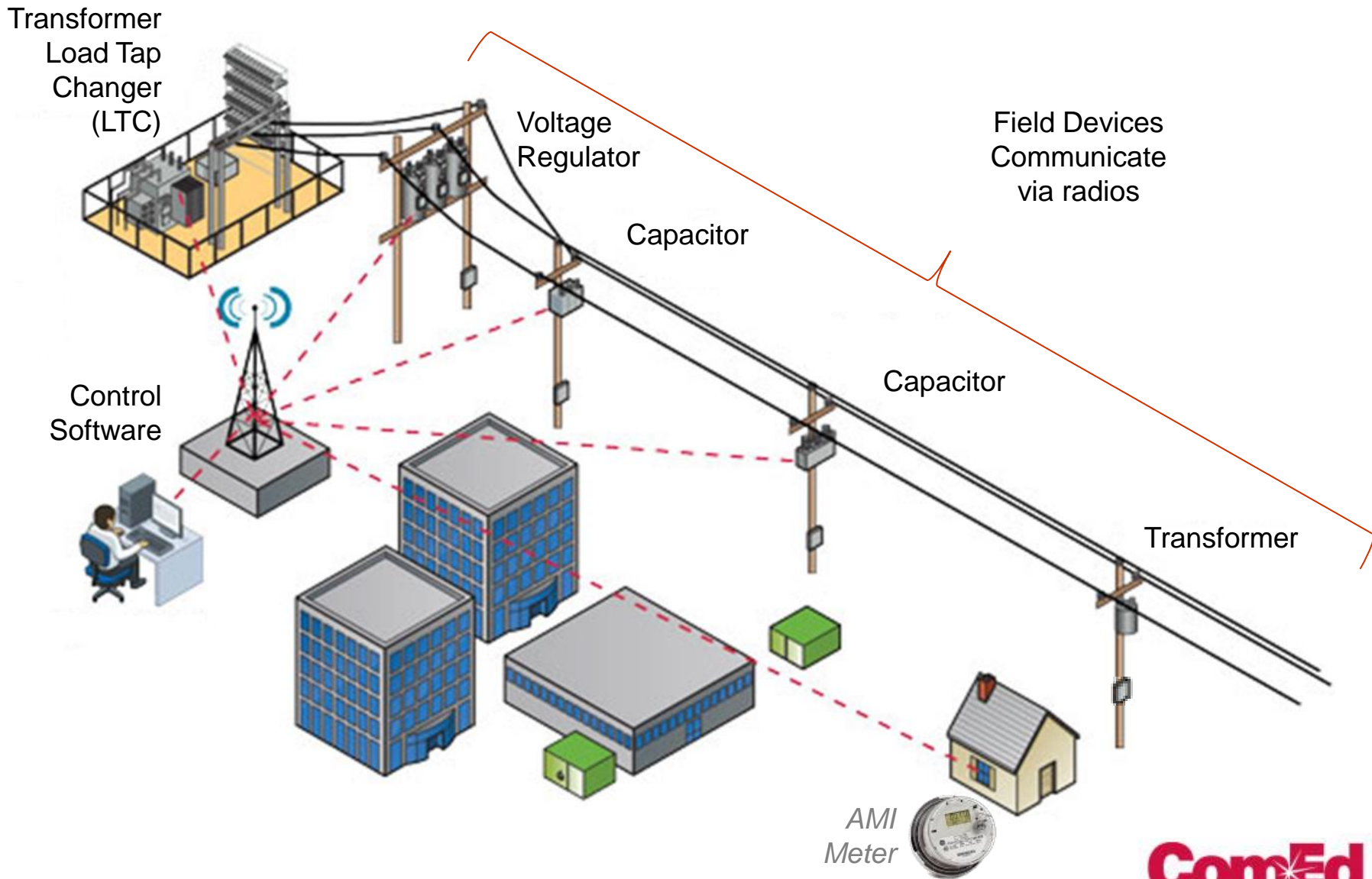


Voltage Optimization

September 2018

- ✓ Voltage Optimization (VO) is the managed reduction in the service voltage received by a customer to reduce energy consumption (kilowatt-hour or kWh) .
 - Lowering voltage means fewer kWhs are needed to run the same lights and appliances.
- ✓ Voltage is adjusted by:
 - Substation Transformer Load Tap Changer (LTC)
 - Field Voltage Regulators
 - Field Capacitors
 - Control Software

