
7TH SOLAR INTEGRATION WORKSHOP, 25 OCT. 2017

# Maintaining Grid Voltage from Spot Renewable Generation

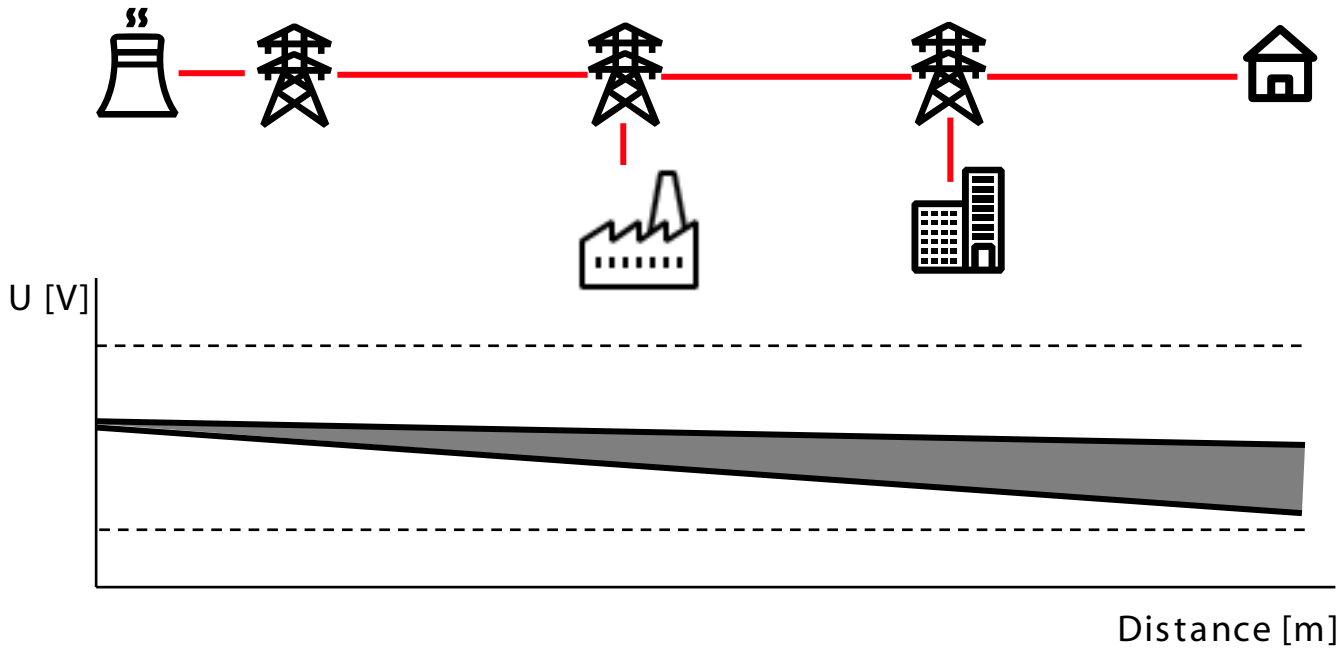
Frank Cornelius, ABB Business Development

# General Introduction

## Effect of fluctuating decentralized power generation

During the last decade, Europe has experienced an unprecedented increase of renewable generation, especially of wind and solar.

- Due to central generated power, the power flow direction was one directional.
- That allowed to design the network in accordance to the min-max load situation to stay within the given voltage requirements.



