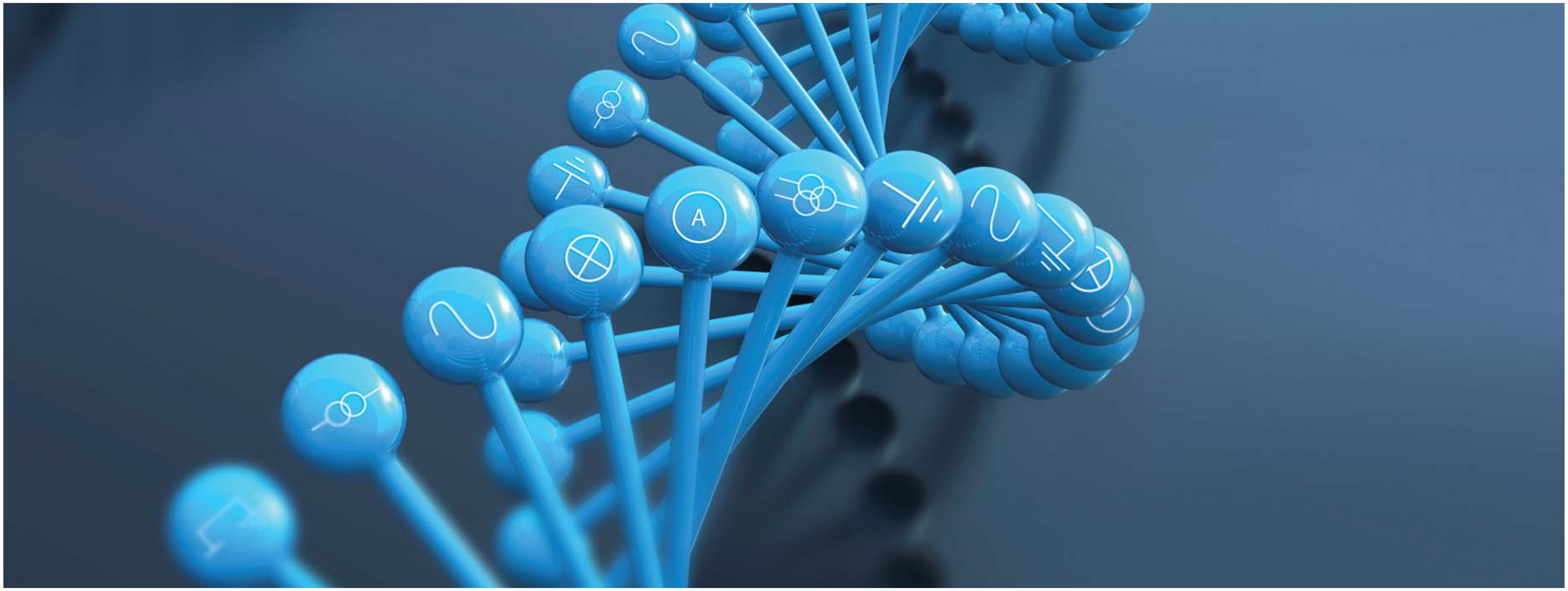


# Smart Design for Smart Grids


Marcel Buckner

October 2018

Powering Business Worldwide


edicated to improving people's
ves and the environment.
Providing power management technologies
that are more reliable, efficient and safe.

# Power for Africa

## Possible Game Changers for Africa

- Hydroelectric power
- Capacity potential of renewable energy such as solar, geothermal and wind
- Gas to power
- Political will and spend
- Growth in consumer demand as population increases
- Advances in technology

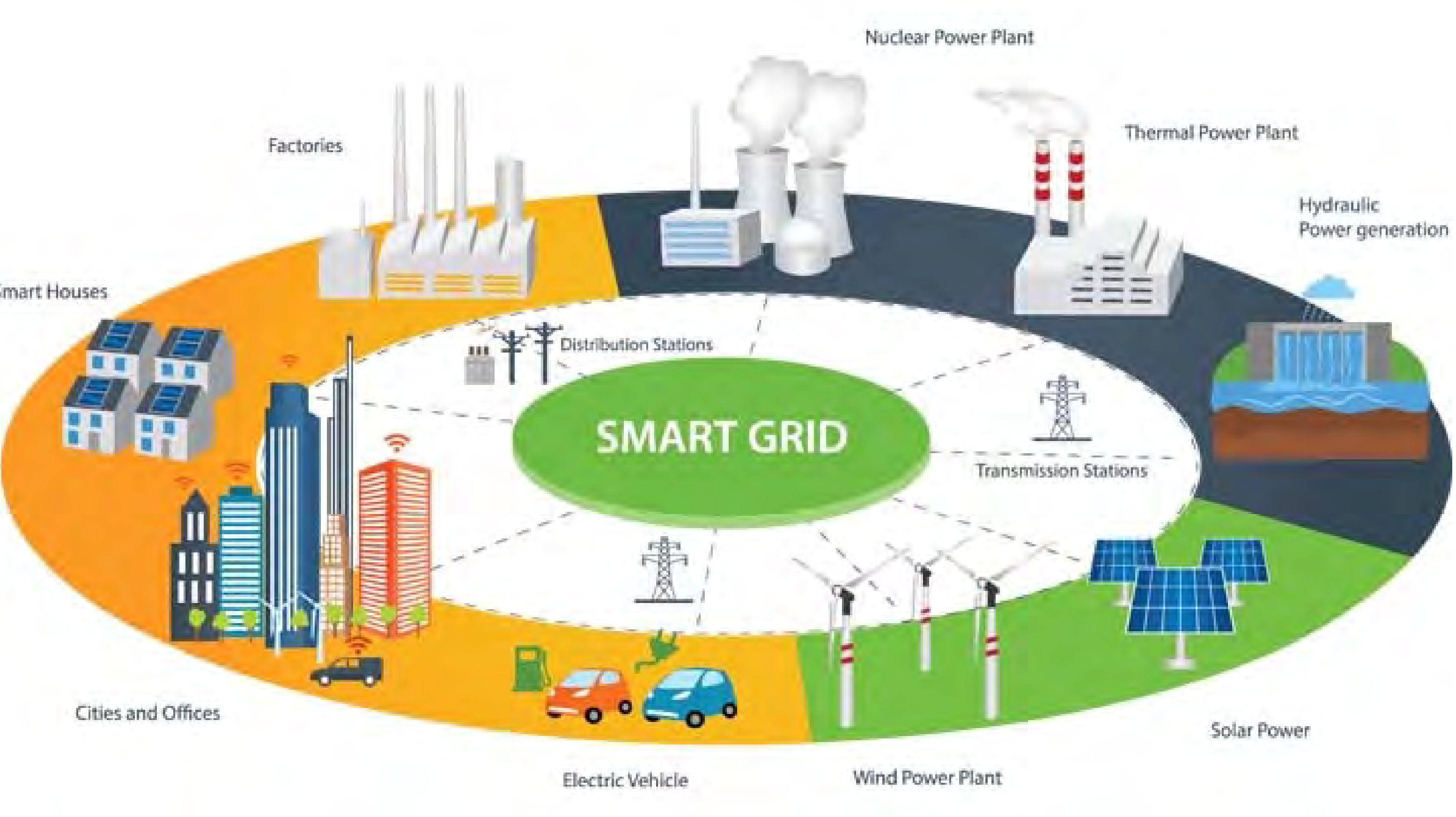
  Internet of Things supporting micro grids

