Central Asia Regional Economic Cooperation Program: Energy Sector

Clean Energy Investments in Power Systems

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We live in an interconnected and energy-dependent world.

World Electricity Consumption

1960
2,000 TWh

1980
7,800 TWh

2000
14,600 TWh

2020
23,650 TWh

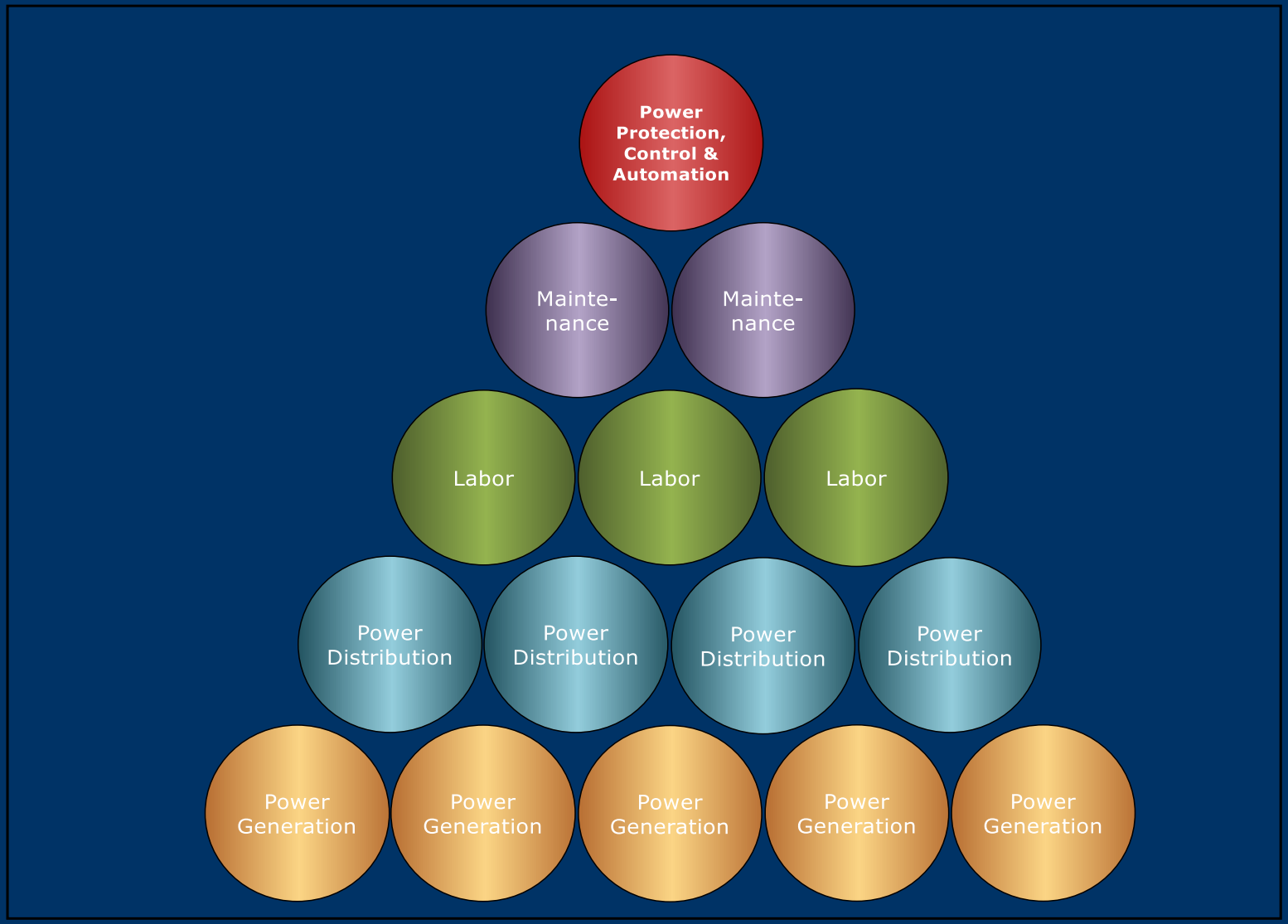
2040
34,457TWh