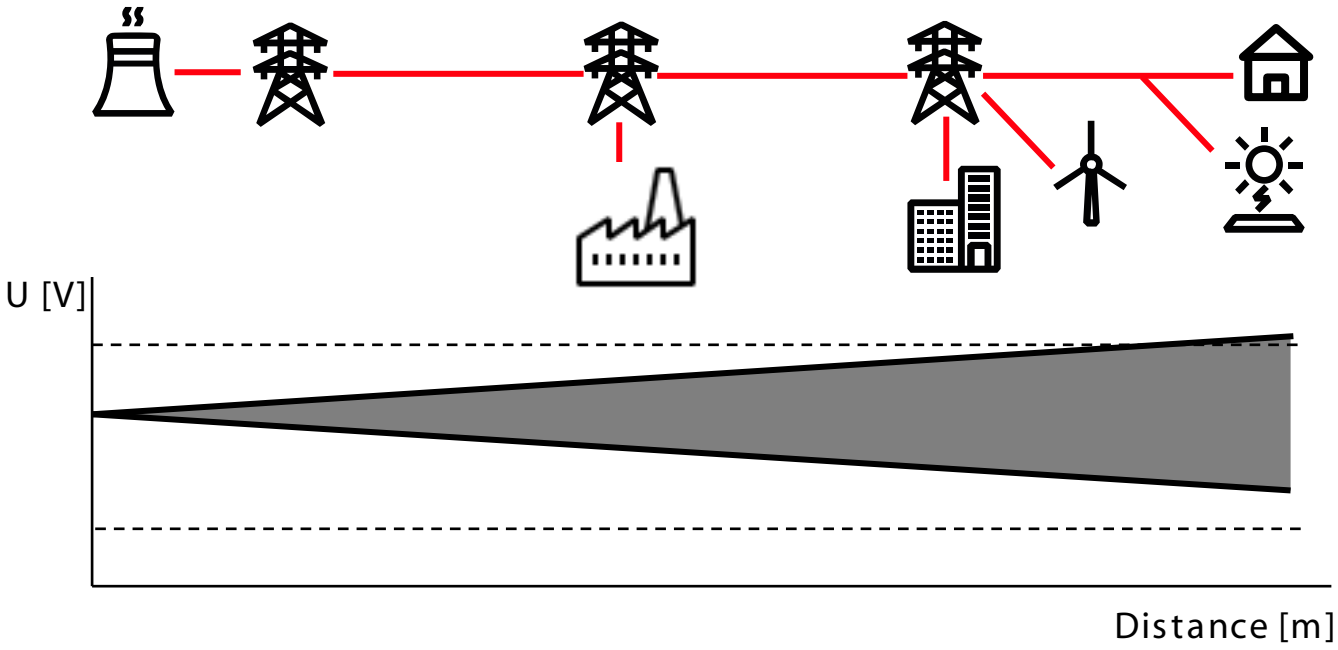
# General Introduction

## Effect of fluctuating decentralized power generation

During the last decade, Europe has experienced an unprecedented increase of renewable generation, especially of wind and solar.

- With high installed peak power of decentralized power sources the power flow direction changes in many parts of the grid.
- Now, the design criteria for the grid changes to max generation – max load.
- The voltage can vary significant and in certain cases leave the allowed band of +-10%