  Africa has opportunity to ‘leapfrog’ traditional developmental milestones

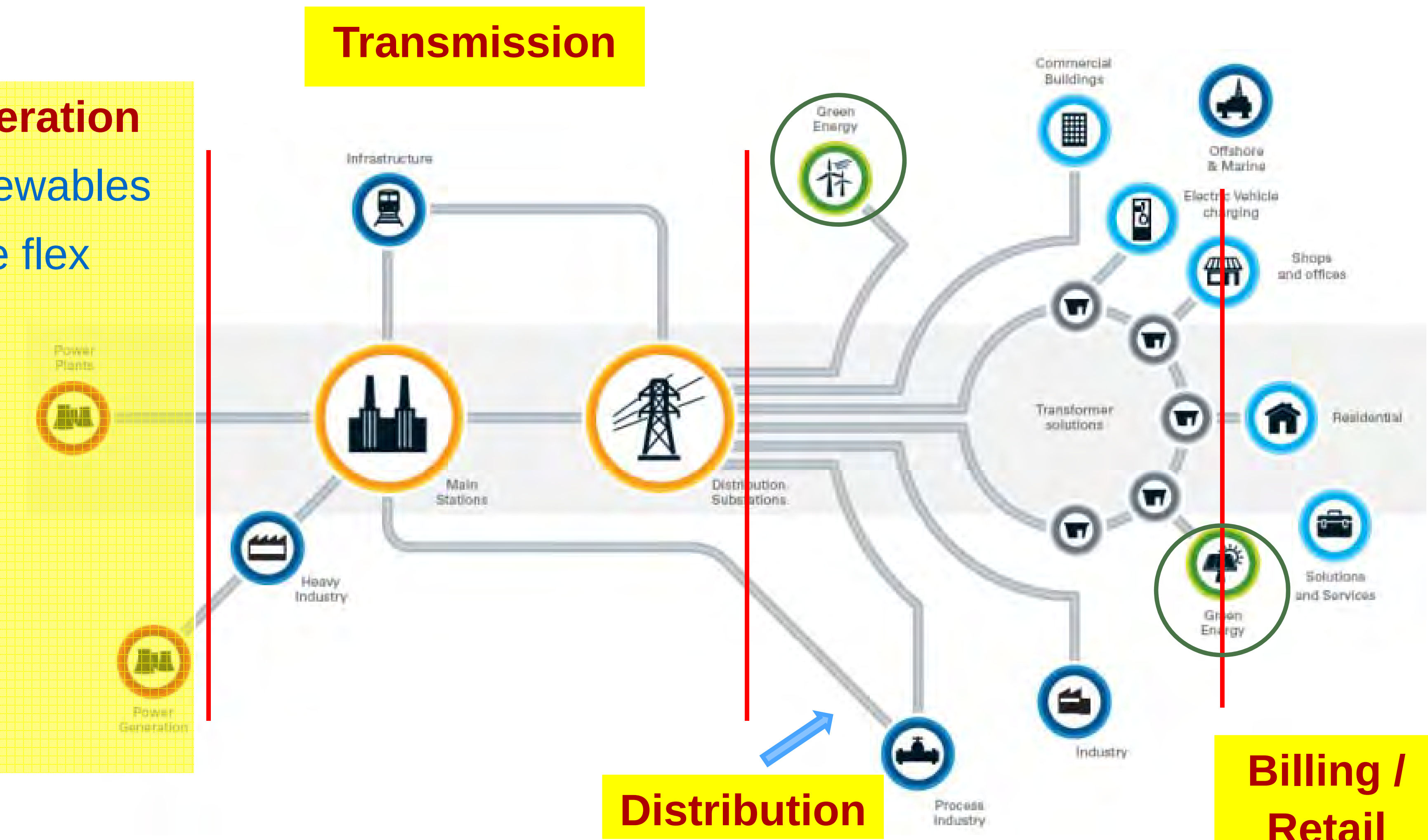
# Key Challenges for Utilities

- Ever increasing public need for **reliable power**
- Aging **infrastructure** leading to high downtime, and/or need for high maintenance
- Distributed, varying renewable power increasing
- **Risk** of cyber (and other) attack / breakdowns
- Lack of skilled labor / aging **workforces**
- **Financial** - How to get paid for energy delivered
- **Financial** – How to fund required investments

# What does a smart grid look like?



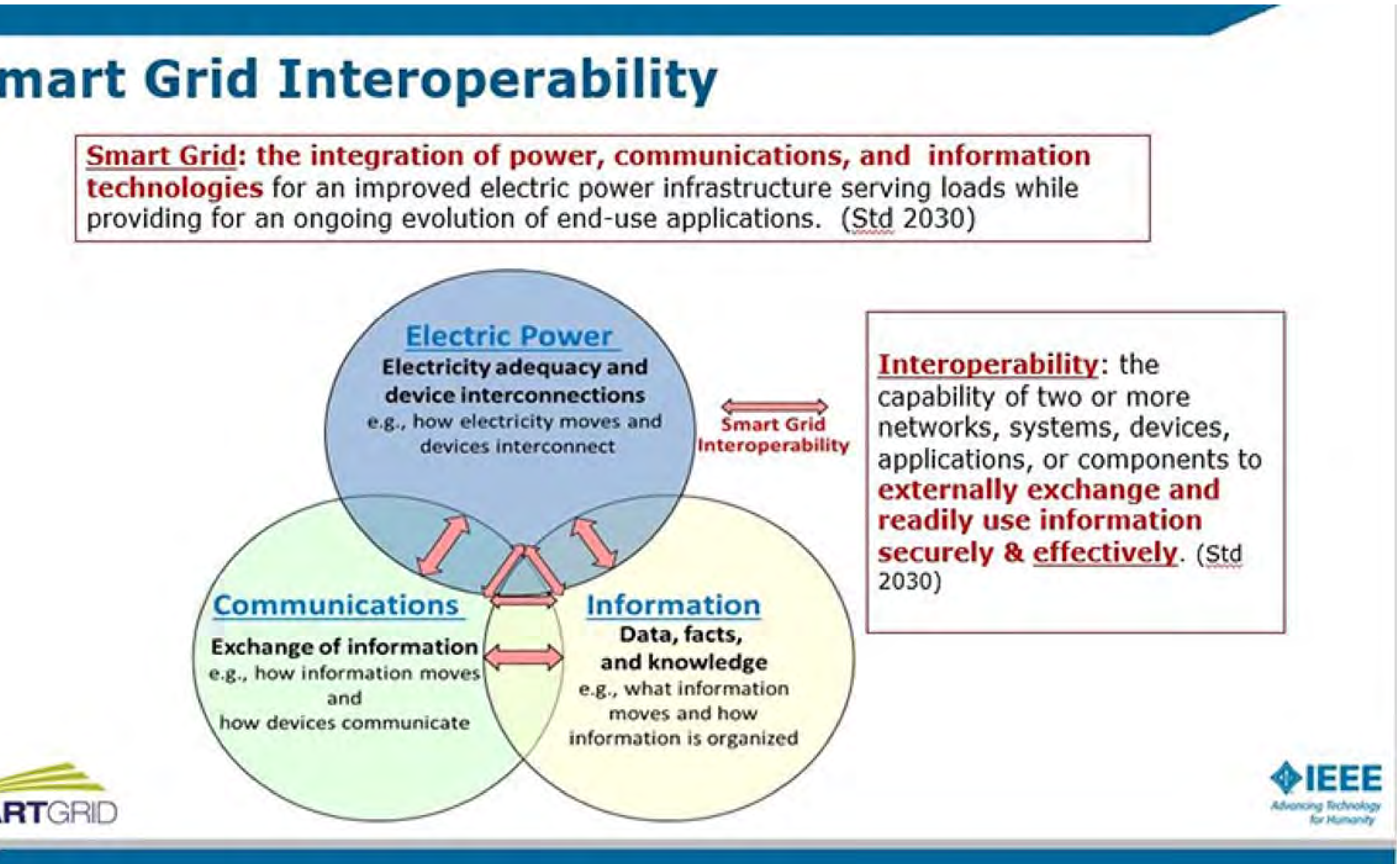
# Utility Grid Construction - tomorrow



# Smart grid characteristics

- Allows for economic growth
- Increase in quality of human life
- Access to real time power-grid information
- Real-time control of electricity spend
- High-load and peak time energy management
- Allows integration of all energy sources into grid, i.e. coal, solar, wind
- Accommodates connection of large numbers of micro grids, widely distributed
- Decentralised power supply
- Bi- and multi-directional directional power generation

# Smart Grid Interoperability



SUCCESS STORY

# Complete electrical supply system
## Stedin Utility, The Netherlands

### Customer challenge

Dutch regional network operator Stedin was faced with a 50-year old infrastructure:

- 2,200 bays of switchgear based on minimum-oil circuit breakers in its HV substations
- 3,200 similarly equipped bays in distribution cabinets.

