of the Doppelmayr/Garaventa Group.

## ESFOR

As a ropeway operator you need more and more to consider energy issues as energy costs, dependencies, supply security, energy origin and footprint.
Frey Stans has therefore developed ESFOR for funiculars and aerial ropeways.
ESFOR stands for “energy storage system for ropeways” and consists of a battery system to store electrical energy inside the ropeway drive which brings many interesting advantages for the ropeway operator in various situations.

## Design

ESFOR consists of an energy storage integrated directly into the DC Link of the drive system where it can be steered by the energy management system of the ropeway control.
The storage consists of safe and durable high-performance batteries, developed for railway applications, with modular size to be increased in 20 kWh steps.

## Main components

Frey Stans has a close partnership with ABB that produces the batteries in Switzerland. The LTO (lithium titanate oxide) cells from Toshiba are water-cooled to ensure best operating conditions.
With the integration of the battery system into the ACS880 converter family we have a well known and reliable base for our storage system.

## Technology comparison

The high energy density combined with the interesting discharge power of about 6C to 8C and the high number of load cycles make the LTO batteries the ideal technology for our ropeway applications.
Standard commercial storages have low discharge power below 1C and supercaps cannot store sufficient energy amount to be interesting.

## Applications

With ESFOR Frey Stans can create following value in ropeway systems:

**Temporary storage of locally generated energy**

The use of renewable energy sources is becoming more and more important. The use of PV installations in particular is an important puzzle piece in the electricity mix of the future. How-ever, this volatile form of energy often does not precisely produce the most electricity when needed. In the case of ropeways, however, there usually is a correlation between hours of sunshine and number of passengers. This is what must be used as optimal as possible. Since ropeways operated in shuttle mode stand still at the stations for boarding and disembarking, it is important that the energy produced by a local power generation plant at that time can be stored and used later. From a financial and also technical point of view, the construction of a PV installation on the drive station is highly recommended. By building a PV installation, most of the energy required for ropeway operation can be produced by the operating company itself. Between two trips, the battery storage can be charged with PV power. This means that peak loads can also be covered with self-consumption.

### Utilization of brake energy

In the case of a ropeway operated in shuttle mode, a high braking power can be required depending on load case and vehicle position. Modern frequency converter drives recuperate this energy. Until now, this energy was fed back into the power grid, often without compensation. With ESFOR, the energy remains in the system and can be reused instantly during the next trip. The energy purchase from the power grid and thus the costs are being reduced accordingly. Depending on the constellation, up to 30% of the required drive energy is gained as recuperation energy.

The recuperated energy can be used to reduce the load peak during the next trip. This procedure applies for each trip in a repetitive way.

### Limited power supply

In the Alpine region for example, new terrain chambers are hardly opened up for development anymore. In most instances, existing installations are replaced by new, more powerful ropeways. What often happens in this case is that the existing power supply is too small and the cost for expansion is disproportional. By using an energy storage system, the power consumption from the grid can be reduced and any peaks reduced. The required energy is drawn from the grid at a more suitable time or is even provided by your own PV installation at best, which reduces the power consumption from the grid. This has a straightforward and positive impact on the power grid quality of the energy supplier.

### Peak-Shaving

Depending on the ropeway's time schedule and power consumption, optimization can also be performed with regard to the quarter-hourly average power value, which in most cases has a direct impact on the electricity bill. This optimization is highly variable depending on the rope-way and depends on the billing method of the energy supplier. For example, if the energy supplier determines a demand tariff based on a quarter-hourly average value while the rope-way runs every 20 minutes, there is potential for optimization in this regard. A certain portion of the grid purchase can be specifically postponed to the next measurement period.

In addition to the financial aspect regarding the demand tariff, there are other aspects that speak in favor of optimization. Peripheral ropeways are often relevant for the design of the dimensioning of the power grid. A reduced peak power has a positive impact on grid quality as well as on grid and voltage stability. This can prevent or minimize cost-intensive expansion.

### Recovery of the ropeway

In order to bring the vehicles with passengers back to the station in the event of main drive breakdown or failure of the main power supply, a ropeway usually is equipped with an emergency drive powered by a diesel engine. Thanks to ESFOR, the diesel engine can be dispensed with. The energy storage system serves as an energy source to bring the vehicles back to the station in the event of a failure of the main power supply. In the event of a main drive failure, the vehicles are brought back with the aid of an electric backup drive. In this context, Frey Stans has developed a new recovery concept together with Garaventa and a notified body.

In order to ensure recovery at all times, a certain amount of energy must always be kept available. The amount of energy provided by the generator and motor need to be dimensioned to suit the most unfavorable load case, since no energy can be fed into the grid during recovery powered by the energy storage system (off-grid operation).

**Mains backup operation**

As a general rule, ESFOR is designed for ropeway recovery only. If the operation of the installation is planned to be continued, a mains backup system (diesel generator) must be used for this purpose. This can make sense, for example, if there is no other possibility to evacuate the persons from the top station. By means of ESFOR, the diesel generator can be dimensioned much smaller. All the generator needs to do is permanently providing the required arithmetic average power. The peak power is covered by ESFOR.

## Potential

To summarize, ESFOR creates value in operation of pendulum ropeways with

- 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
- if a ropeway operator has to pay high electricity prices
- especially in case of winch ropeways (only one vehicle)
- if a modification is planned
- if a completely new ropeway is being built

In the case a completely new ropeway is being built, the potential for ESFOR is very interesting as the whole energy-, drive- and backup concepts can be designed from scratch without having to consider existing infrastructure like diesel engines. In this way, the greatest possible financial and energetic benefit can be generated.

## SMC Funicular in Switzerland

ESFOR was implemented on the SMC funicular connecting Sierre with Crans-Montana in Switzerland during the complete renewal of the ropeway in 2022.

Multiple value generating ESFOR applications could be implemented

- Storage and reuse of braking energy
- Installation of a PV system on the station roof
- Peak shaving to reduce energy price from the energy provider
- As the ropeway was completely renewed, a recovery concept without Diesel generator could be designed, reducing considerably the investment.

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

## Return on investment

The financial and ecological effectiveness of ESFOR 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.
With the introduction of EU CSRD, the introduction of sustainable measures has also gained in importance.

## Frey Stans consulting expertise and simulation tool

Frey Stans has a high expertise for consulting ropeway customers in energy themes
Thanks to our simulation tool to quantify ESFOR potential on a project base we can define the ideal ESFOR setup considering:

- physics of specific ropeway
- time table or operation data
- PV plant or locally generated energy
- associated consumers
- grid energy pricing