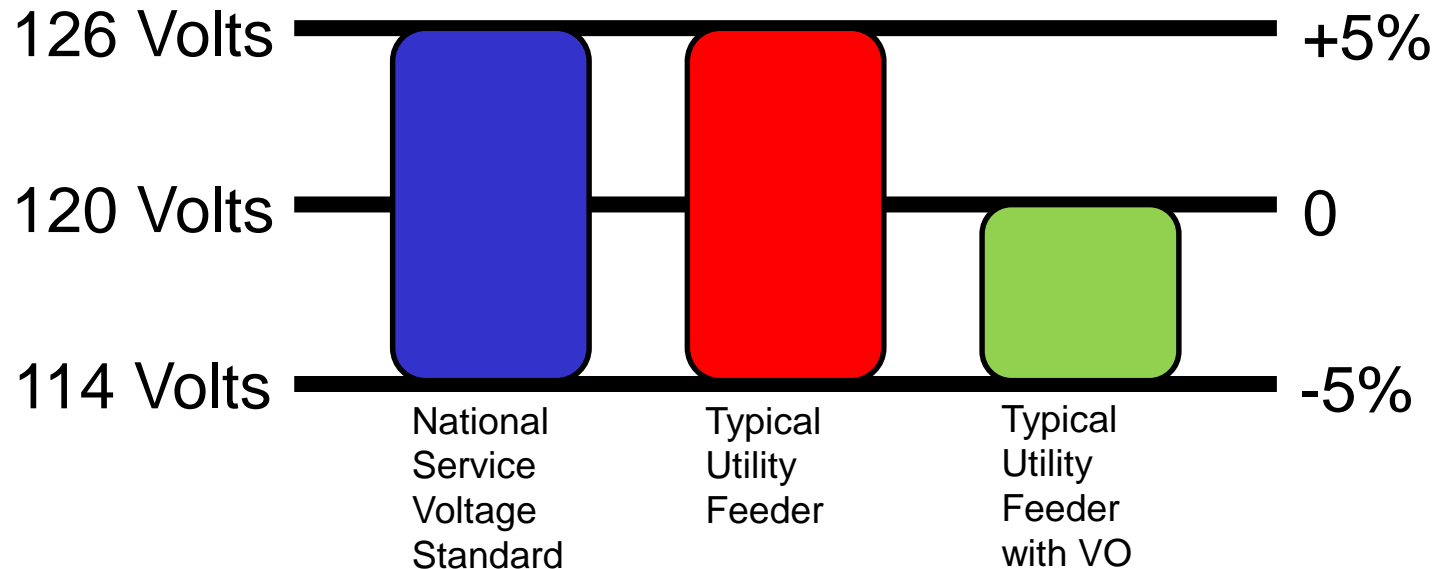
Voltage Optimization System Components



What is Service Voltage?

