# Metering in DC Distribution

## Workshop for Future DC Distribution, Golden Colorado

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October 2, 2024

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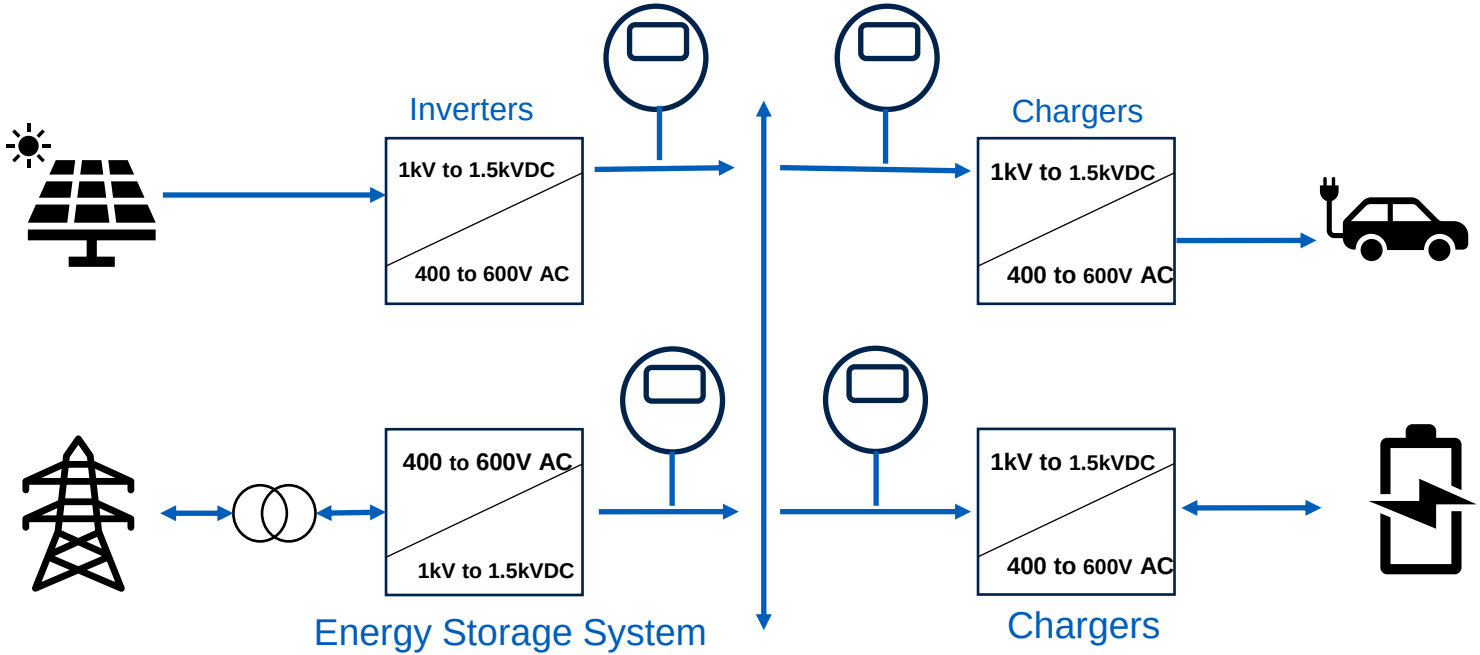
# Metering in DC Distribution - EV Charging




As the adoption of electric vehicles (EVs) accelerates, the demand for efficient and reliable charging infrastructure is rising.
DC Metering ensures that EV owners are billed accurately for energy consumed.

