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Renewable integration
Distribution Automation Systems

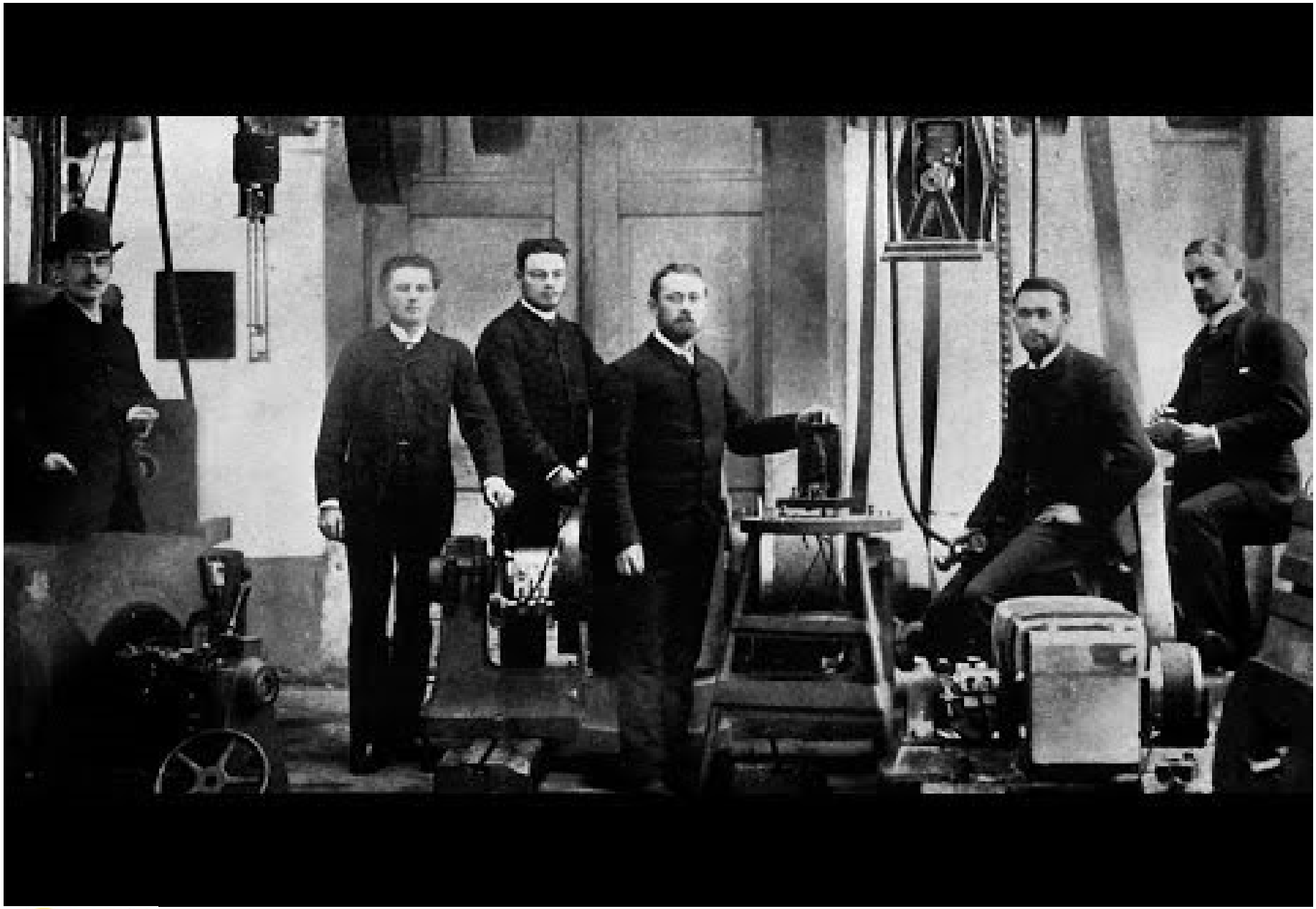
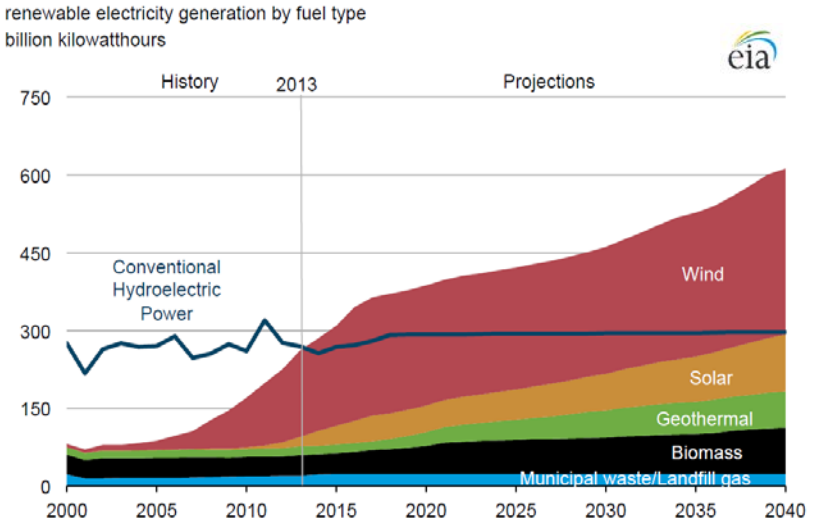