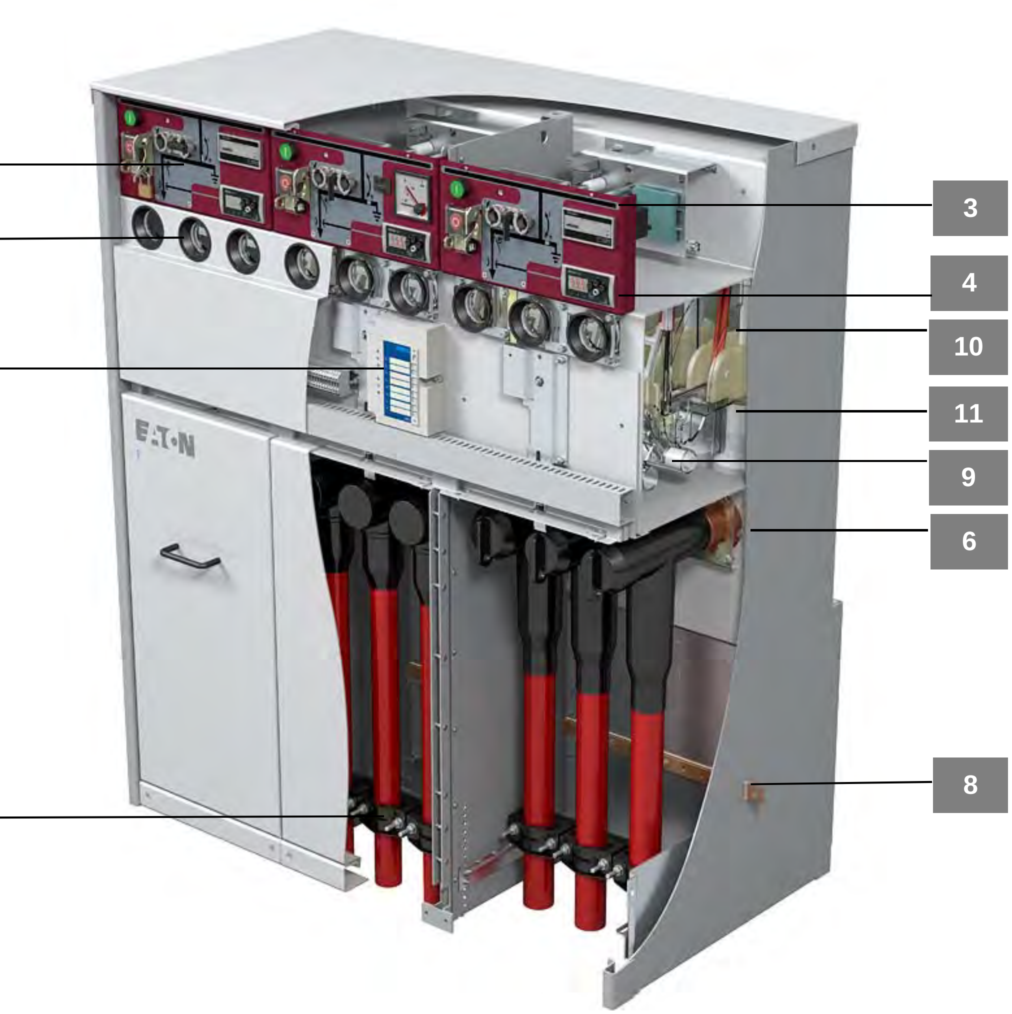
### Eaton solution

Stedin and Eaton devised a two-fold approach to minimize risk and impact on the company’s core business. The switchgear would all be replaced within 20 years. Throughout this period Eaton and Stedin would work together to conserve the old equipment prior to replacement.

### Business outcome

Both Stedin and Eaton are confident that the safety and security of the substations and distribution cabinets that use obsolete breakers can be maintained until the replacement program is completed in 2032.

# Typical RMU – Basic Design-for ring applications *(LBS-CB-LBS)*

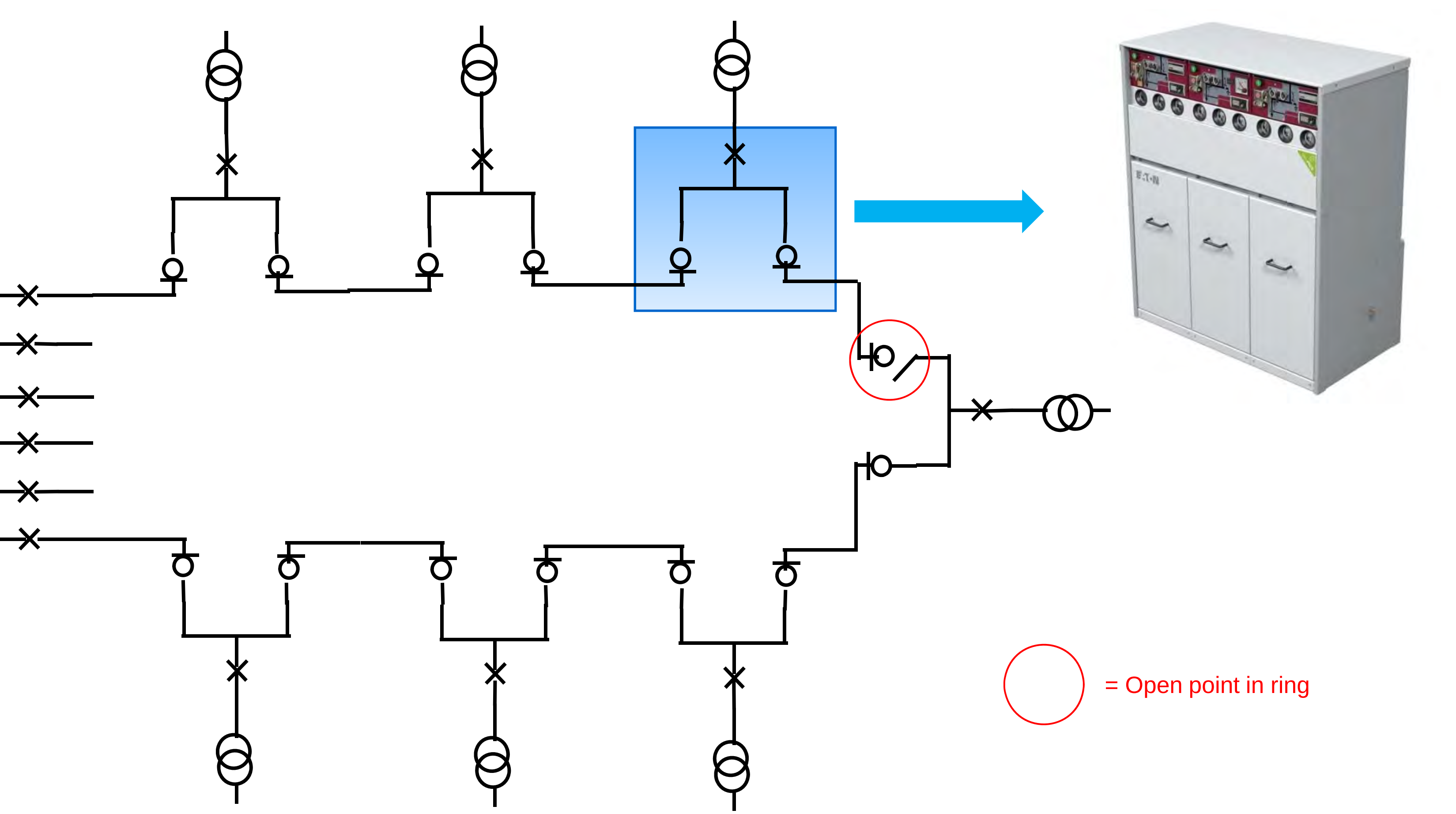



1. Protection relay
2. Control panel
3. Mimic diagram
4. Voltage detection system
5. Inspection window
6. Cable cones
7. Cable clamps
8. Earth bar
9. Busbar
10. Change-over switch
11. Vacuum interrupter

***LBS = Load-break switch***
***CB = Circuit-breaker***

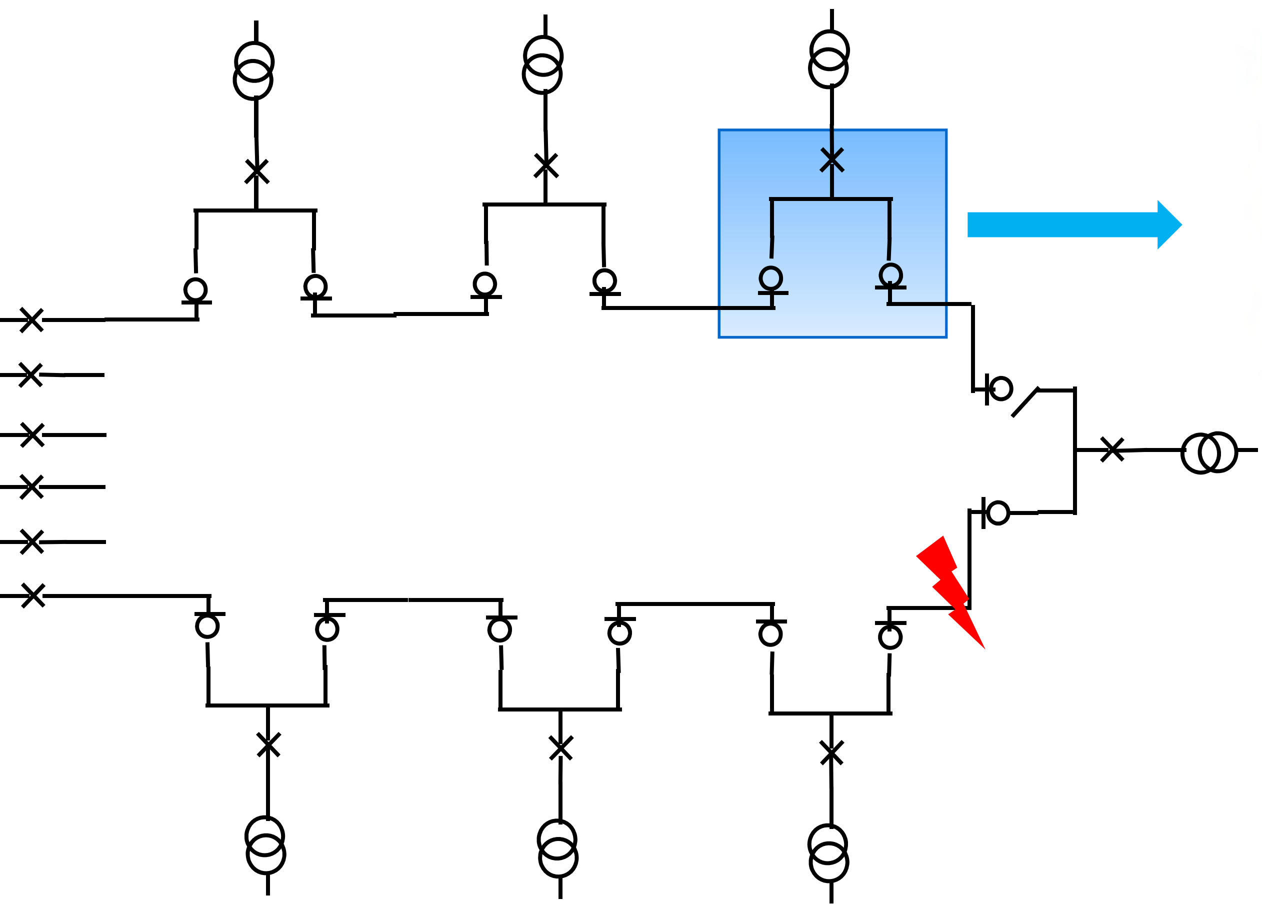
# Typical application of RMU (LBS-CB-LBS)