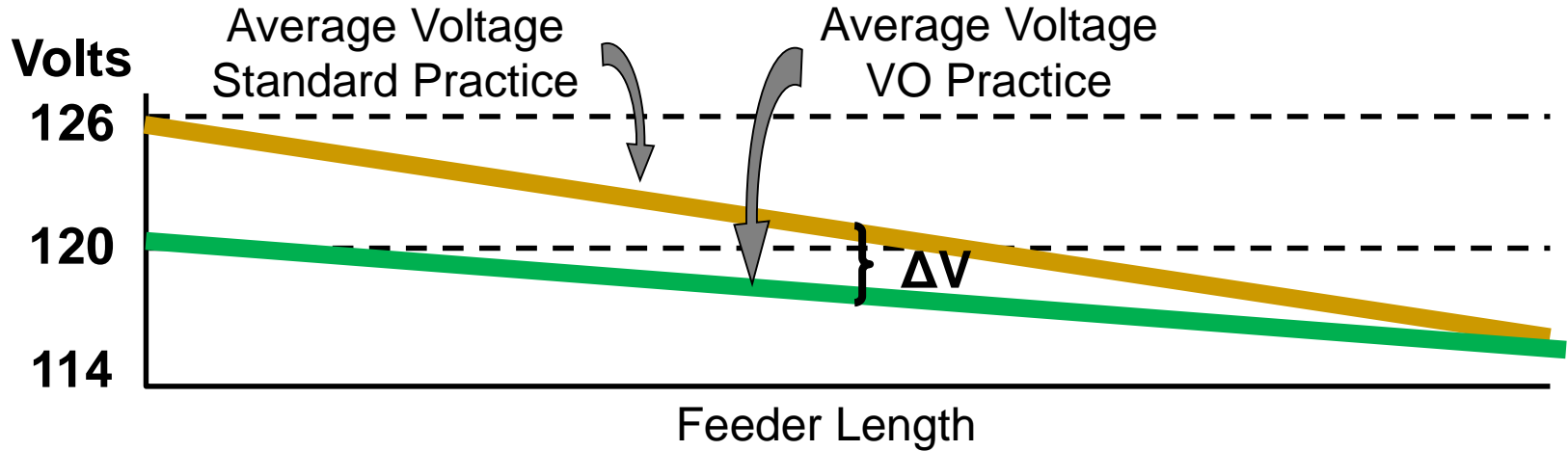
✓ Voltage at the customer meter

- National Service Voltage Standard (ANSI C84.1)
 - “Range A” or Normal Conditions: 114V-126V
 - Allows $\pm 5\%$ service voltage bandwidth
- Typical utility feeders operates in upper half (120V-126V)
- Voltage Optimization feeders operate in lower half (114-120V)

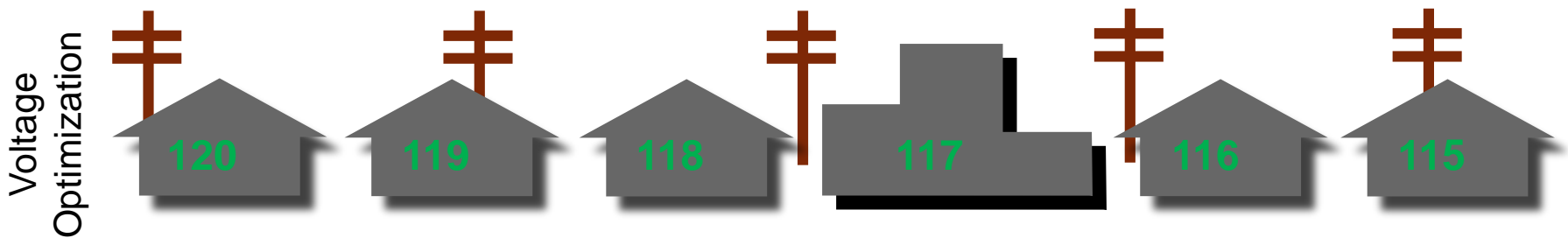


Note: Illinois Administrative Code (113-127V)