ABB is active in Azerbaijan since 1995

Renewable integration
Main trends and challenges

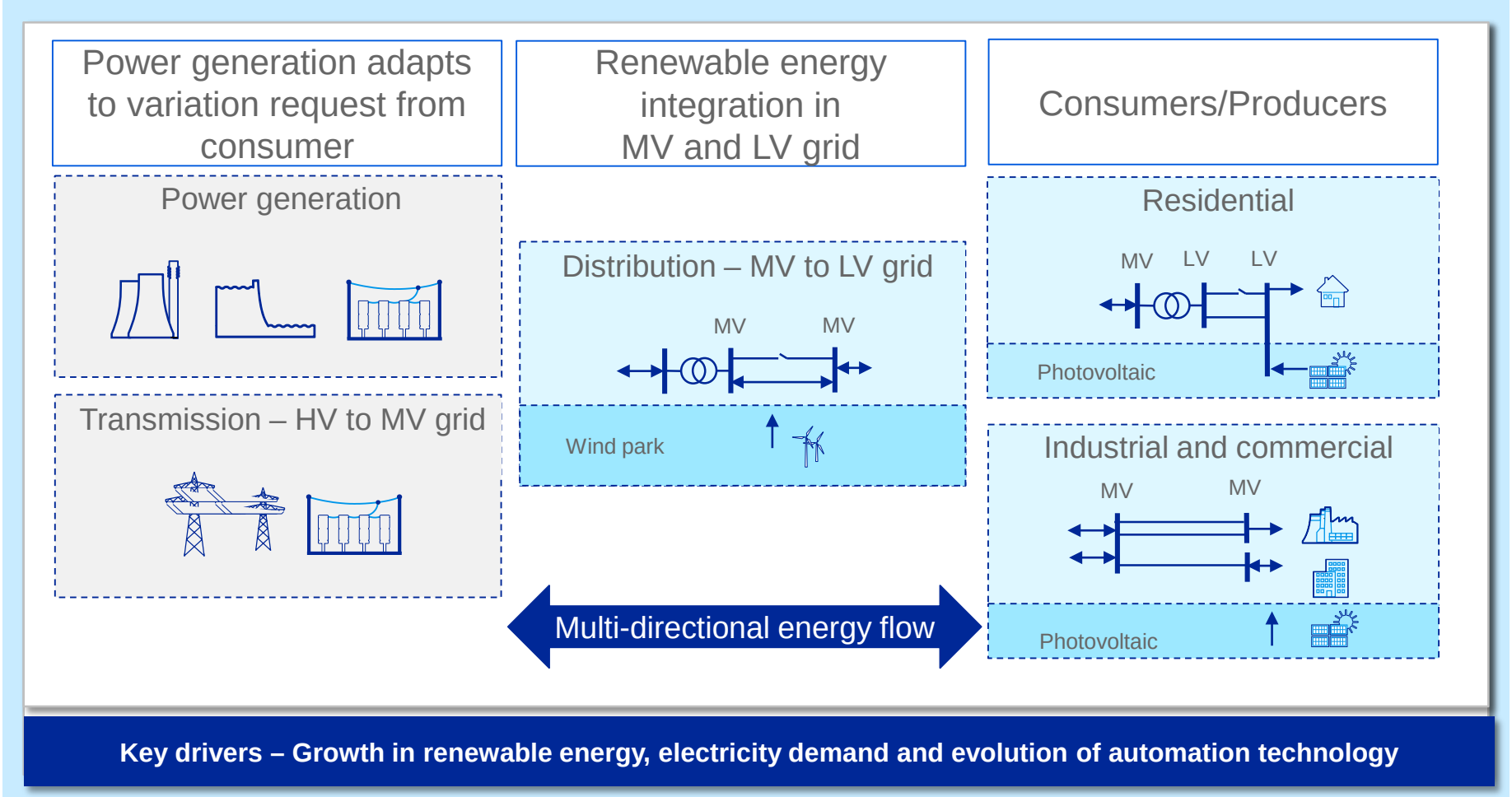
Trends and challenges

- Non-hydro renewable generation grows to **double** hydropower generation by 2040
- 25% of power generation from renewables by 2018
- **Integration in MV and LV grid**
- Growing need for green **energy generation** and **distribution automation** to serve new infrastructure and electricity consumers
- **New automation solution required for energy management and energy storage**



Source: U.S. Energy Information Administration (EIA) Annual Energy Outlook 2015 and 2016

Renewable integration
From traditional towards future power grids



Renewable integration

Renewables bring new challenges and opportunities

Market integration

- High costs for new investments
- Increasing competition on the distribution market
- Utilities are forced to work more efficiently than ever

System-wide generation

- Time intensive in terms of expansion of lines and power transformers
- Intermittent generation
  - Seasonal and intra-day variability
  - Day/night cycles (solar)
- Need to offer all-time reliable and highest-quality power (harmonics, flicker etc.)

Local connection to the grid

- Grid operation and safety
  - Voltage profile
  - Reverse power flow
  - Grid capacity constraints
- Need for economical solution able to increase grid capacity
- Governmental regulations

Renewable integration

Governmental regulation - Guideline to regulate infeed differs per country

Guideline to regulate the infeed

- Different technical requirements were specified for:
  - voltage level of connection point
  - installed power of the plant
  - communication, measurement and control requirements
- Specifications can be met by:
  - digital commands and signals
  - control with the aid of analogue measured values and set points
- **General trend to improve regulations**
  - **higher requirements on Q/V control, PQ curve and Fault Ride Through capability**

*Renewable plants > 100 kW

- Reduce the infeed remotely at any time in the event of imminent system overload
- And retrieve the respective actual infeed

*Solar plants between 30 and 100 kW

- Reduce the infeed remotely at any time in the event of imminent system overload

*Solar plants < 30 kW

- Reduce the feed-in power in the event of imminent system overload or
- Limit the maximum P feed-in to 70% of the installed power

Source: * - German Renewable Energies Act (EEG), Legal requirements of EEG, 2014

Distribution Automation offering
Introduction

Complete and coherent solution from automation, electrical distribution to grid connection

Service team to support training, planning, engineering, project, commissioning and maintenance