*Configuration in Distribution Ring*



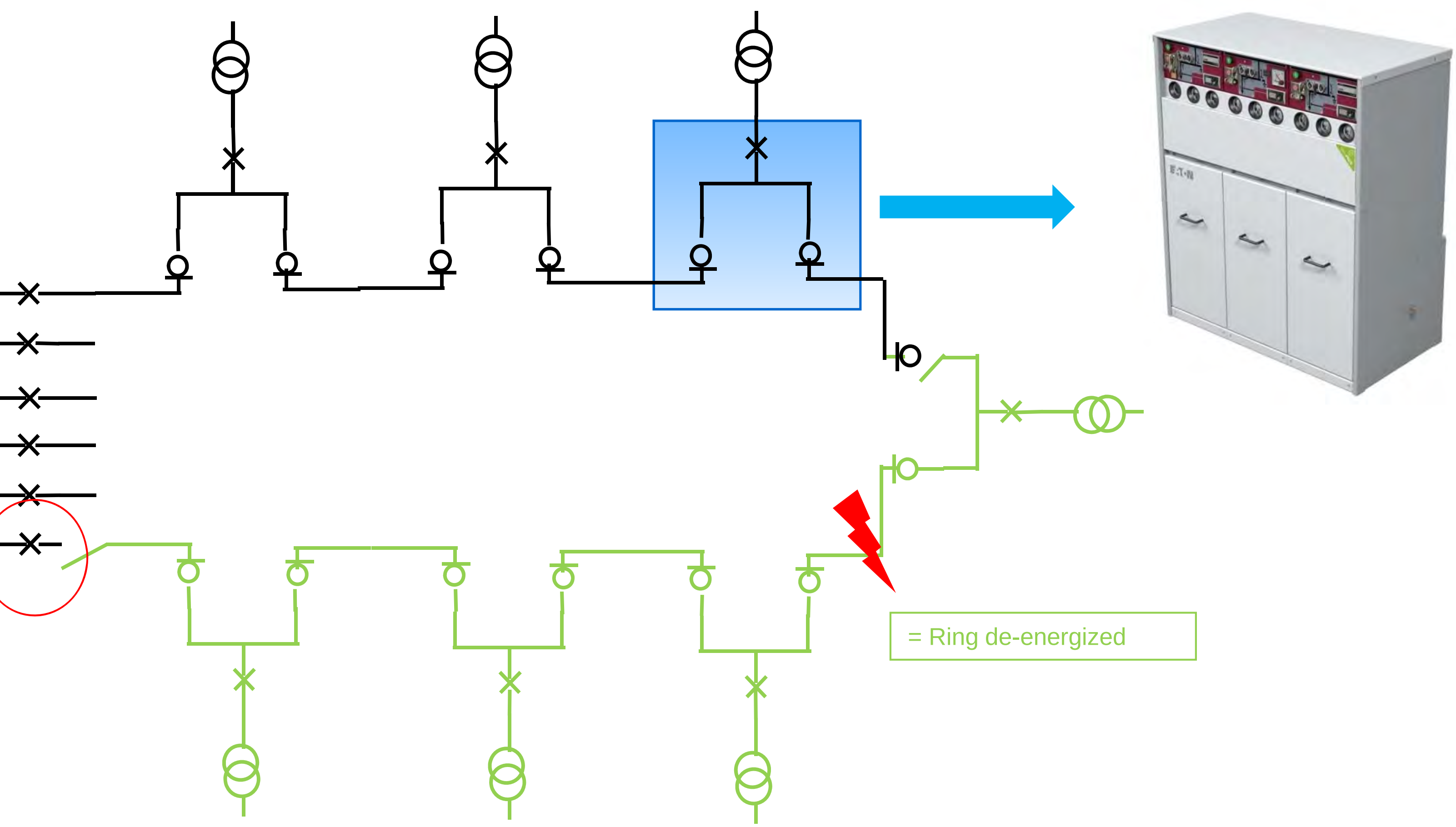
# Typical application of RMU (LBS-CB-LBS)

*Switching behavior – Step 1: Cable fault*



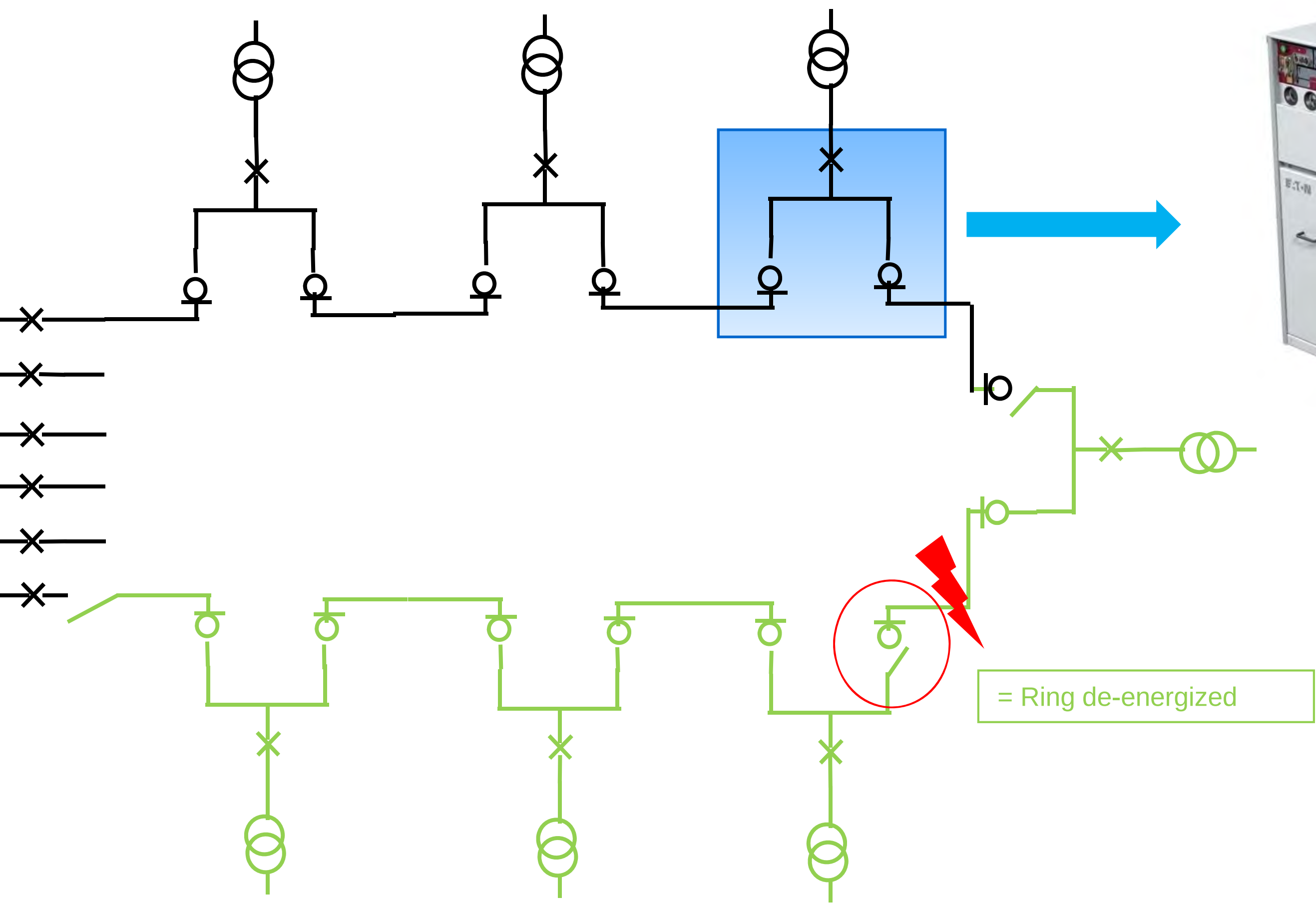
# Typical application of RMU (LBS-CB-LBS)