Typical Voltage Profile with Voltage Optimization



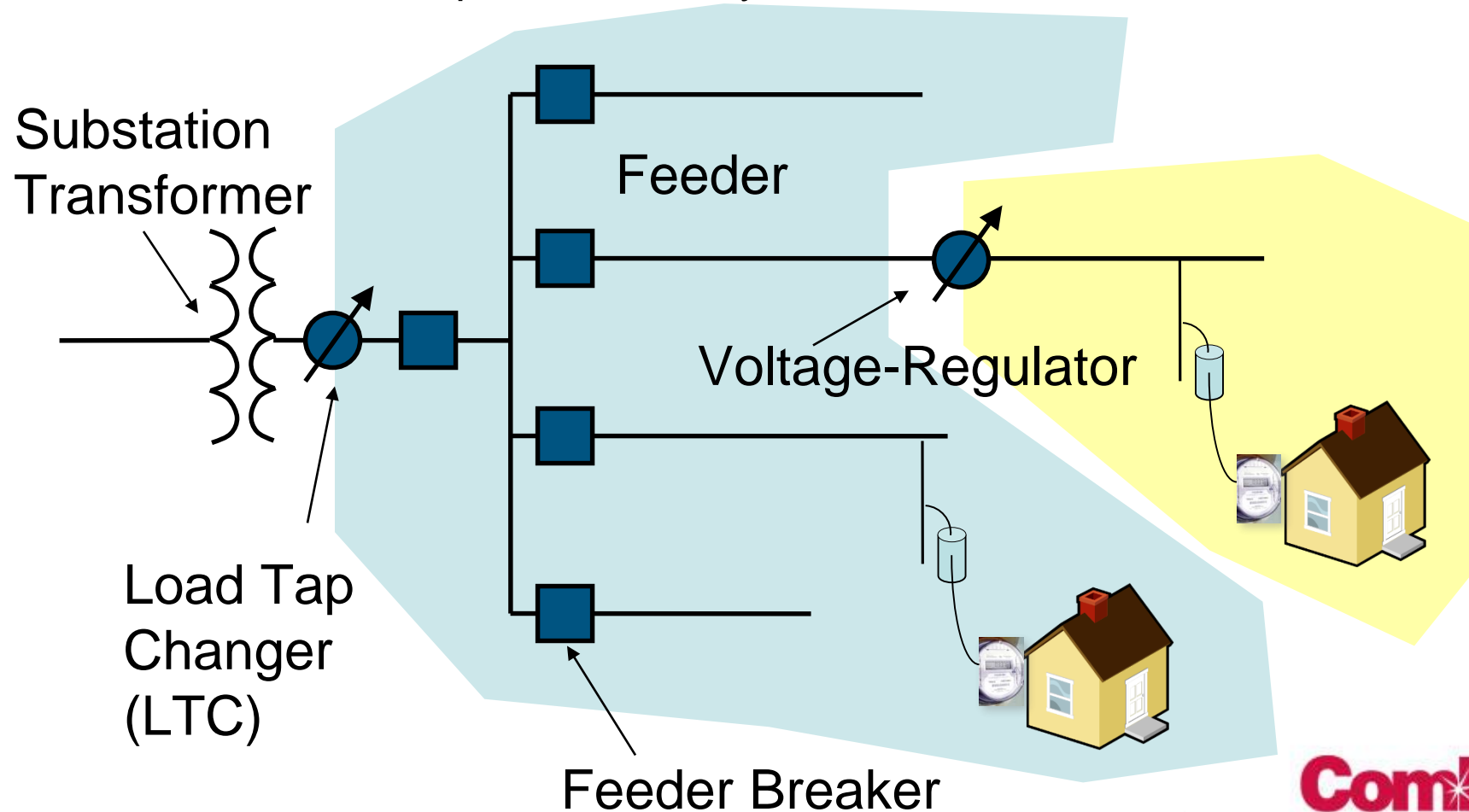
System improvements help to flatten the voltage profile and allow additional voltage reduction.



Voltage Control Zones

✓ Voltage regulation at the substation effects all the feeders in that voltage control zone.

- This necessitates prioritization by substation.