Distribution Automation turnkey projects

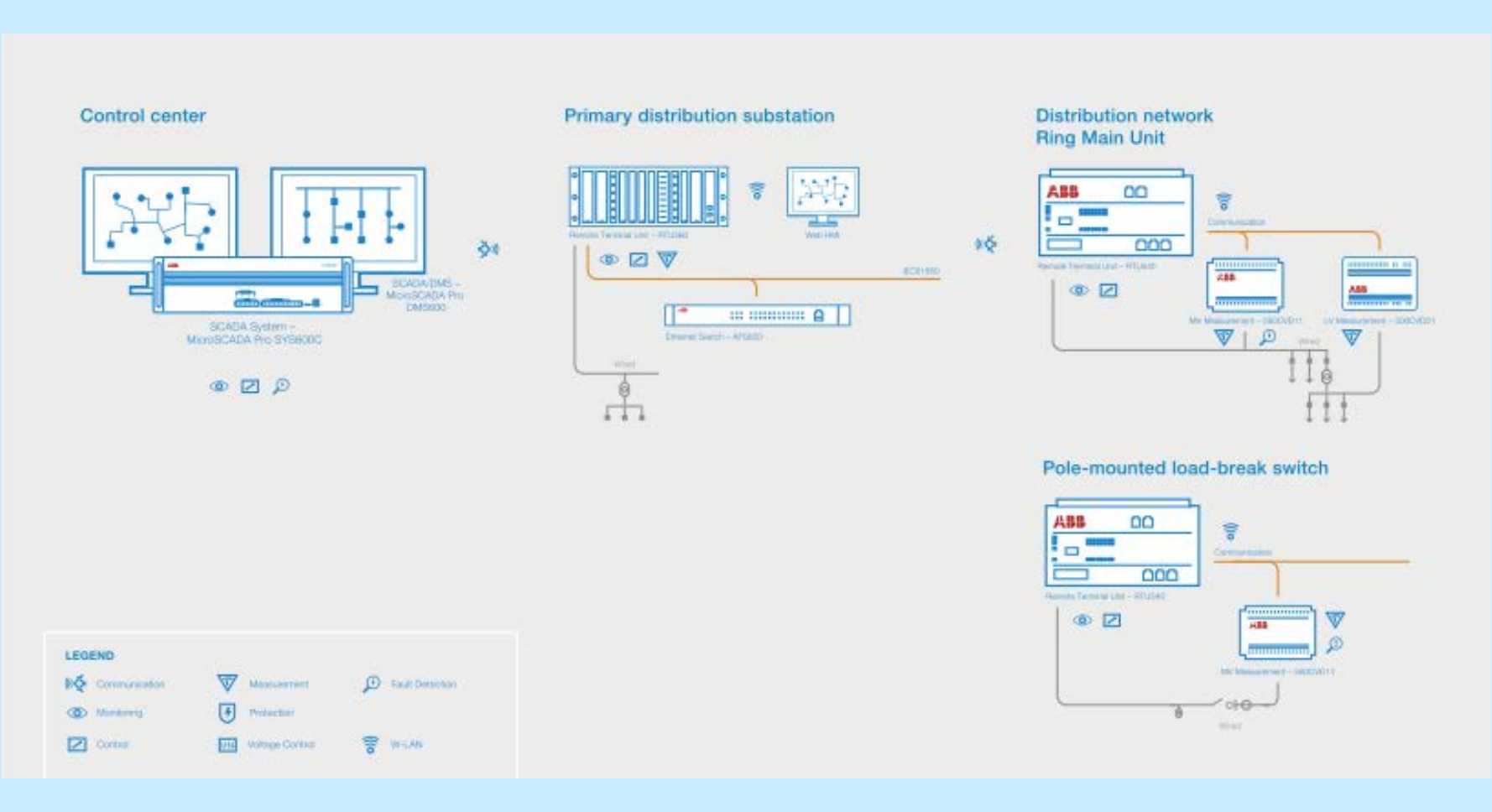
All the essential distribution automation elements from high voltage to low voltage exist to meet the challenges

Primary, secondary and communication equipment packaged together and factory tested

ABB products

Engineered packages

Distribution Automation offering
Remote Monitoring, Control and Measurement



Flexible and ready to use solution

Seamless integration of renewables in a higher control system

Reference

Stadtwerke Lindau, Kraftwerke Mainz – Wiesbaden, RWW and MVV, Germany

Customer challenge

- Monitoring and control of renewable sources
- Secured communications

ABB solution

- Engineered packages with GPRS communication and connection to SCADA

Customer benefit

- Better grid visibility
- Cyber-secured communication
- Scalable and flexible solution