Source: World Energy Council 2016

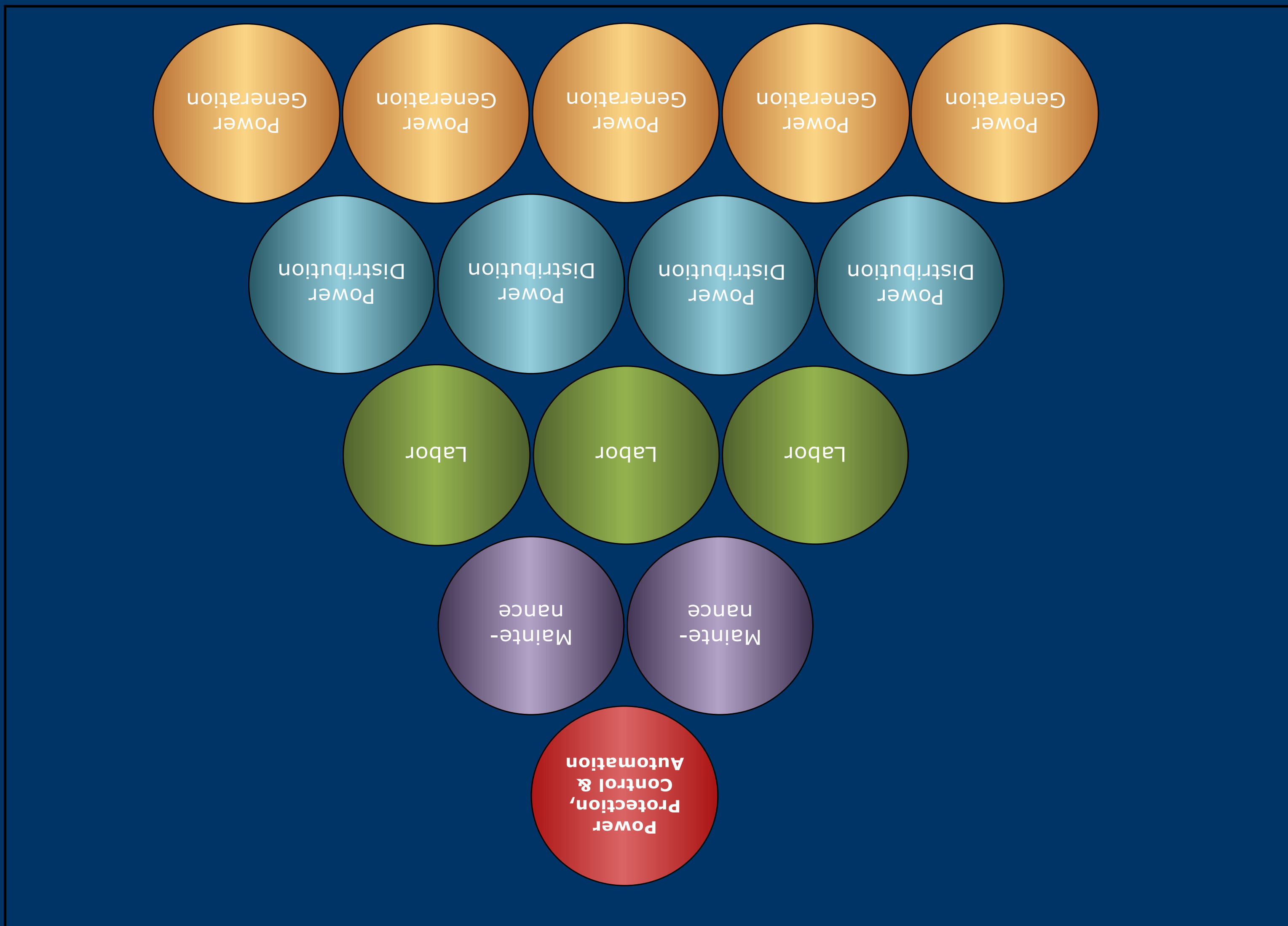
Clean Technologies for Grid Management: Conceptual Framework

- Primary Equipment (e.g. transformers, etc)
- Secondary Equipment ("smart grid")
  - Protection (... protecting the grid)
  - Control (… controlling the grid)
  - Automation (… automating the grid)
  - Small area or wide area
  - Single country or multiple countries