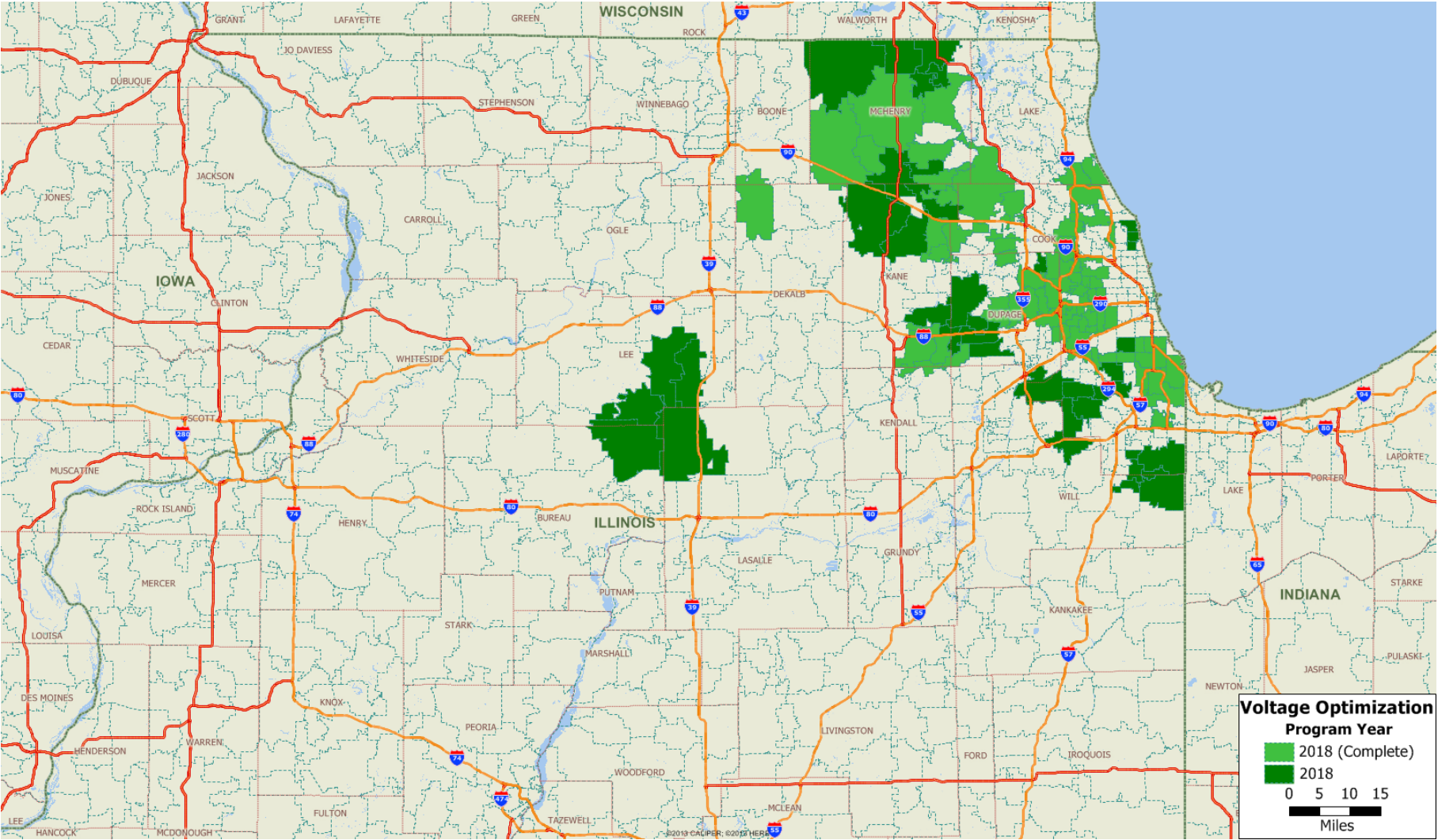


- ✓ Voltage Optimization (VO) Program at ComEd is designed to reduce customer energy consumption by reducing circuit voltage.
- ✓ ComEd's VO program is prioritized by the estimated Benefit to Cost Ratio (BCR) by substation.
- ✓ BCR is the ratio of the Present Value (PV) of customer energy savings to the PV of installing and maintaining VO over 15 years.

$$BCR = \frac{\$Energy\ Saved}{\$Investment}$$

- ✓ VO is prioritized by BCR to maximize the energy efficiency savings by substations per dollar spent.
- ✓ VO is implemented at a substation level.
- ✓ Since the voltage control zone is included in the controller, all circuits fed from the substation need to be implemented with VO at the same time.
- ✓ Substations cross several demographic areas.