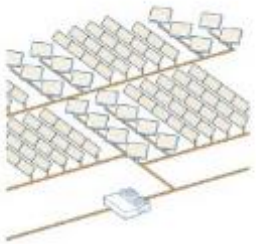
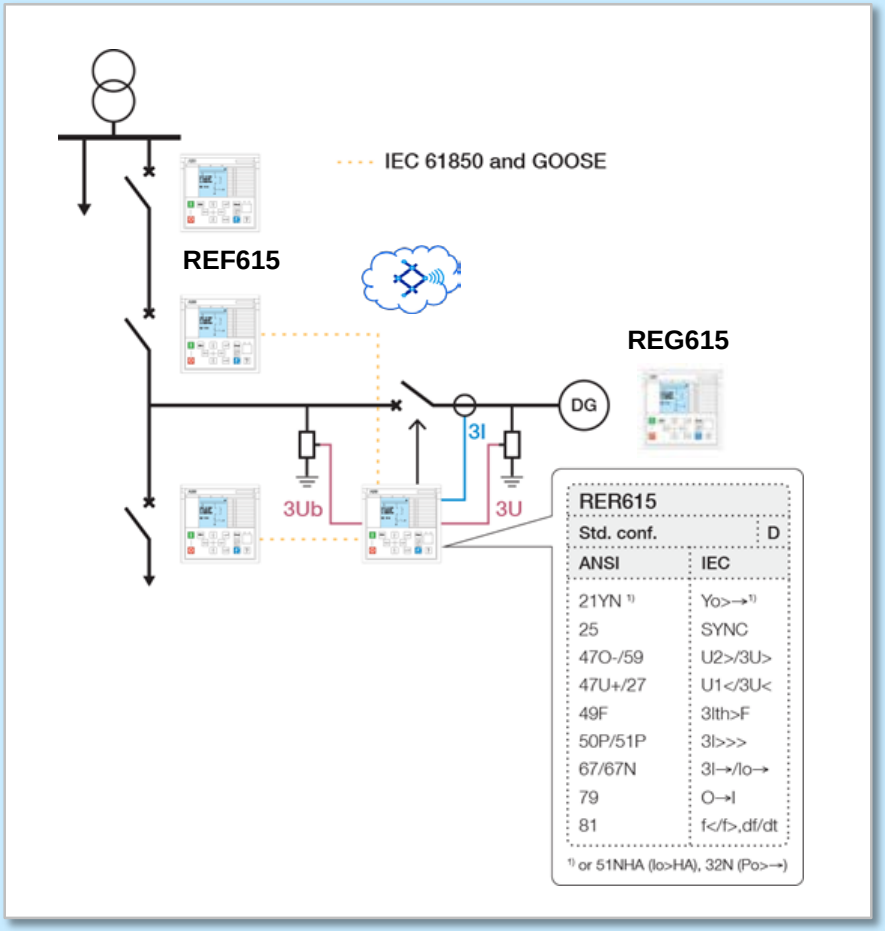


ABB Offering
Remote Monitoring, Control and Protection

System protection

- Protection relays **ensure system protection** with:
  - protection selectivity
  - islanding effect detection
  - reverse power flow detection
  - inrush detection
- **Novel multifrequency admittance protection** algorithm provides
  - **accurate fault detection** and
  - **location of the fault** (DMS/GIS map) **even with renewables feed-in**

Protection selectivity and fault detection enable seamless renewables integration



Sundom Smart Grid - Sustainable energy solutions integration

Enhance reliability of overhead lines with grid automation

Reference

Vaasan Sähkö, Finland

Customer challenge

- Enable integration of renewable sources
- Enhance distribution reliability and efficiency
- Reduce the need for infrastructure investments

ABB solution

- Automatic FDIR with fast reclosing shorten average fault duration and frequency
- Reclosers provide and protection of cable networks from faults in overhead lines