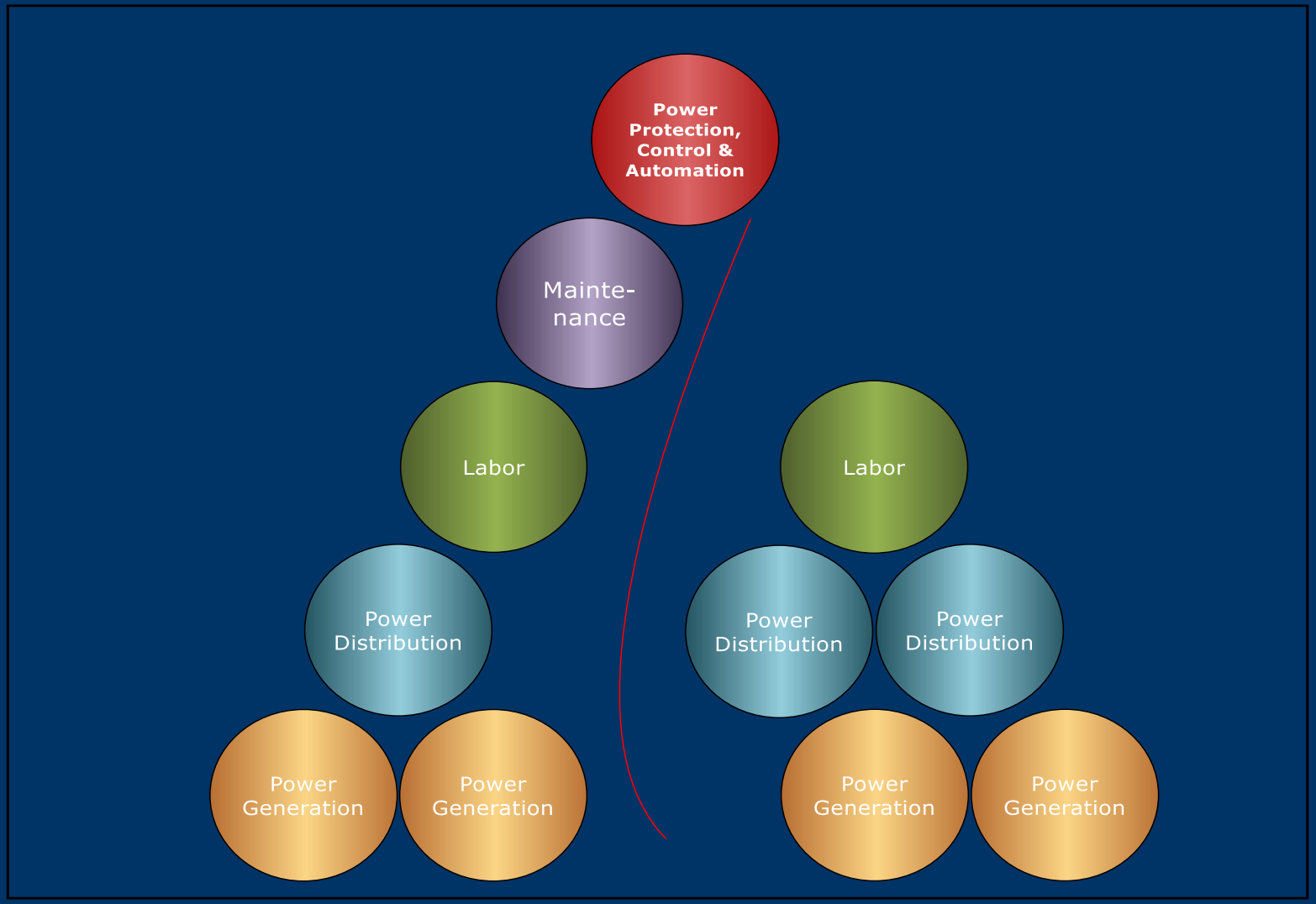
Typical Power Sector Investments



Importance of Power Protection, Control and Automation Technologies



Cost Savings Impact through the Power System Value Chain applying Clean Technology



Examples of Clean Technology Grid Management Applications

- Fault Location
- Substation Cable Reduction
- Distribution Automation
- Wide Area Management