**A smart and economic solution is needed to prevent extensive grid expansion**



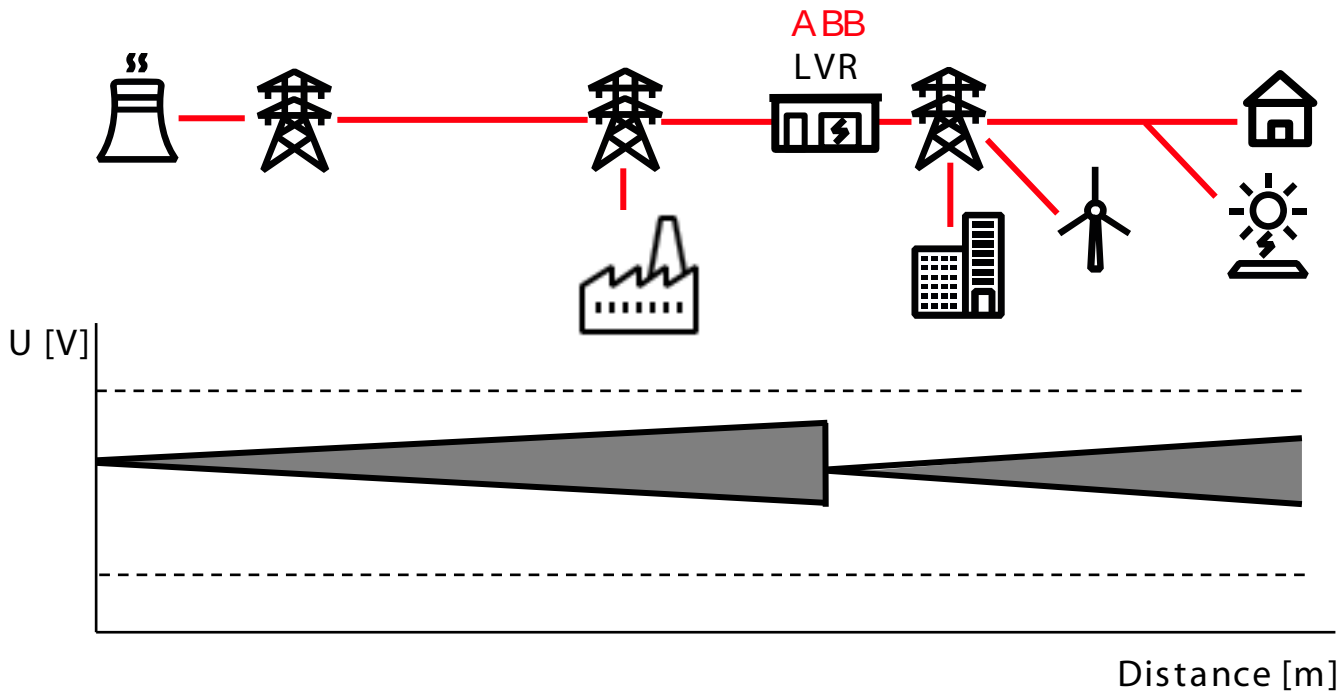
# General Introduction

## Effect of fluctuating decentralized power generation

During the last decade, Europe has experienced an unprecedented increase of renewable generation, especially of wind and solar.

- With high installed peak power of decentralized power sources the power flow direction changes in many parts of the grid.
- Now, the design criteria for the grid changes to max generation – max load.
- The voltage can vary significant and in certain cases leave the allowed band of +-10%