## *Switching behavior – Step 2: Tripping of Circuit-breaker*



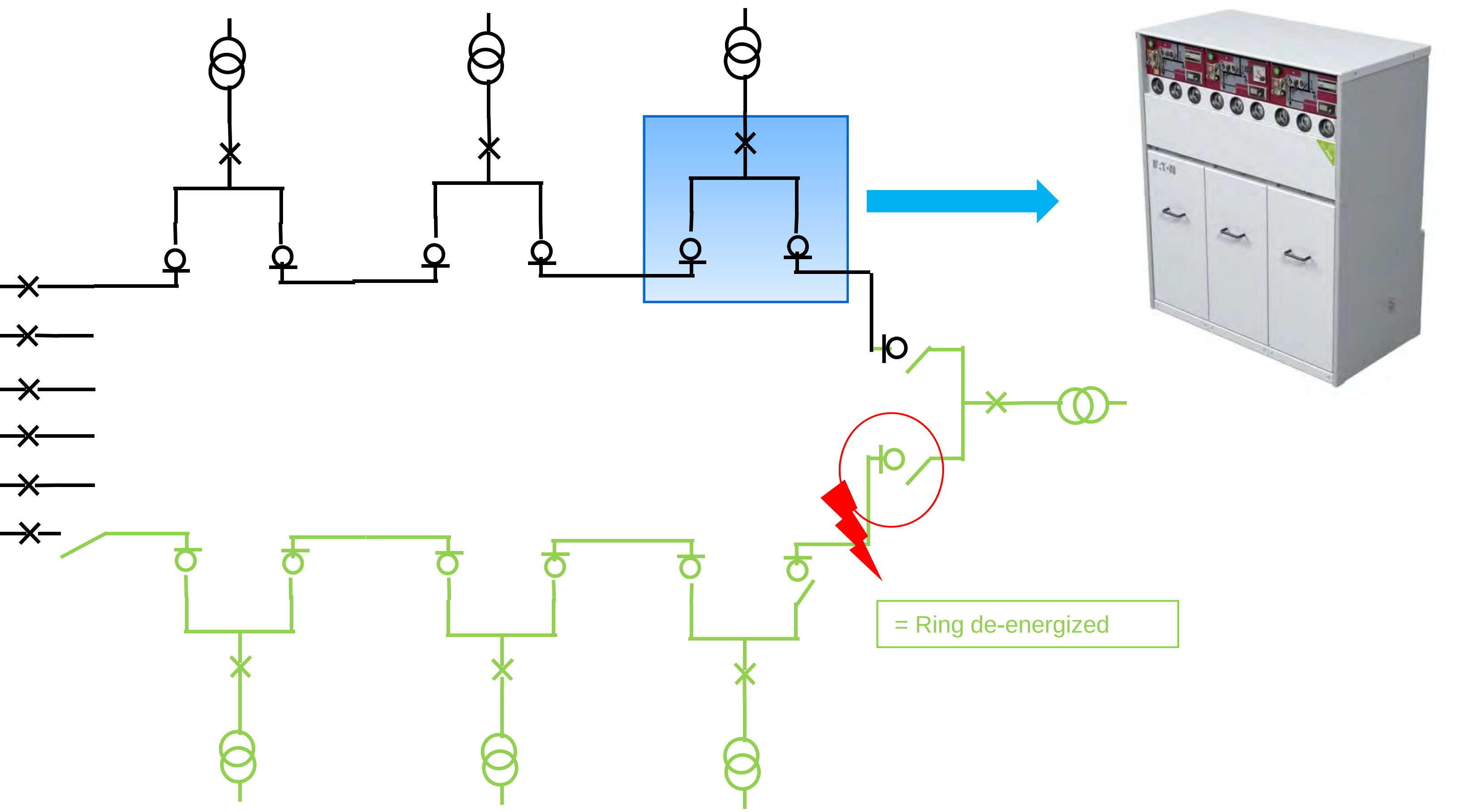
# Typical application of RMU (LBS-CB-LBS)