2018 Voltage Optimization Plan

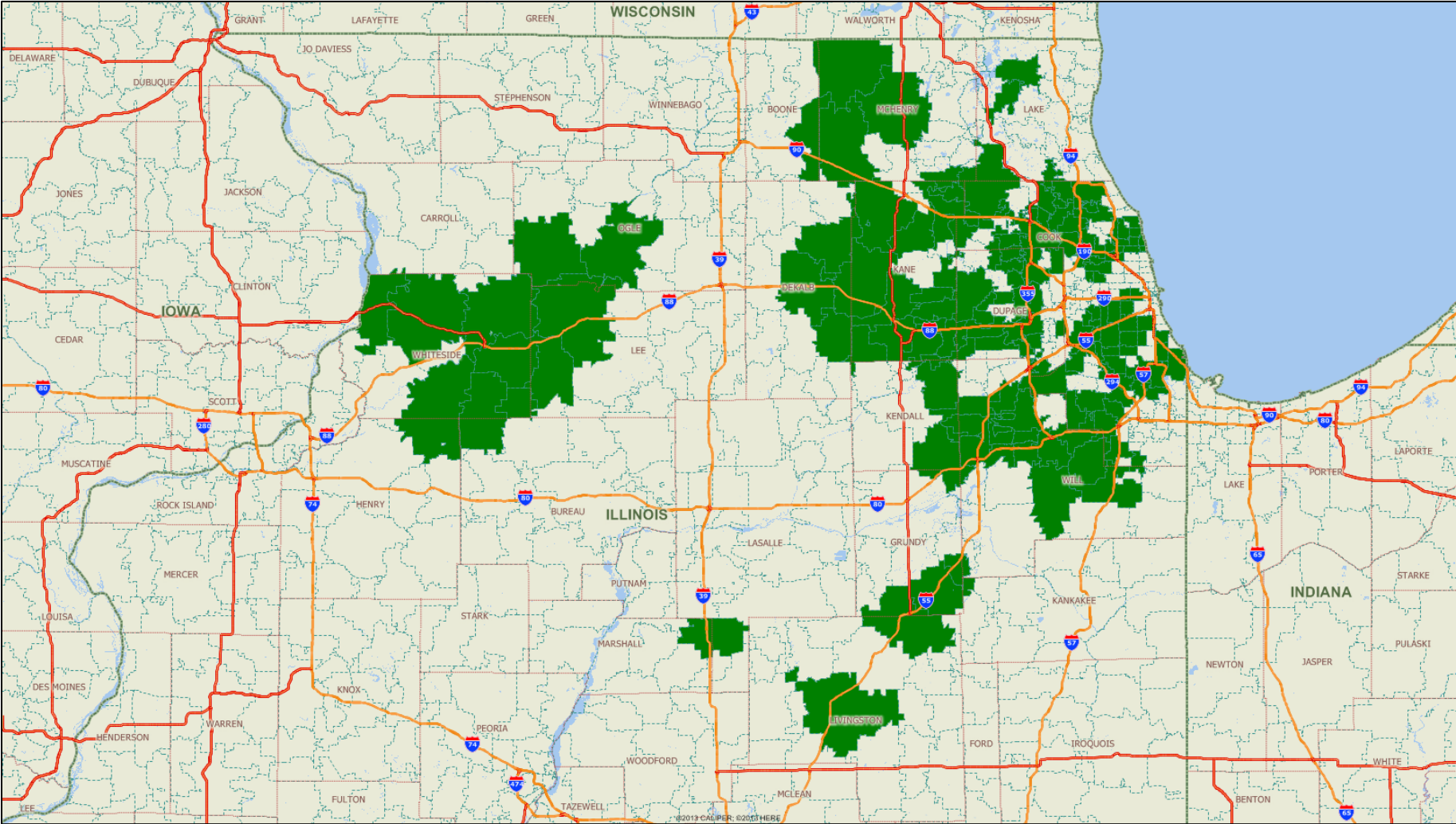


Substations and associated feeders by zip code

Preliminary Draft - Subject to Review and Modification