**The ABB LVR increases the grid capacity significant, by active voltage regulation**



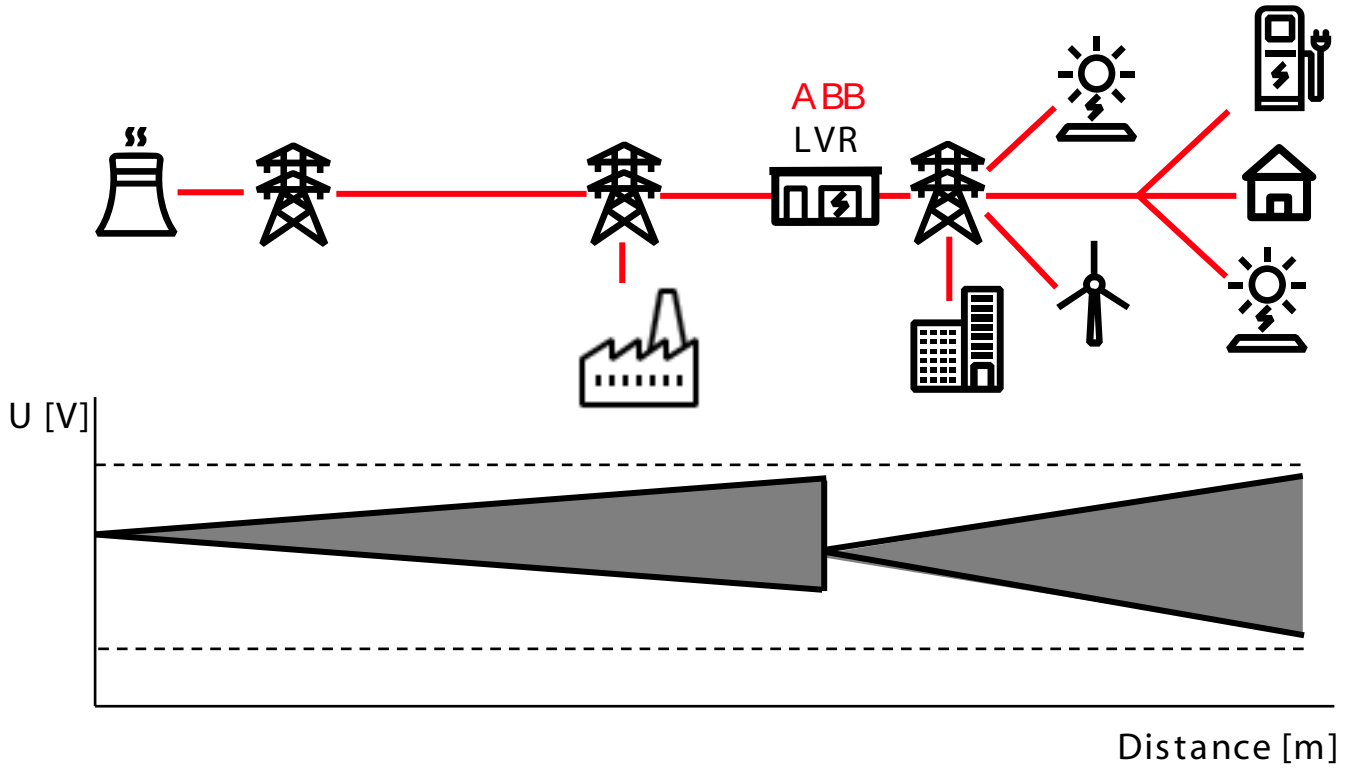
# General Introduction

## Effect of fluctuating decentralized power generation

Forecasts for the next decade sees two trends

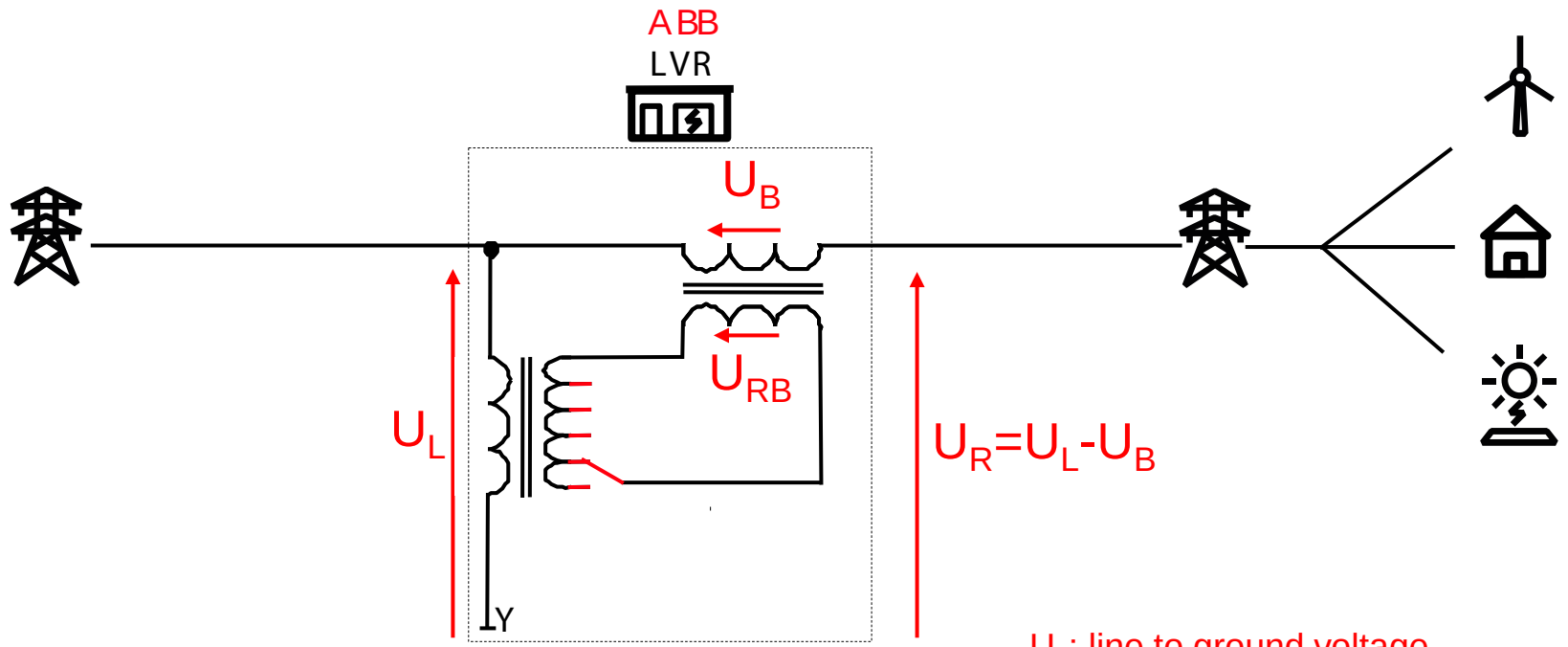
- Renewable energies will further increase, where a certain share is decentralized
- E-Mobility infrastructure is expected to be becoming important.
- The effect for the network will be significant since both design parameters, max power and max load, will be shift to the negative direction.