Customer benefit

- Less outages, shorter duration, boosted customers satisfaction and less penalties

Distribution Automation offering
Volt-VAr Management

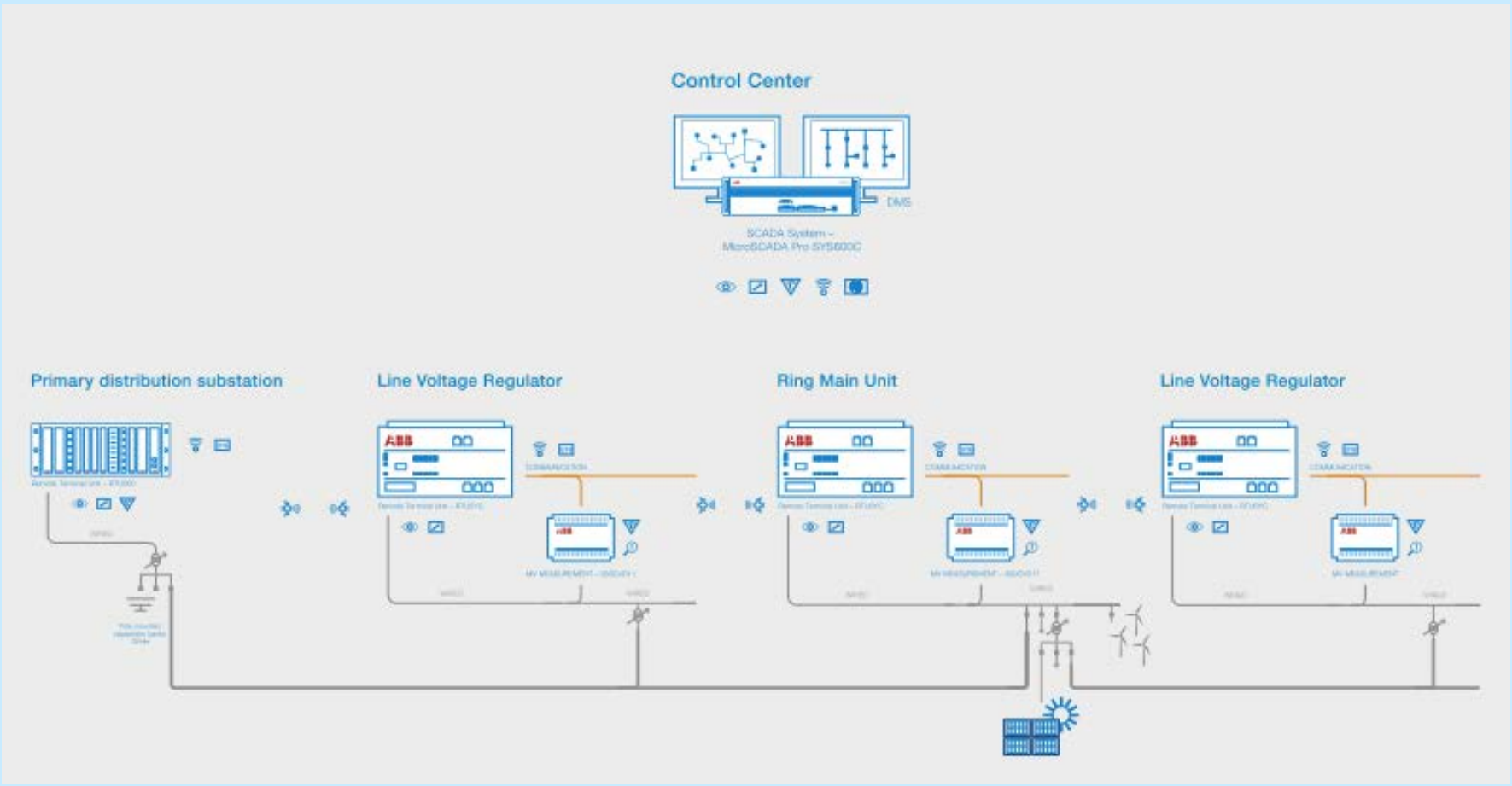
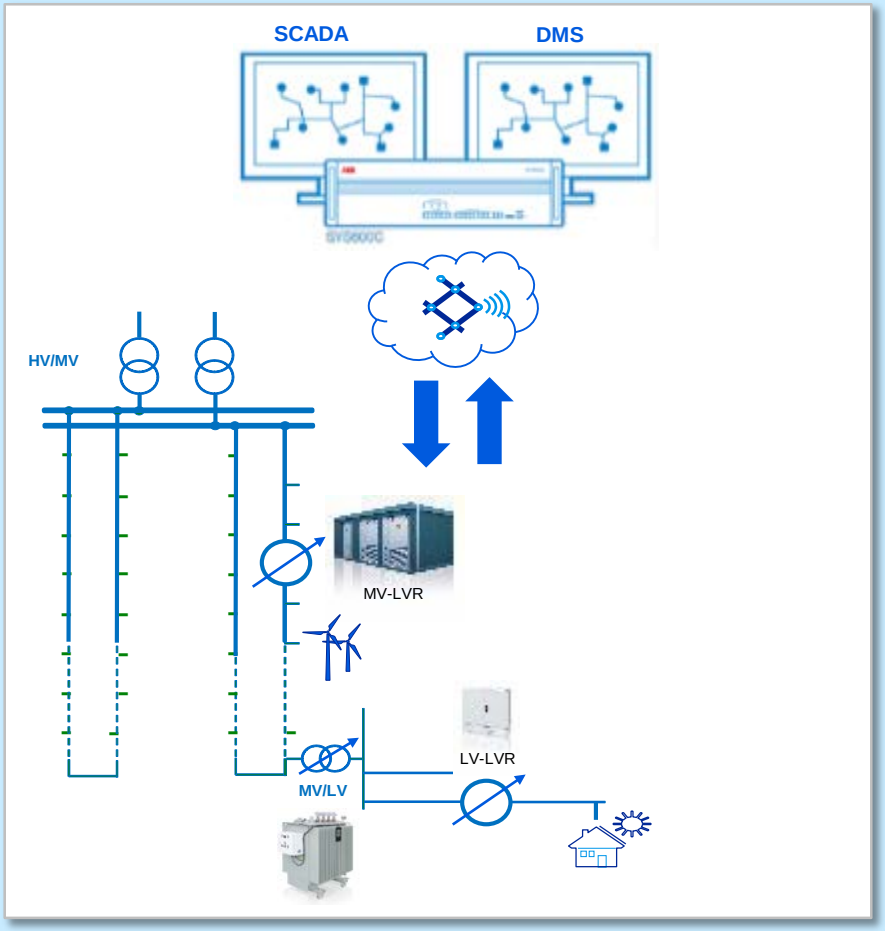