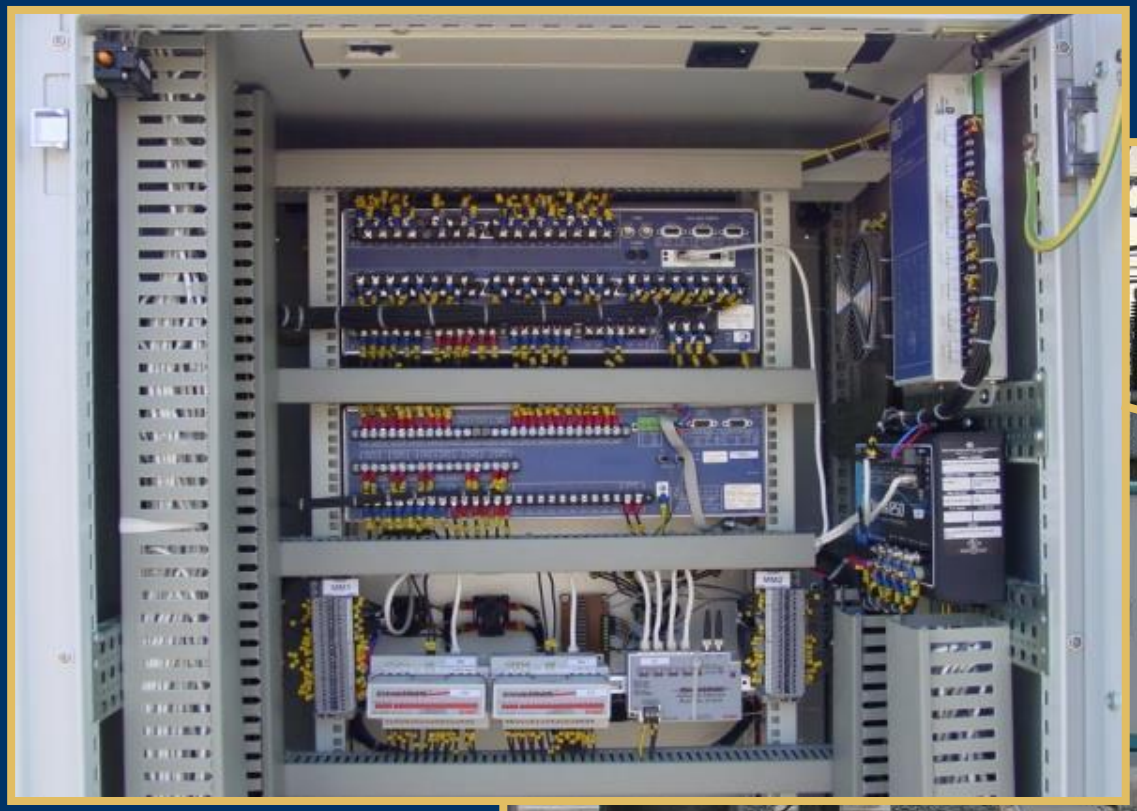
Fault Location Technologies

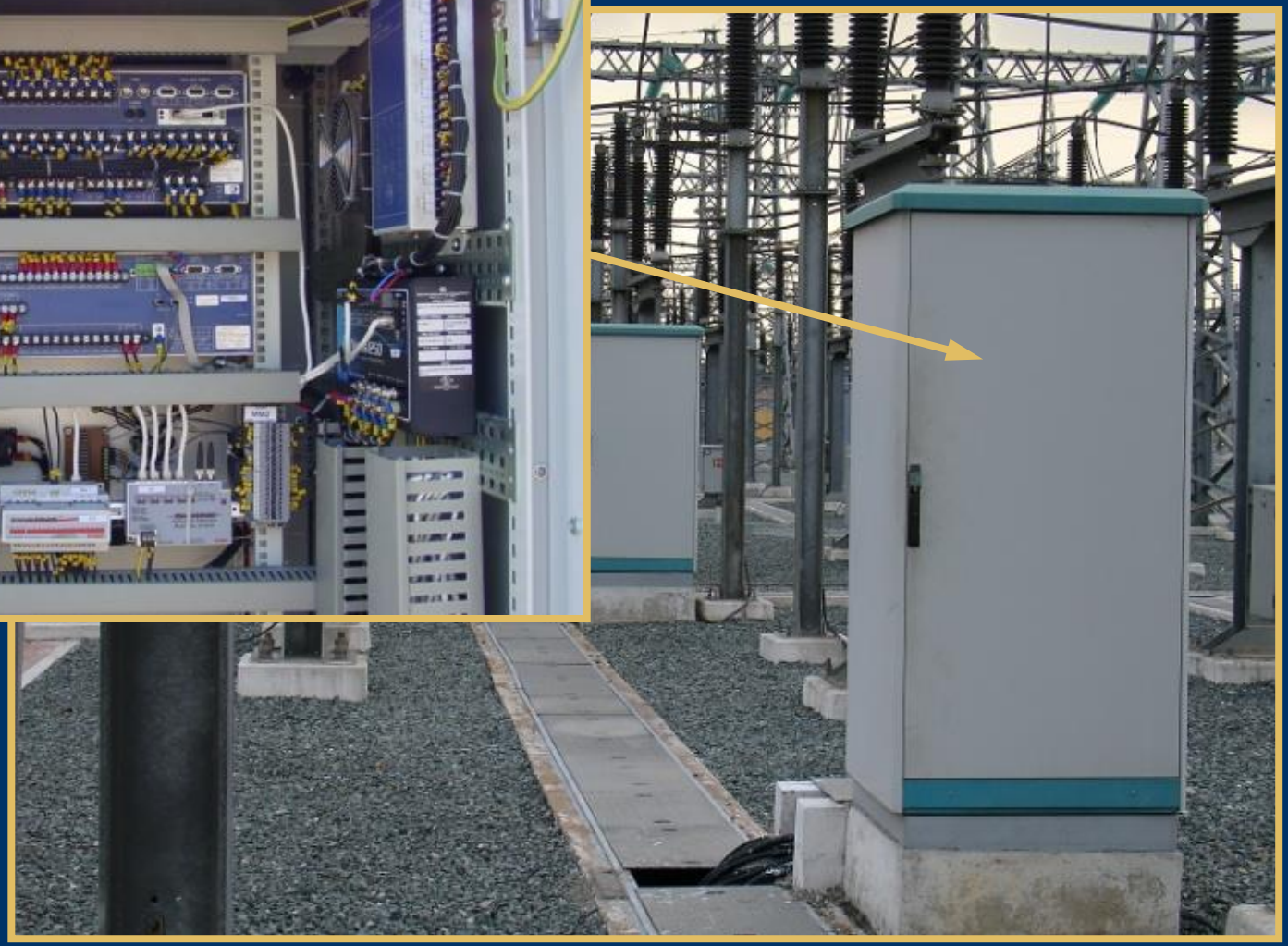
- Much more accurate than in the past
- Transmission level:
  - Accurate within one tower span
  - Can even locate cracked insulators
- Distribution level: throughout the network
- Results:
  - Guiding repair crews directly to the fault or close to it
  - Repairs done faster at less costs

Cable Reduction Strategies

- Conventional designs depend on control equipment centralized in control houses depending on substantial amounts of copper cable
- New technologies minimize copper by placing control equipment closer to primary equipment instead of only in the control room
- Reduces:
  - Investment costs
  - Equipment mis-operation

Outdoor Cubicles Reduce Cabling





Existing Copper Cabling

Thu Duc Substation (Vietnam)

Copper Cabling Reduced

Cable Reduction through Modernization Case Study: Vietnam

- Phu Lam EVN 500kV sub-station
  - 4x 500kV feeders; 10x 220kV feeders
- Originally required 280,000m of copper conductors
- After modernization only 56,000m of copper left and 5000m of fiber optic cable
- Results: 80% copper reduction; 75% reduction in installation time; 77% reduction in labor costs; cost of installation dropped from $69,000 to $16,000; cost of materials dropped from $571,000 to $129,000

Source: EVN, Vietnam

Distribution Automation Technologies

- Automatic network reconfiguration or “self-healing” distribution systems
- Sectionalizing of networks
- Results:
  - Limits power outages
  - Increases network reliability

Distribution Automation Case Study: Bosnia

Source: Brcko Disco, Bosnia

- USAID funded, small distribution automation pilot
- Brcko: 2x 10kv distribution feeders
- Outcome:
  - Six months Energy Not Supplied (ENS) reduction from 16.61 MWh to 4.95 MWh over a period of six months.
  - First operation saved 17,000 customers from 3-day outage