2020 Voltage Optimization Plan

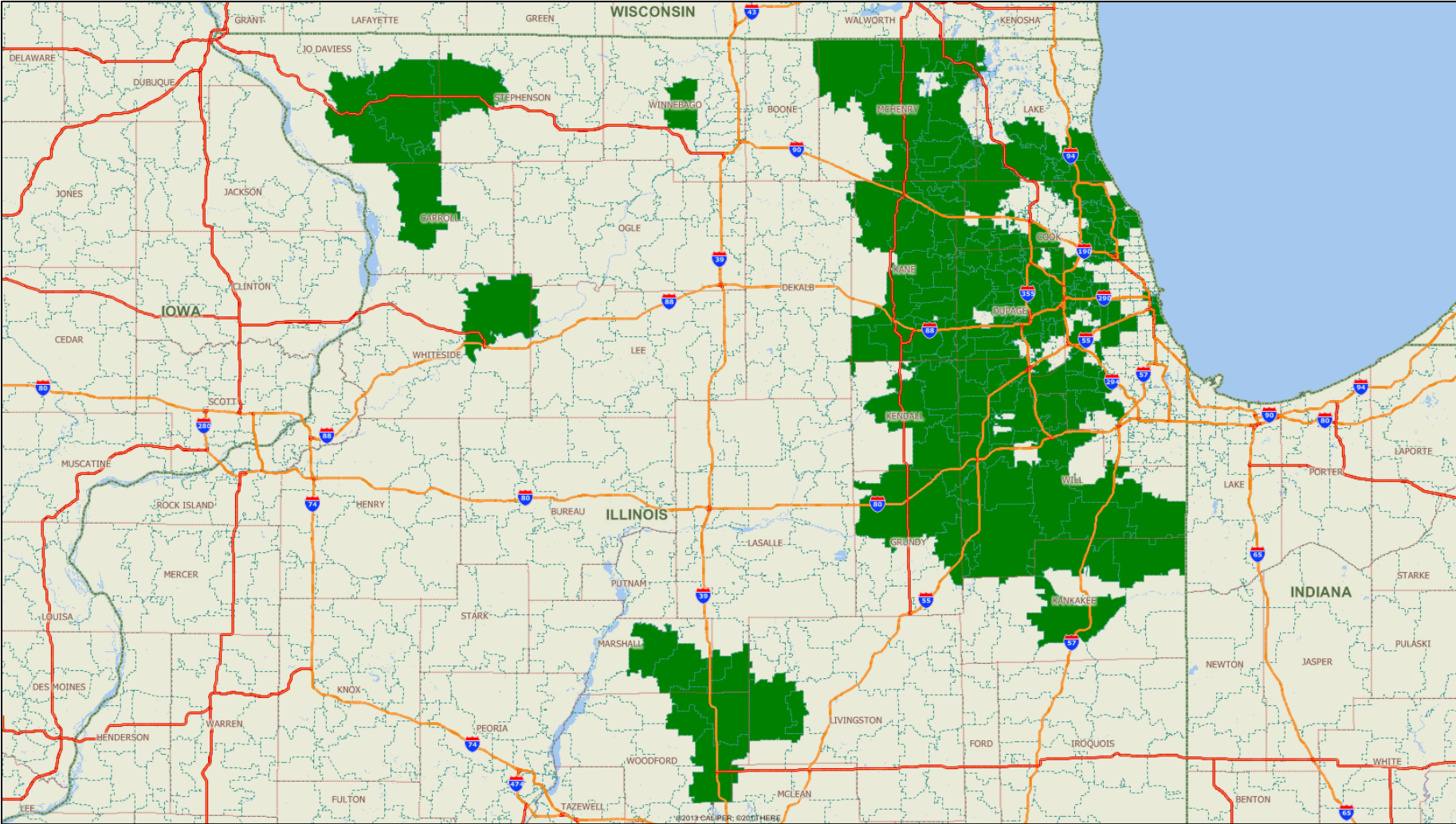


Substations and associated feeders by zip code

Preliminary Draft - Subject to Review and Modification



2021 Voltage Optimization Plan