*Switching behavior – Step 3: Opening of load-break switch*



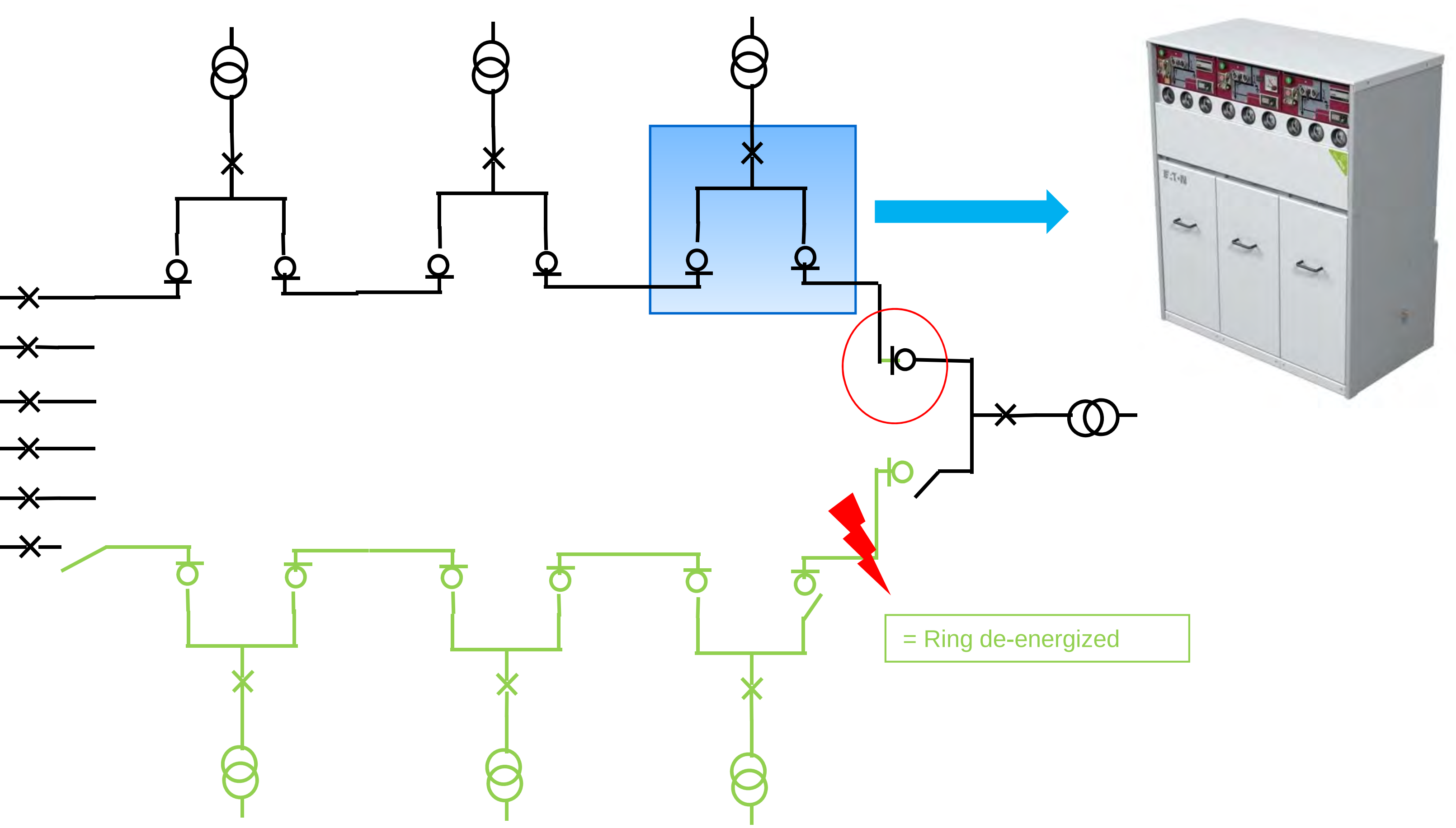

# Typical application of RMU (LBS-CB-LBS)

## *Switching behavior – Step 4: Opening of load-break switch*



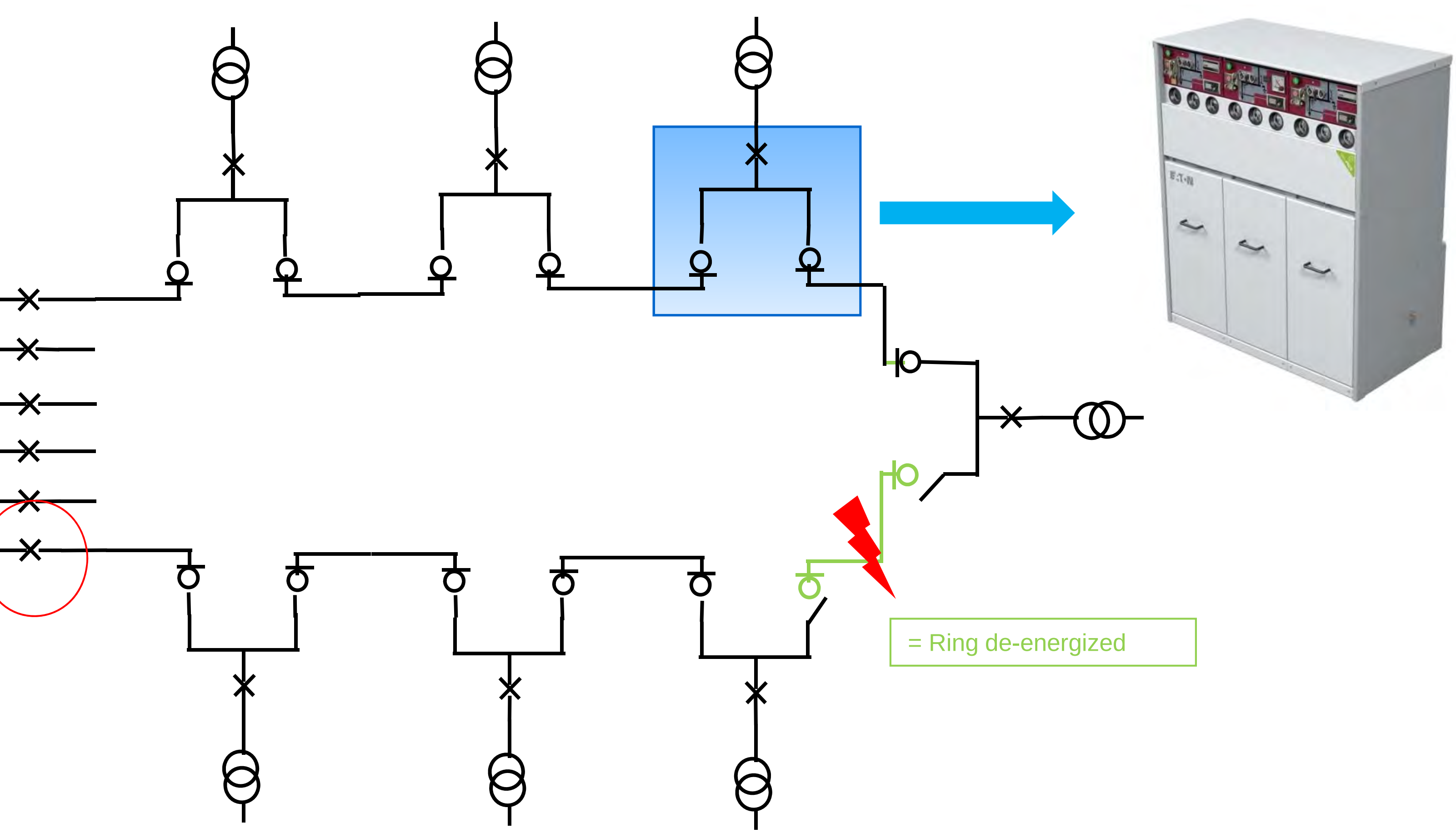
# Typical application of RMU (LBS-CB-LBS)

*Switching behavior – Step 5: Closing of load-break switch*



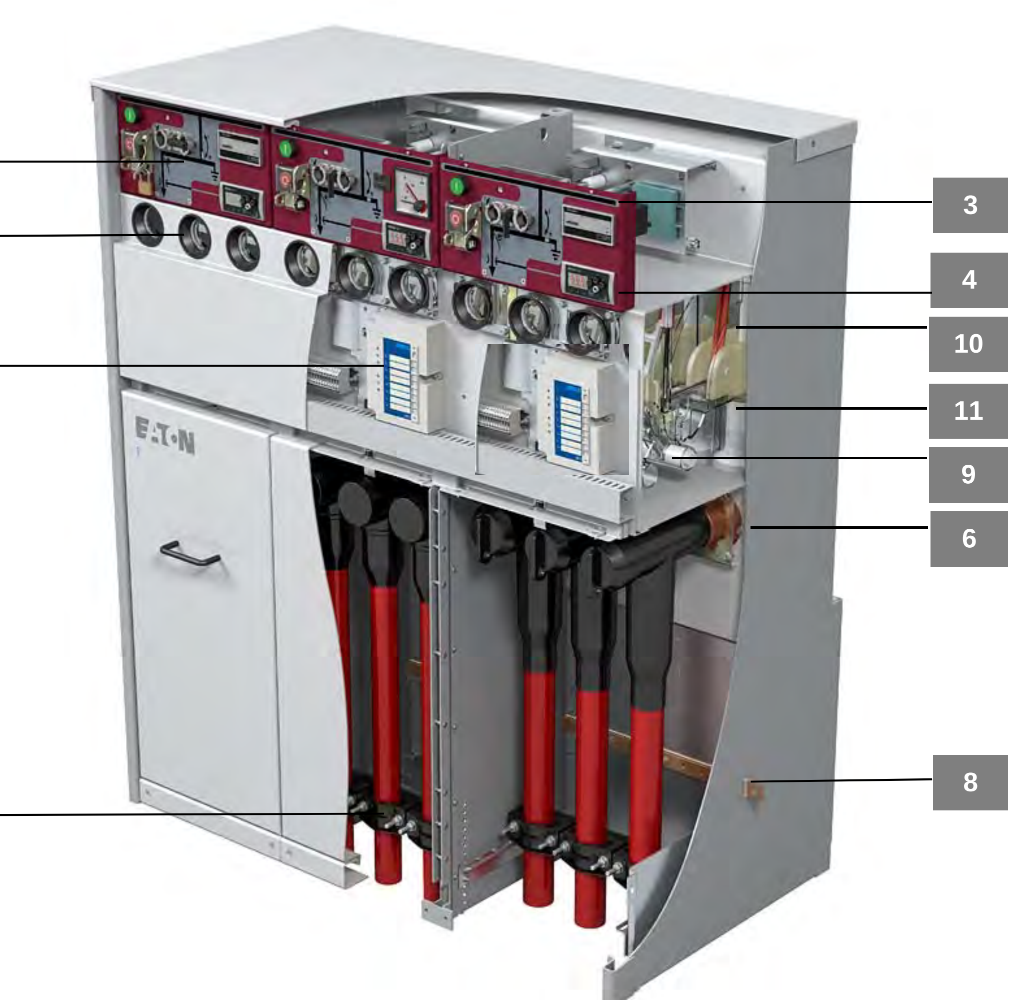
# Typical application of RMU (LBS-CB-LBS)

*Switching behavior – Step 6: Closing of circuit-breaker*



# Modern block version – Smart Design

*CB-CB-CB configuration*

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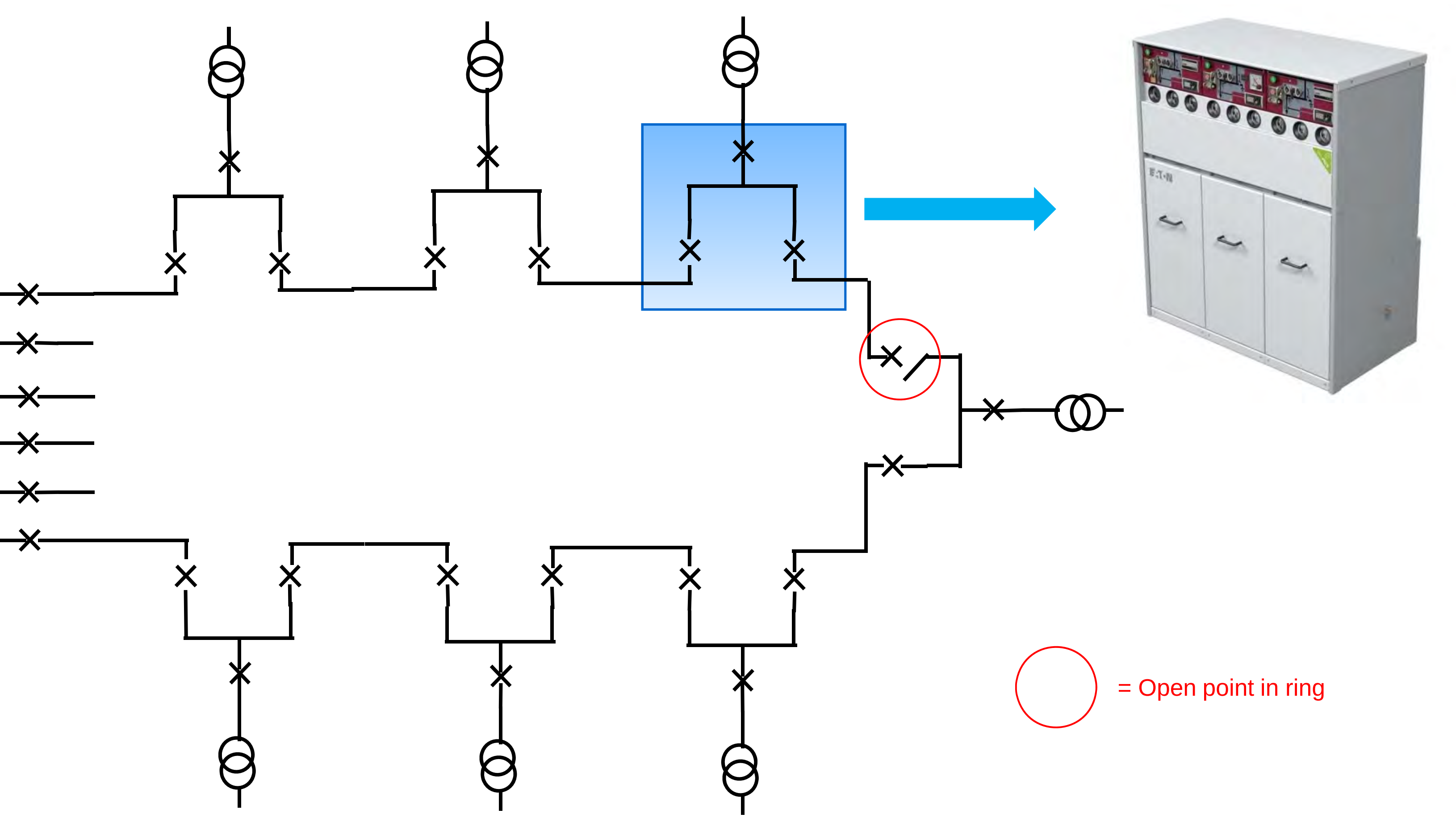
# Modern application of RMU (CB-CB-CB)