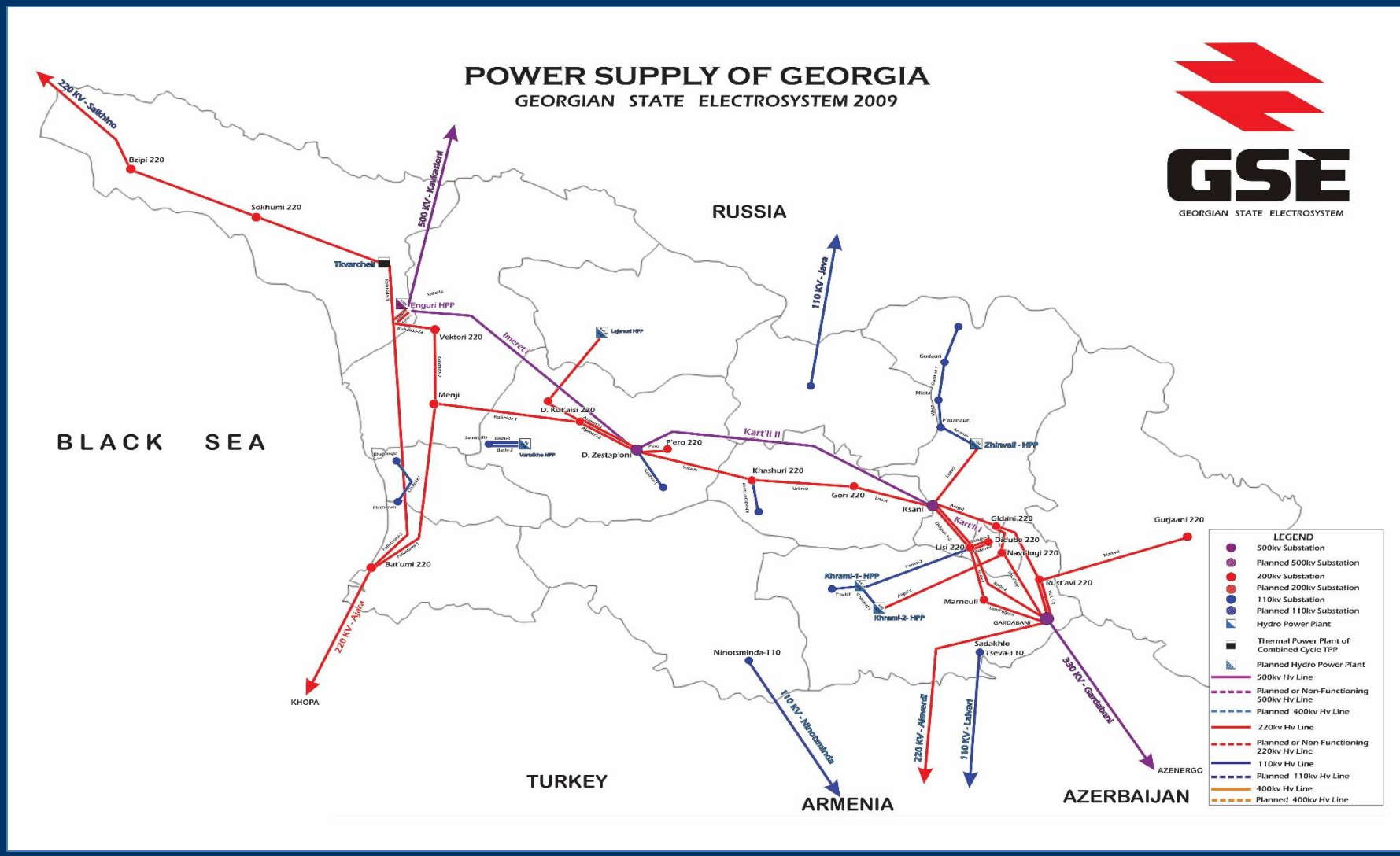
Wide Area Management Technologies

- Power Systems Need Wide-Area Protection and Control to minimize blackouts.
- Blackouts can be caused by e.g.:
  - Equipment overloads
  - Too much or too little generation
  - Insufficient load shedding
  - Loss of a transmission line