**The ABB LVR increases the grid capacity significant, by active voltage regulation**



# Line Voltage Regulator

## Reliable answer to voltage variations with significant Advantages




$U_L$: line to ground voltage
$U_B$: booster voltage on line side
$U_{RB}$: booster voltage on regulator side
$U_R$: regulated line to ground voltage

# Line Voltage Regulator

## Characteristics of MV Voltage Regulators

**Robust, efficient, economical, flexible**

| | |
|---|---|
| Power | Up to 14 MVA |
| Voltage | Up to 36 kV |
| Tap Changer | Automatic OLTC |
| | Typical 11 steps +- 1,2% |
| Energy efficiency | Very high (>99.8%) |
| Remote Control | Via ABB RTU |
| Transformers | ABB RESIBLOG DRY Type |
| Dimensions | 2,5m x 5,5m |

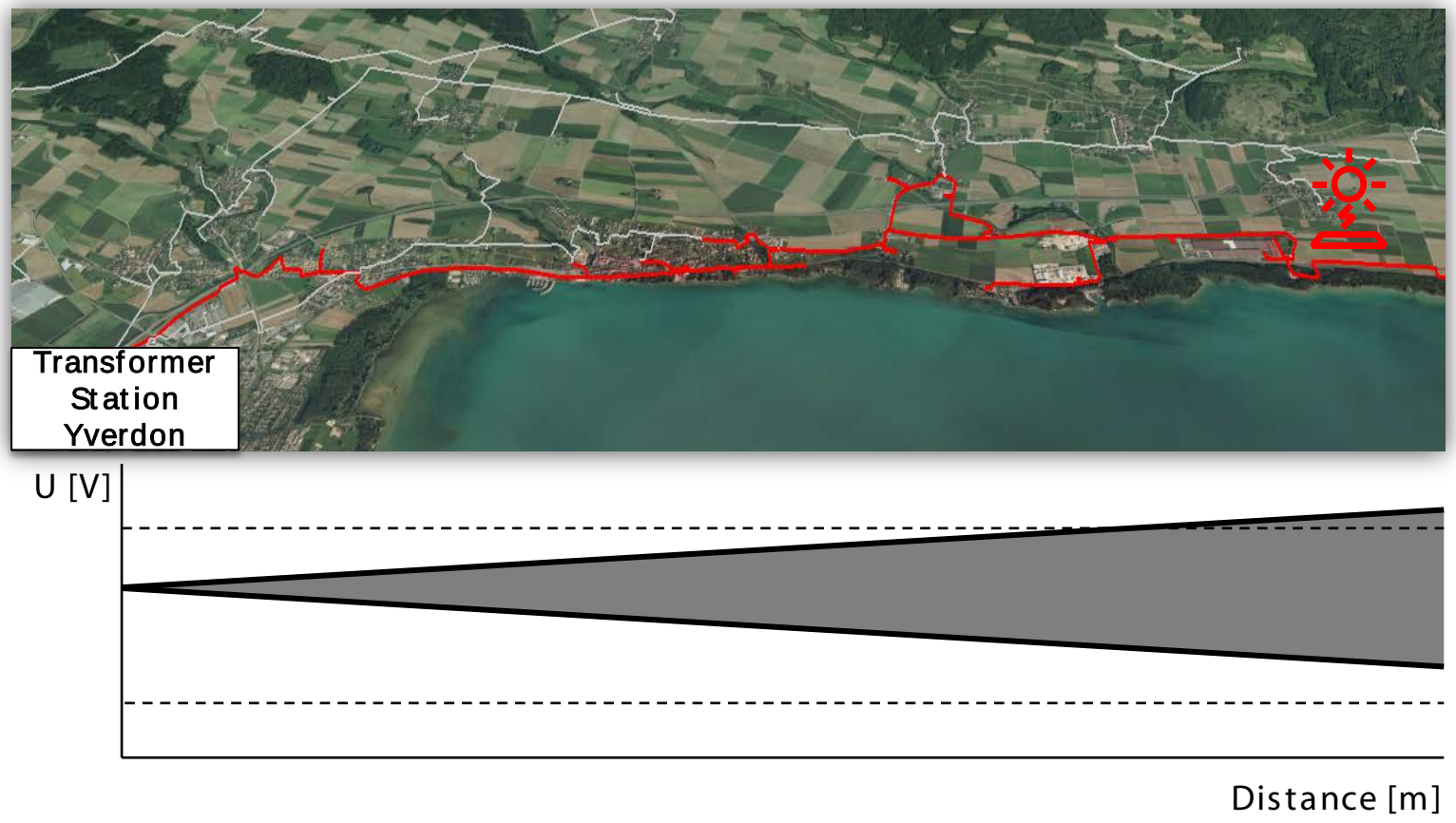
Gas insulated ABB Medium voltage switchgear
ABB SafePlus

# Specific Grid Situation at Romande Energy

Large roof mount PV spot causes voltage fluctuation above the limits

## Criteria for justify the LVR usage

- High penetration of generation plants in the medium voltage grid
- Spatial arrangement of the generation units and their connection points to the grid
- Function of the reactive power control of the generation units
- Influence of the length of the medium voltage line