*Configuration in Distribution Ring*



# Modern application of RMU (CB-CB-CB)

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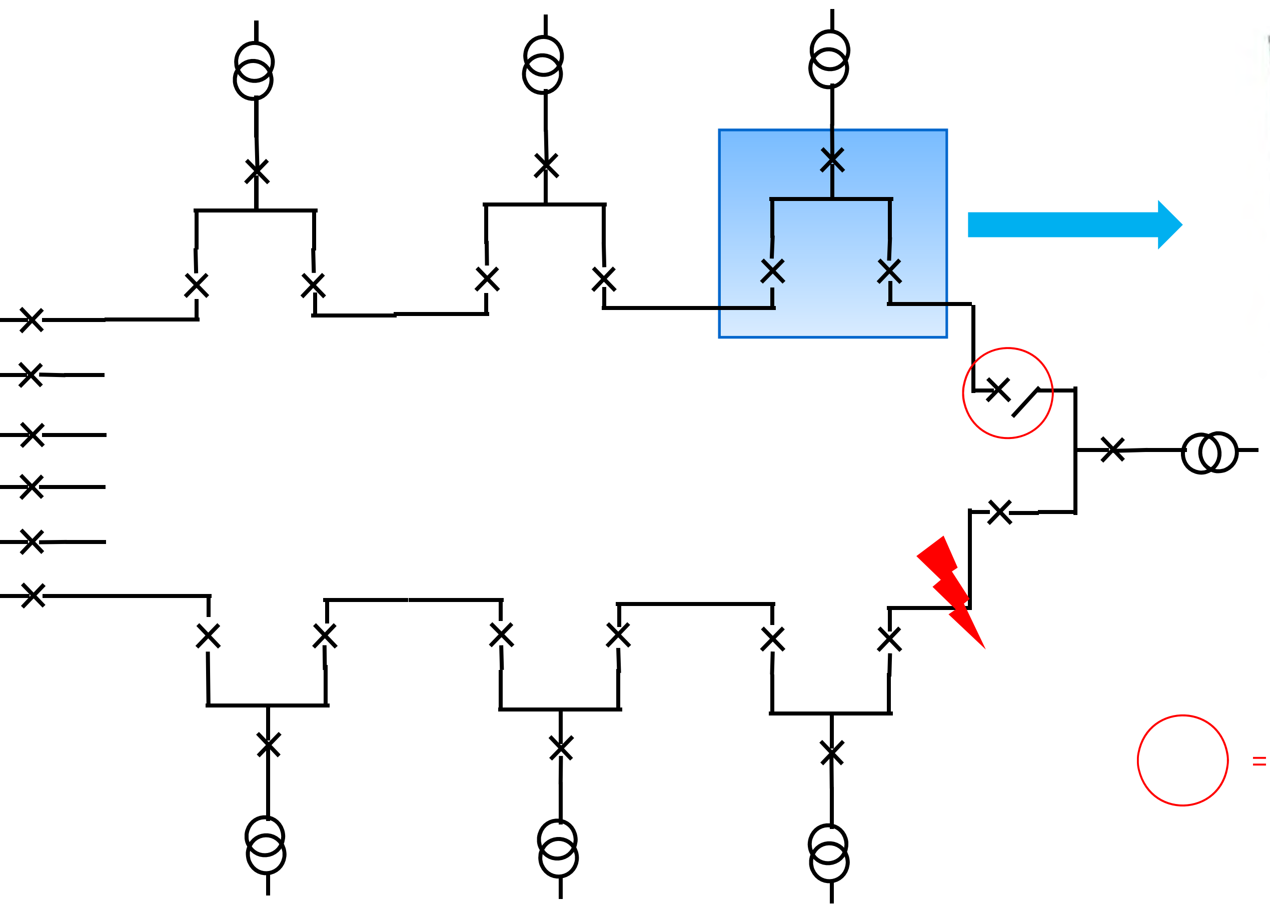
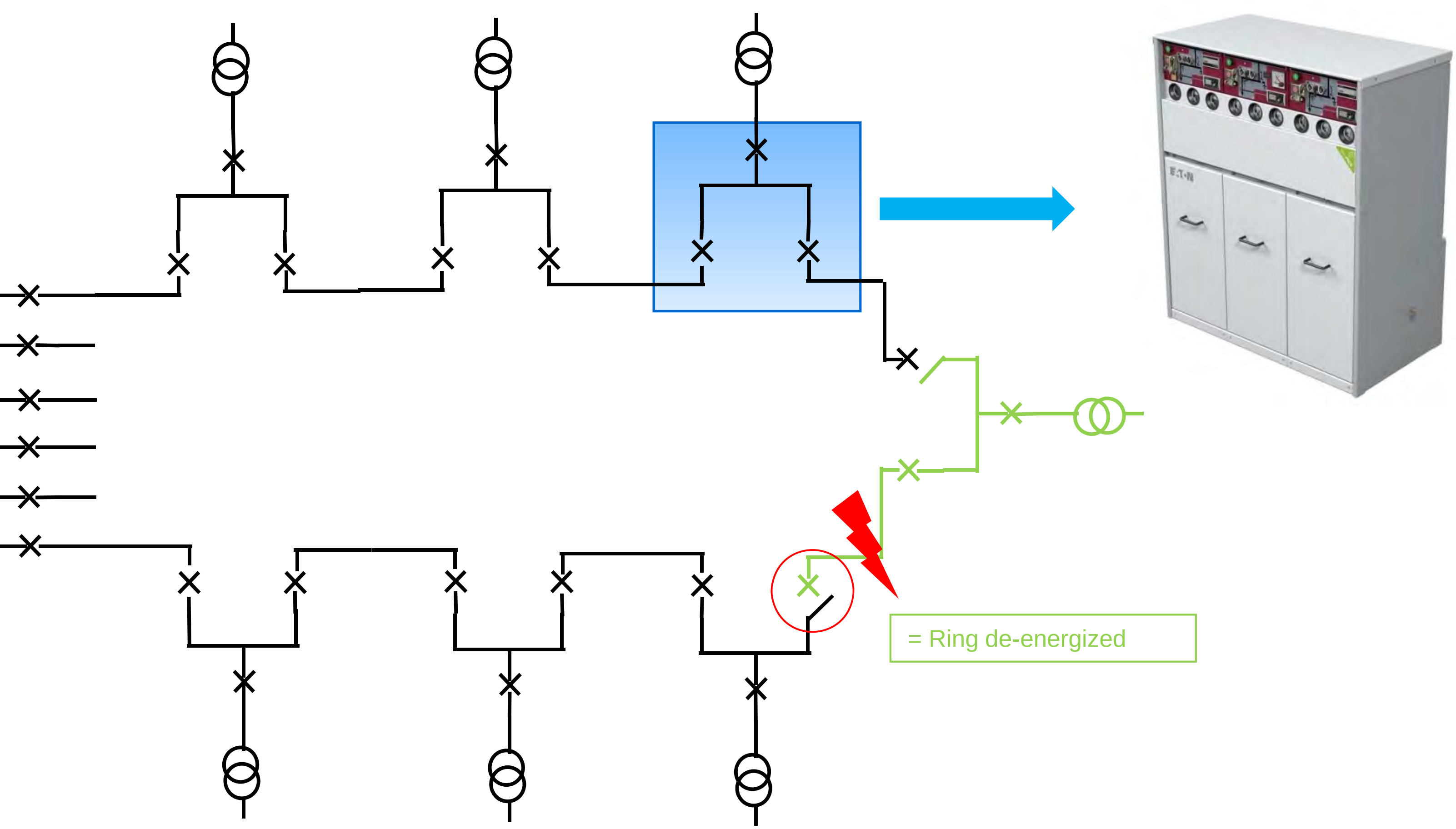