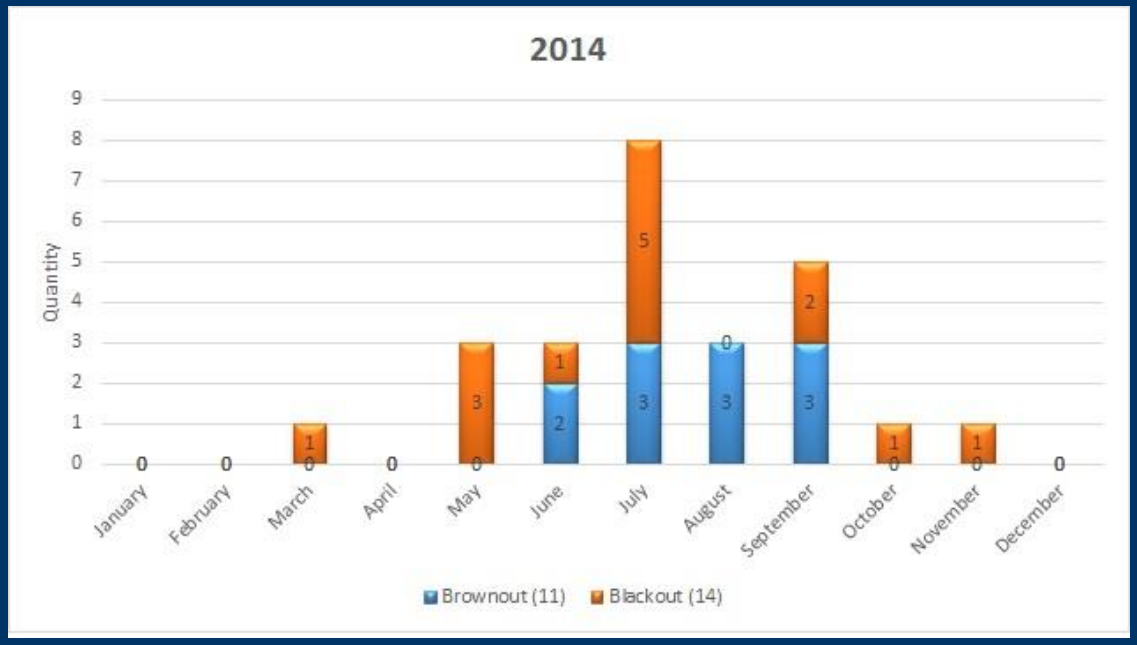
Wide Area Management Technologies

- Wide Area Management Technologies prevent/limit blackouts by:
  - ♦ Monitoring power systems faster,
  - ♦ Reacting to contingencies faster than any possible human intervention
  - ♦ Fast load shedding