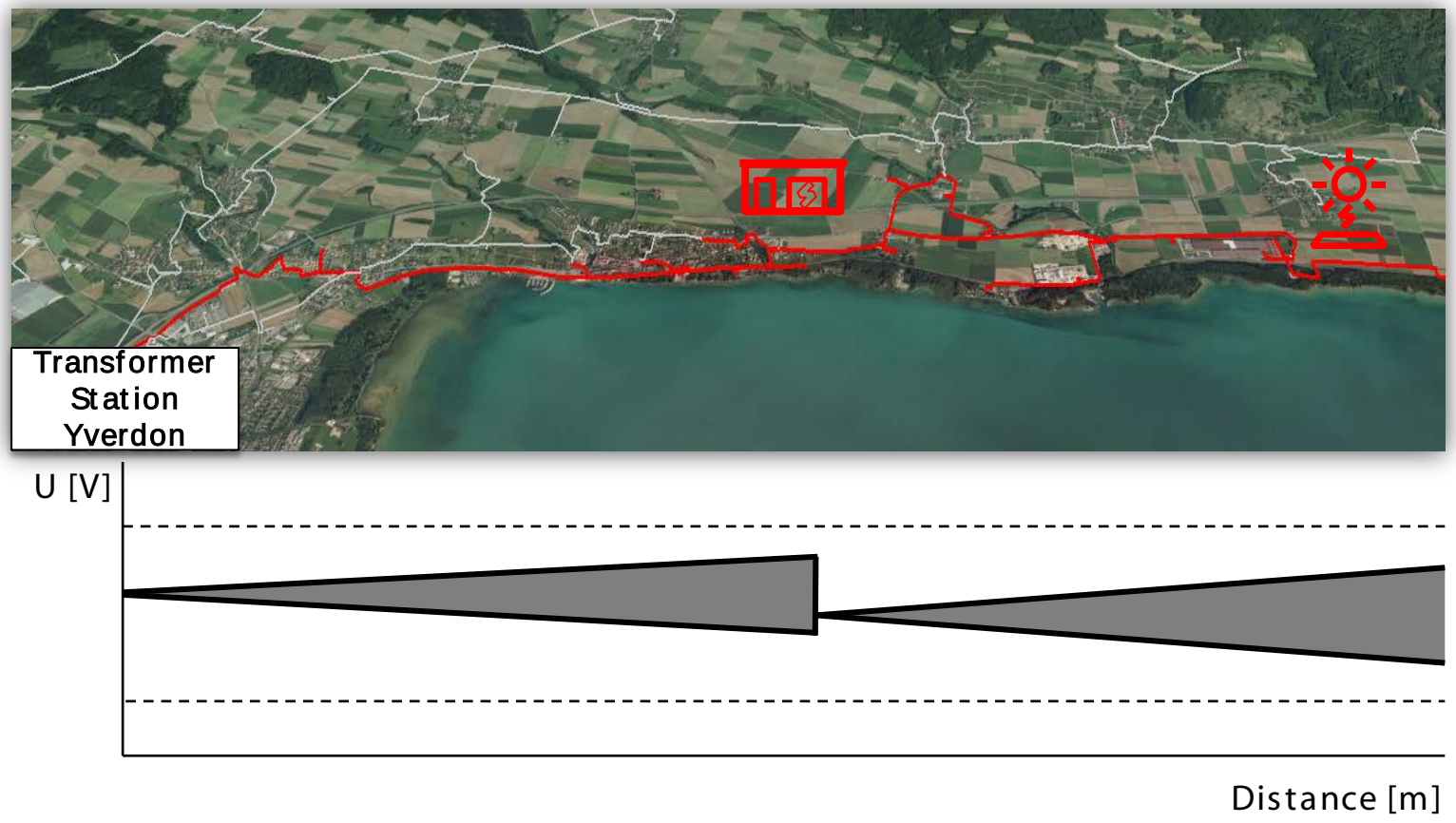
# Specific Grid Situation at Romande Energy

## Large roof mount PV spot causes voltage fluctuation above the limits

### Results of criteria evaluation by ABB Customer

- LVR is able to transmit electrical power up to 14 MVA by creating a new reference point for the electrical voltage
- The LVR significantly increases the connection capacity of generation power
- For a direct comparison with a technically equivalent effect caused by expanding the medium voltage grid, the capital investment for new electricity lines exceeds by far the capital expenditure for the LVR

**LVR is flexible and by far the most economical solution**



# Operation of a MV-LVR

"Without LVR, the voltage at the end of the line would increase significantly"

- The project was realized within 4 month
- This LVR is in operation since May 2017 and solved the problem
- Set-point value for the voltage is U=20.5 kV
- The LVR output voltage stays constantly within a voltage range of +/ -1.5%
- The selected "stepping time delay" of 60 s did appear so far as being an appropriate value.
- If required, the delay can be adjusted to 10 s or less.


Bruno Gravel and Julien Maret in front of the first Swiss Medium-Voltage Line Voltage Regulator

# Summary

The LVR…

…controls voltage rise or drop

…allows to feed additional decentral power into existing grids

…available for applications up to 14 MVA

…is often the better economic solution than grid extension

…doesn't influence the protection system

…can be realized fast

…makes existing grids flexible for infeed of decentral generation in most economical way