ABB Offering
Active control of voltage and power flows

Volt-VAr control

- 24/7 closed-loop active voltage control algorithm
- Based on network model load flows and sensitivity-based gradient control (changes in voltages respect to controls, sensitivity matrix)
- Instructions to minimize reactive power flows while maintaining voltage limits with:
  - capacitor banks
  - power transformers with tap changer
  - line voltage regulators

Reduce energy losses and improve voltage profile



Thai solar plant harnesses MicroSCADA Pro protection

Energy from sun, delivered by ABB

Reference

Lopburi solar plant in Thailand

Customer challenge

- Amongst the largest installation using thin-film photovoltaic panels

ABB solution

- RTU (Remote Terminal Units)
- MicroSCADA Pro
- Meteorological sensors collect and combine information with the power being generated
- Live updates to the national grid

Customer benefit

- Improve the reliability of the operation and it's efficiency
- Disturbances to be quickly identified

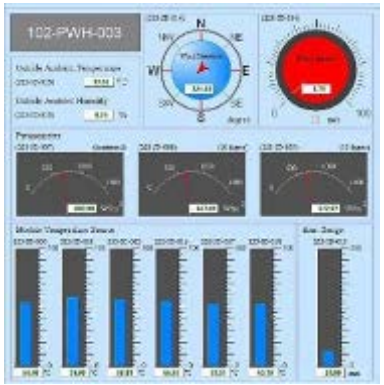
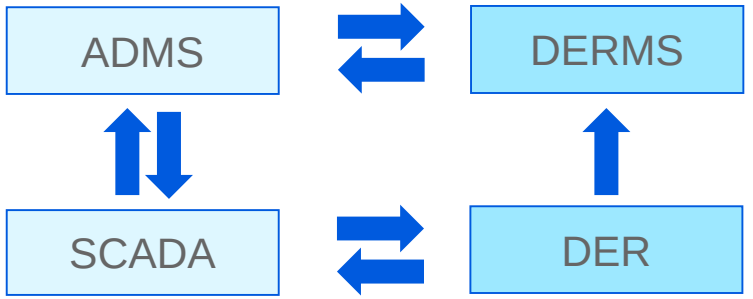


ABB Offering
Advanced DMS and DERMS

Advanced DMS and DERMS

- Real-time monitoring, analysis and control of distributed energy resources (DER)
- DMS can use **load forecast** with **generation forecast** and **generation schedules** from DERMS – Controls can be planned in advance before problems arise
- Predictive Volt-VAr Optimization, as part of DMS, **predict network violations** and helps to find optimal controls to mitigate violations
- DMS can also control **renewable generation** when other controls are not adequate

Maximize DER penetration with predictive voltage control



RiesLing - implementation of an intelligent grid control in the Ries area

Predictive Load Flow based on forecasts of DER‘s

Reference

EnBW ODR and REG, Germany

Customer challenge

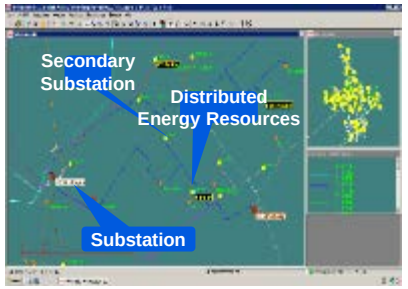
- New challenges caused by high share of distributed energy resources (DER)
- Voltage control and optimization
- Implementation of automation equipment in secondary substations

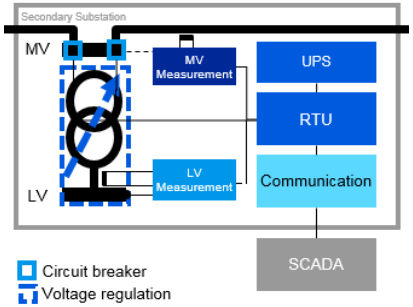
ABB solution

- Equipment for monitoring, voltage control and fault detection
- Predictive Load Flow based on forecasts of DER‘s
- Topology change by remote controllable RMU via MicroSCADA Pro/ DMS600

Customer benefit

- Modular, scalable solutions
- Detection of bottlenecks and voltage problems in advance

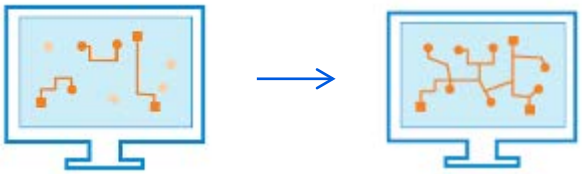




Renewables integration
Benefits

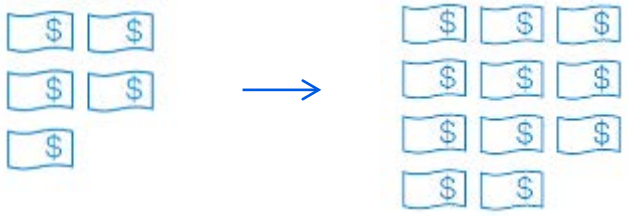
Utility benefits

- Improve system power factor
- Reduce network losses
- Regulate voltage
- Reduced operational and maintenance costs
- Improved reliability
- Increase power availability



Power plant owner benefits

- Increase system capacity
- Decrease downtime
- Generate higher revenue



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