# Modern application of RMU (CB-CB-CB)

*Switching behavior – Step 2: Opening of circuit-breaker*



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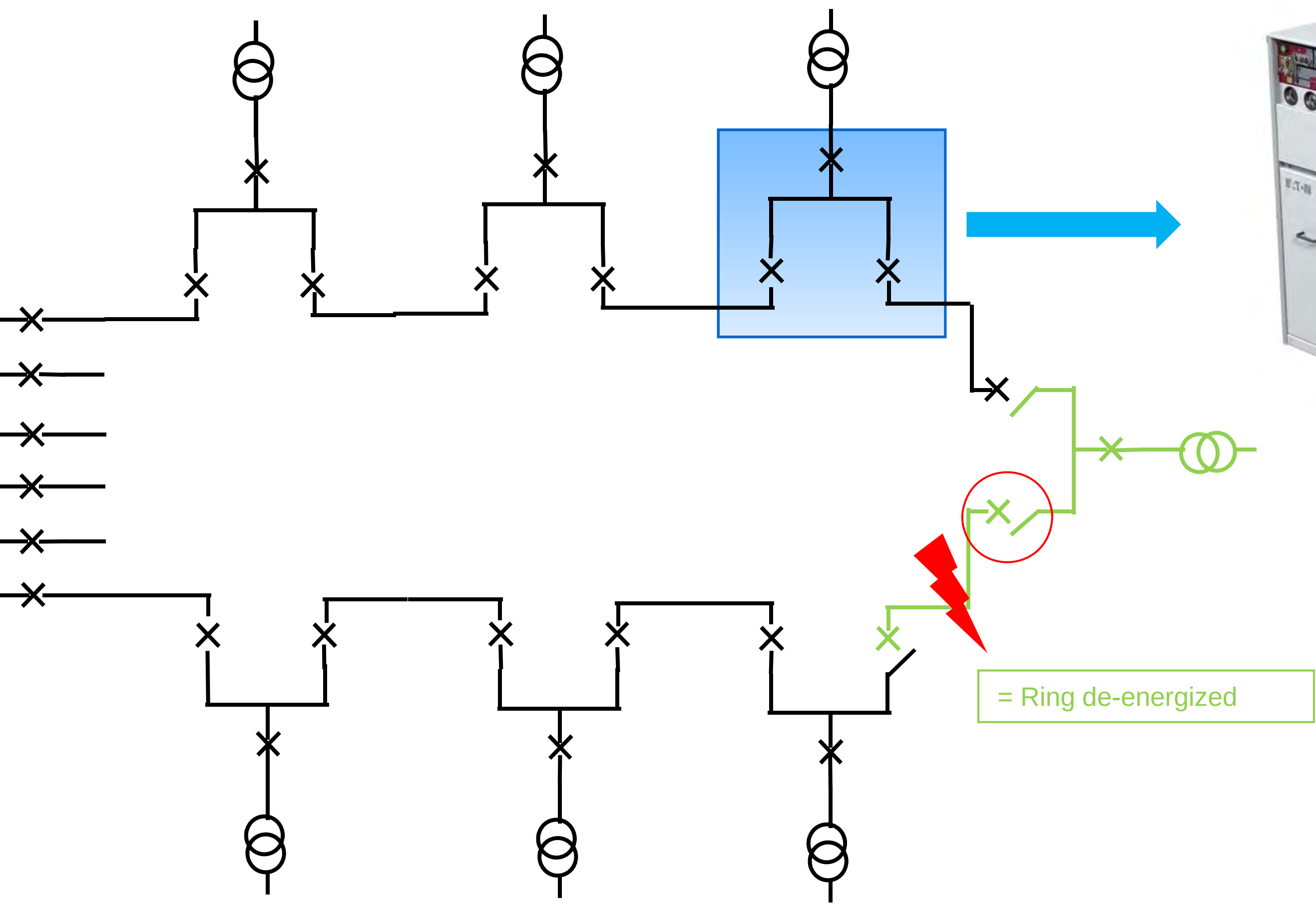
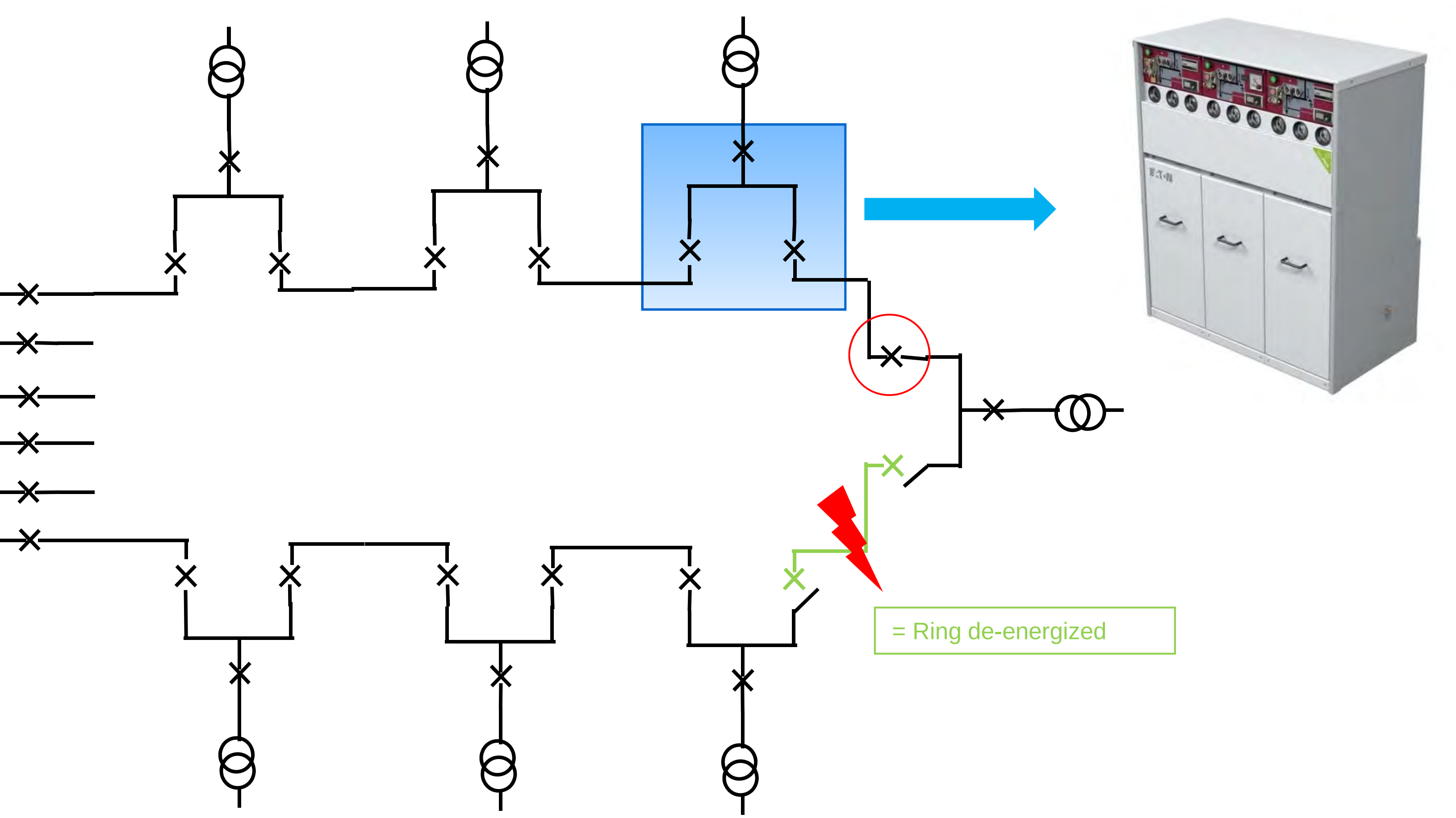



# Modern application of RMU (CB-CB-CB)

*Switching behavior – Step 4: Closing of circuit-breaker*



# ypical LBS-CB-LBS ***vs*** Modern CB-CB-CB

## LBS-CB-LBS

- **Low initial purchase cost**
- **Higher total cost of ownership**
- **Higher downtime**
- **Switching bigger part of the ring**

## CB-CB-CB

- **Higher initial purchase cost**
- **Lower total cost of ownership**
- **Lower downtime**
- **Switching smaller part of the ring**

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- Named one of *Corporate Responsibility* magazine's *"100 Best Corporate Citizens"*
- Inclusion in the *FTSE4Good Index Series,* designed to measure the performance of companies demonstrating strong *Environmental, Social and Governance (ESG)* practices

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