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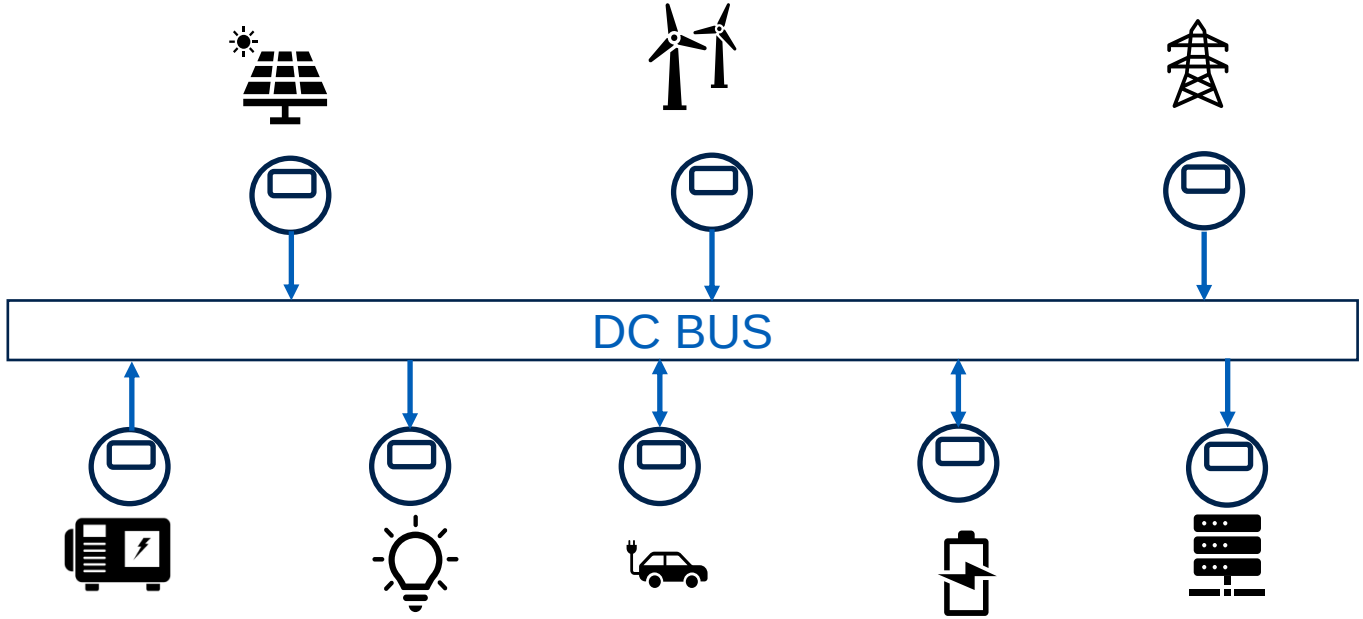
# Metering in DC Distribution - Microgrid




DC metering facilitates the seamless integration of the renewable sources into grid, enhancing overall efficiency. Meters providing power quality information help reduce downtime

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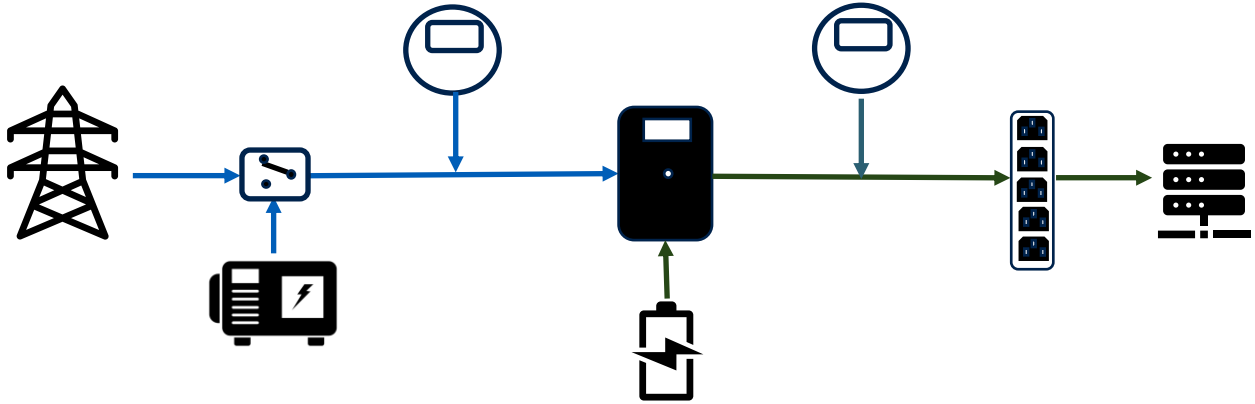
# Metering in Data centers



DC metering in Data Centers allows precise cost allocation and energy management. Meters providing power quality information help reduce downtime and optimize the use of power.

# Challenges with DC metering

- **Current measurement:** Current Shunts, Hall effect sensors and zero flux transducers have limitations, such as temperature dependance, size, and cost

- **Voltage measurement:** Resistive dividers used for voltage measurement introduces errors, especially at high voltages

- **Accuracy and Precision:** Measuring DC current accurately can be difficult due to the presence of AC ripple and high-frequency noise.

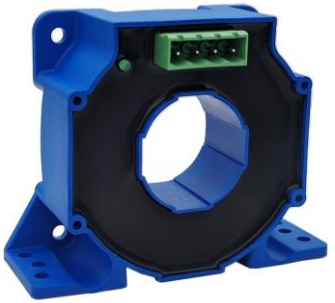
- **Power Quality:** AC ripple on DC voltage and rapid load variation makes power/energy measurements difficult. There may be 10% of AC ripple on top of the voltage at frequencies in the 60Hz to 360Hz range. No power quality standards defined.

