Low Voltage Regulation System LVRSys™

- Power range: 7,5 kVA up to 630 kVA
- Regulation ranges: ± 6 % … ± 20 %
- Number of steps: up to 9
- Overall efficiency: 99,4 % bis 99,8 %
- maintenance like outdoor LV-cabinets
- Phase independent regulation
- No grid interferences

Changes in the distribution grids create new challenges

Smart Grids and the resulting changes in the distribution grids face many distribution grid operators with different challenges. These include:

- Voltage range deviations becoming more frequent and more critical.
- Photovoltaic systems in the low-voltage grid raise the voltage level.
- Photovoltaic systems dominate the daytime voltage level.
- The increase of heat pumps and electric vehicles lower the voltage level, and both dominate the voltage level in the evening as well as at night.
- The majority of electric vehicles are charged at home in single-phase.
- Voltage increases and voltage decreases are usually time-shifted.
- Asymmetries of the 3-phase voltages occur more frequently.

This economic analysis is intended to help power utilities in the planning process of the distribution grid to make the right decision for their investment and to pitch if a line expansion is worthwhile or not.

Low investment- and operating costs make the LVRSys™ attractive in comparison to line expansion

Economic analysis

Our analysis examines, in which scenario LVRSys™ pays off compared with conventional line expansion. A distinction is made as to whether the line extension is carried out with a low capital investment (scenario "country") or with a high capital investment (scenario "village"). For the cost comparison, LVSys™ system with 110 kVA is used. A useful life of 40 years is assumed in all scenarios.

LVRSys™ investment costs

The investment costs of the individual resources were summarized based on the BMWi distribution network study (Büchner, J.; Katzfey, J.; Flörcken, O. (2014): "Moderne Verteilernetze für Deutschland", BMWi). The costs of the low-voltage control systems were given on the basis of the list prices of A. Eberle. The comparison of the investment costs is shown in table 1.

	Investment [in T€]
Line per km	**68 – 86**
LVRSys™ 110 kVA	**14,5**

Table 1: Investment costs line per km vs. LVRSys™

LVRSys™ operating costs

The operating costs consist of the maintenance costs, the electricity heat losses and the planned replacement of the electronics after 20 years until the end of the total service life. No maintenance costs are expected for the lines. The comparison of the operating costs is shown in Table 2.

	Costs [in T€]	**Useful life/ interval [in years]**
Country/village line	**0**	**40**
LVRSys™ Electronics	**1,5**	**20**
LVRSys™ Maintenance	**0,5**	**5**

Table 2: Operating costs line vs. LVRSys™

Maintenance is limited to cleaning the control cabinet and checking the screw connections. For the cost of electricity heat losses, it is assumed that the systems are in operation throughout the whole year with an average load factor of 50%. The results of the analysis are illustrated in Figure 1.

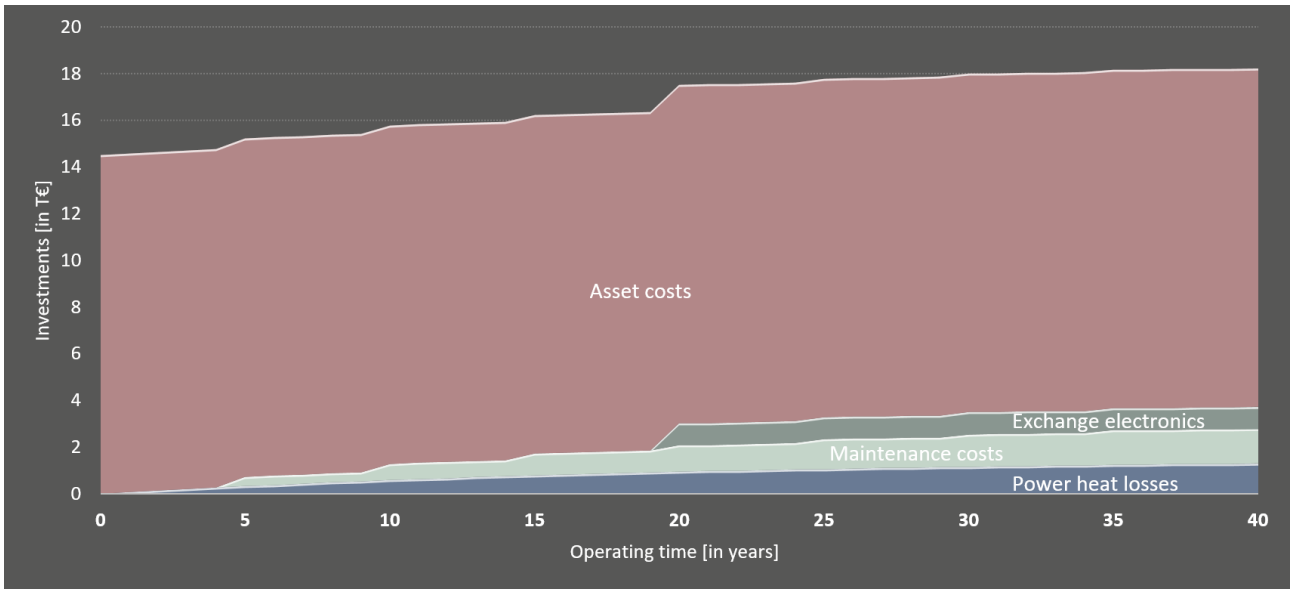

Figure 1: Investment requirement LVRSys™ 110 kVA with a useful life of 40 years and discounting of 5%.

Cost parity already exists from a few hundred meters of line

Investment calculation

The investments are calculated over the entire lifetime and discounted to the current year according to the capital value method. For LVRSys™ 110 kVA it results in a total investment requirement of approximatly. 18,000 €.

	Lower limit	Upper limit
Line expansion	68 T€/km	86 T€/km
LVRSys™ 110 kVA	260 m	200 m

Table 3: Cost parity of the LVRSys™ compared to the line extension.

Economic benefit

As Table 3 reveals, there is a cost parity of LVRSys™ to line extension starting at a length of about 260m, when the lower bound of the distribution network study is assumed, and starting at a cable length of about 200m when the upper bound is assumed.

Alternative to line extension

LVRSys™ represents a real alternative to line extension due to tension. As shown in our calculation, line expansion is associated with high investments. These investments tie up the capital employed for decades. The use of LVRSys™ is different. With the use of our system, comparatively low investments are required, which are also flexible and independent of location. If the conditions in the distribution network change fundamentally, the system can simply be relocated and work elsewhere.

Additional benefits of using LVRSys™

Compared to line expansion, the following additional benefits must be taken into consideration:

- Flexible use: assembly/disassembly as required.
- Guarantee of VDE-AR-N 4105 with regard to voltage swing (3%) through decentralized generation systems.
- Optional with EN 50160 monitoring.
- Recording of useful data in the grid.
- Increase in the transmission power of the lines used by 20%.
- Reduction of network losses.

Conclusion: Not just an alternative, but a useful tool for the future

LVRSys™ low voltage regulation system is not only a cost-effective alternative to line expansion, but a tool for the grids of the future. Its use makes sense not only from an economic point of view. The system is developed with future viability in mind and is designed to meet future challenges. It also offers a range of useful functions that useful functions that will provide our customers with significant added value in the low-voltage grid for years to come.