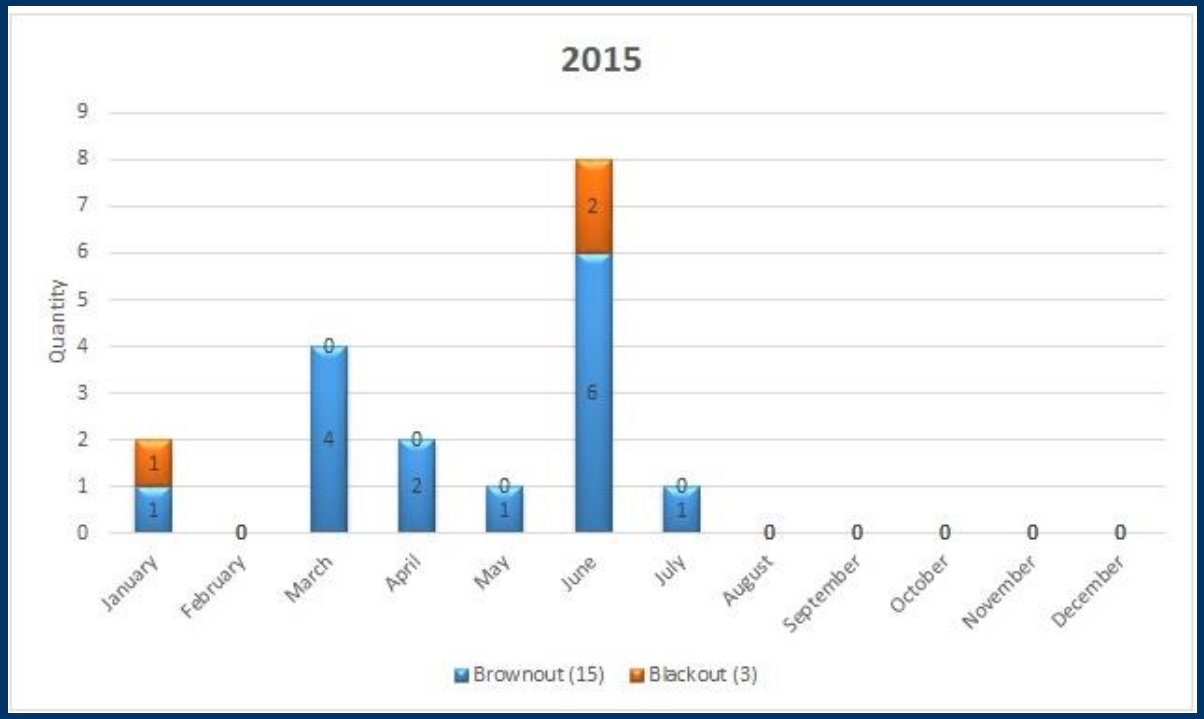
Wide Area Management Case Study



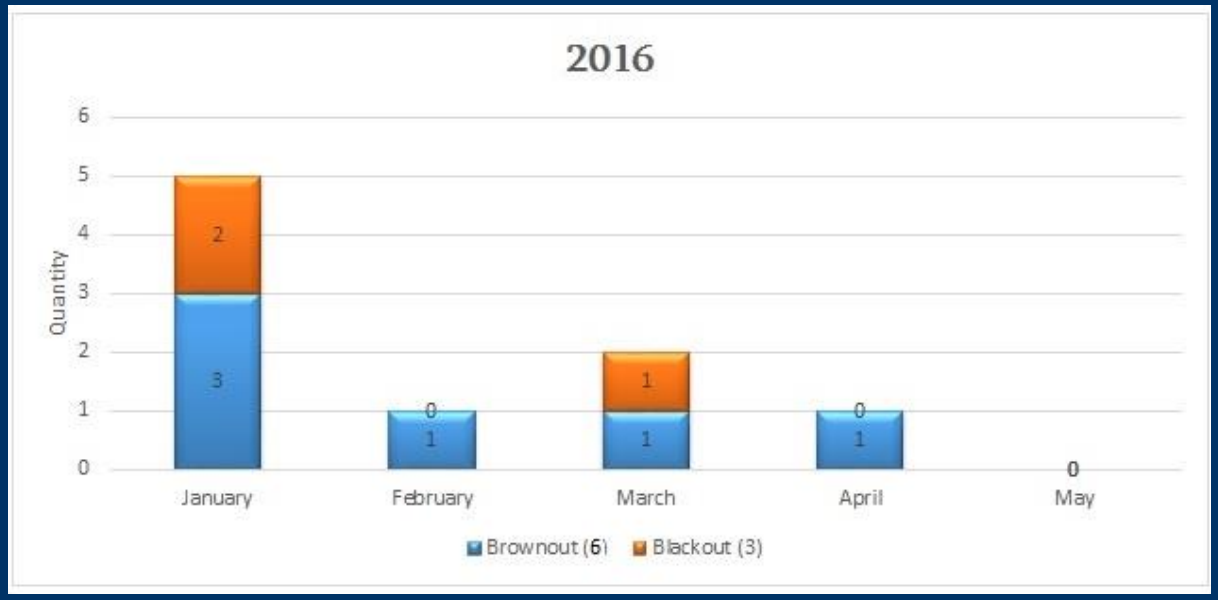
Georgia Special Protection System Operations (Blackout Prevention) for 2014



Georgia Special Protection System Operations (Blackout Prevention) for 2015



Georgia Special Protection System Operations (Blackout Prevention) for 2016



Source: Georgian State Electrosystem (GSE)

Georgia Clean Technology Benefits

- The GDP for Georgia is approximately US$1.59M per hour, alternatively a blackout of one hour in Georgia costs about US$1.59M
- The Georgia wide are management system cost around $2M.
- Based on the number and duration of blackouts it is clear that the implementation of the RAS has been financially very beneficially to Georgia.
- The cost of the project was quickly recuperated by the amount of blackouts already successfully prevented by the technology.

Source: Georgian State Electrosystem (GSE)

Thank you - Questions?

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