# DC Current Sensing

- Current Shunts
  - Need pre-installation. Retrofitting is difficult
  - Large DC offset voltages. No simple way to correct
  - Temperature impacts the measurement
  - Very low signal form high current shunts

- Hall-effect sensors
  - Require power supply
  - High accuracy with compensating current measurement
  - High cost

- Flux gate sensors
  - Few suppliers
  - High cost
  - Good temperature stability
  - High accuracy
  - Requires additional electronics to drive core to saturation



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# Power Quality

- No Power Quality standards defined - European Standard EN 50160 and IEC61000-4-30 committees started some work on LVDC and MVDC PQ
- Most of the power quality issues are common between AC and DC distribution:
  - Supply voltage deviations
  - Voltage unbalance
  - Ripple/harmonics
  - Voltage swells and voltage dips
  - Voltage supply interruptions
  - Rapid voltage changes and flicker


# Introducing…
# Eaton's PXQ
# event analysis system

**Power Xpert Quality event analysis system is Eaton's next generation of Power Quality metering**

PXQ can be relatively easily extended to monitor DC Power Distribution system in the future.

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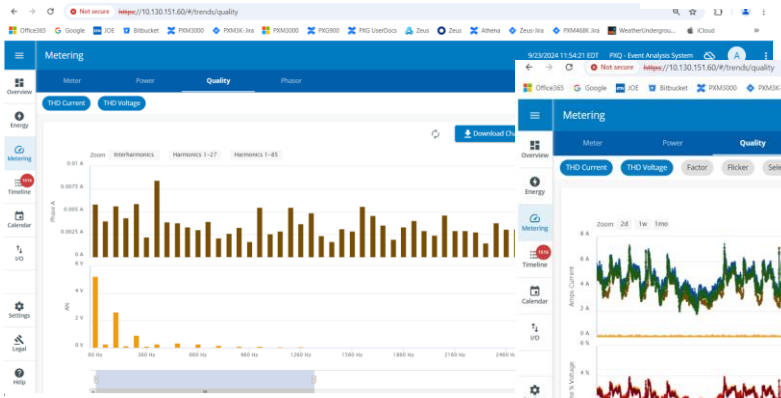
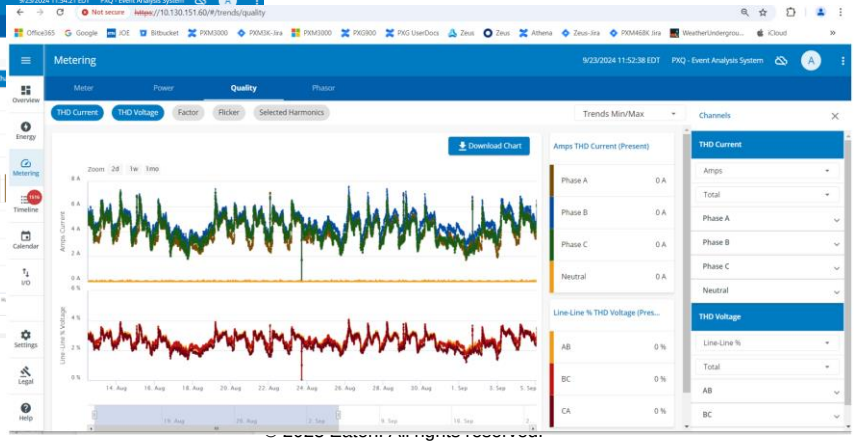
# Leveraging existing platforms for future DC metering

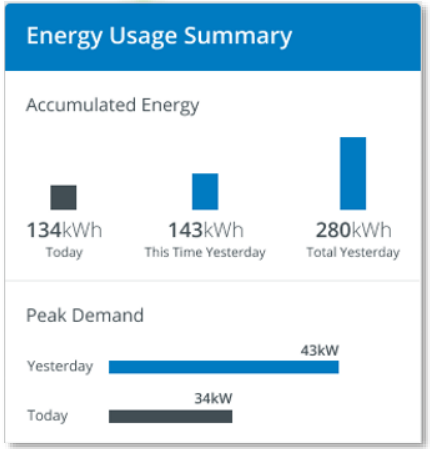
**Disturbance Navigator Timeline** provides a single view that puts PQ events in context

Event Sequence RMS

- Power Quality Health Index
- Energy usage & demand comparisons
- Graphical ITIC / SEMI-F47
- Event Sequence RMS
- Event Analysis Calendar
- Sag Source Analysis
- Disturbance Navigator Timeline view
- Min/Max/Avg Trended data

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