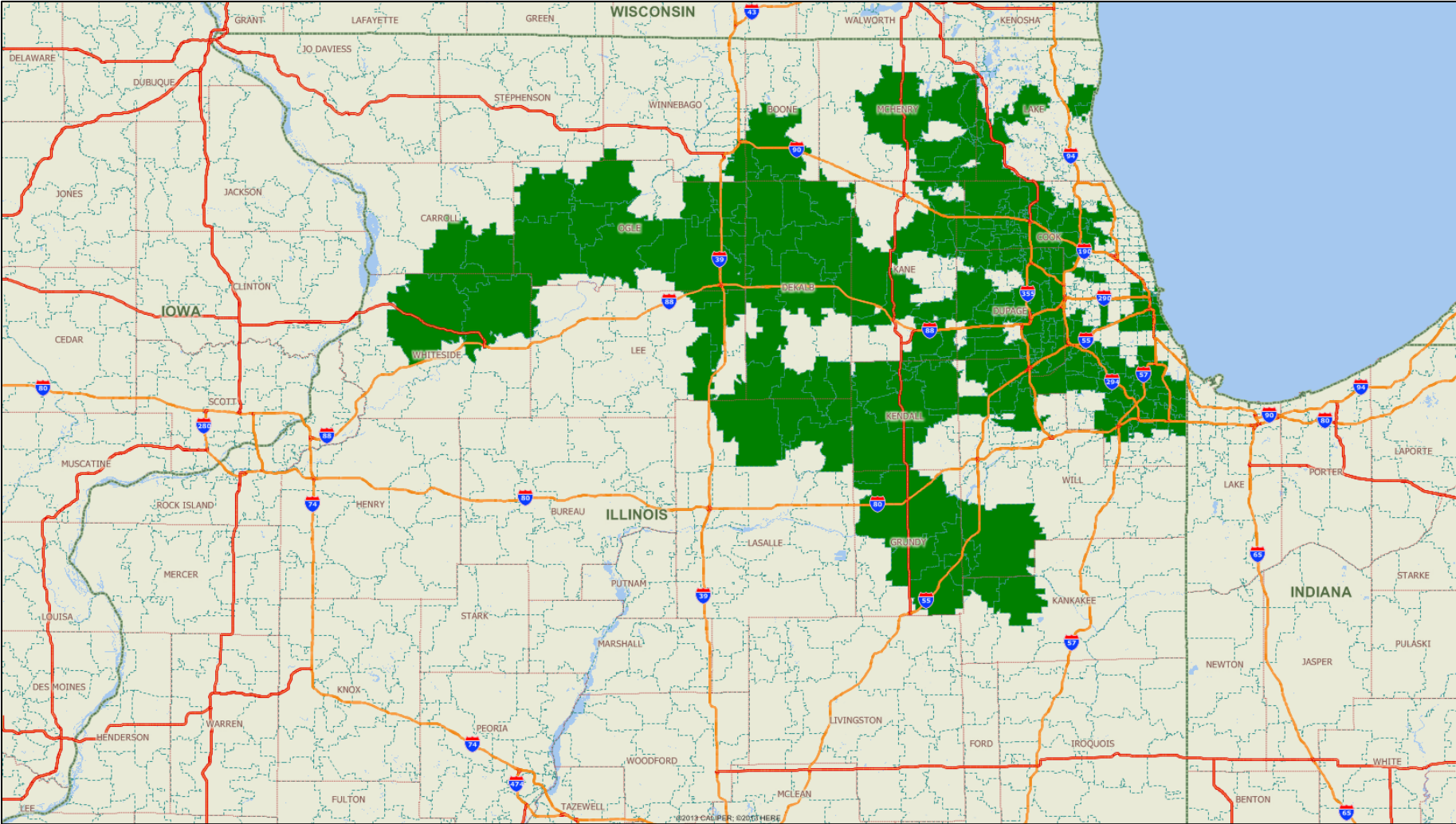


Substations and associated feeders by zip code

Preliminary Draft - Subject to Review and Modification



2022 Voltage Optimization Plan

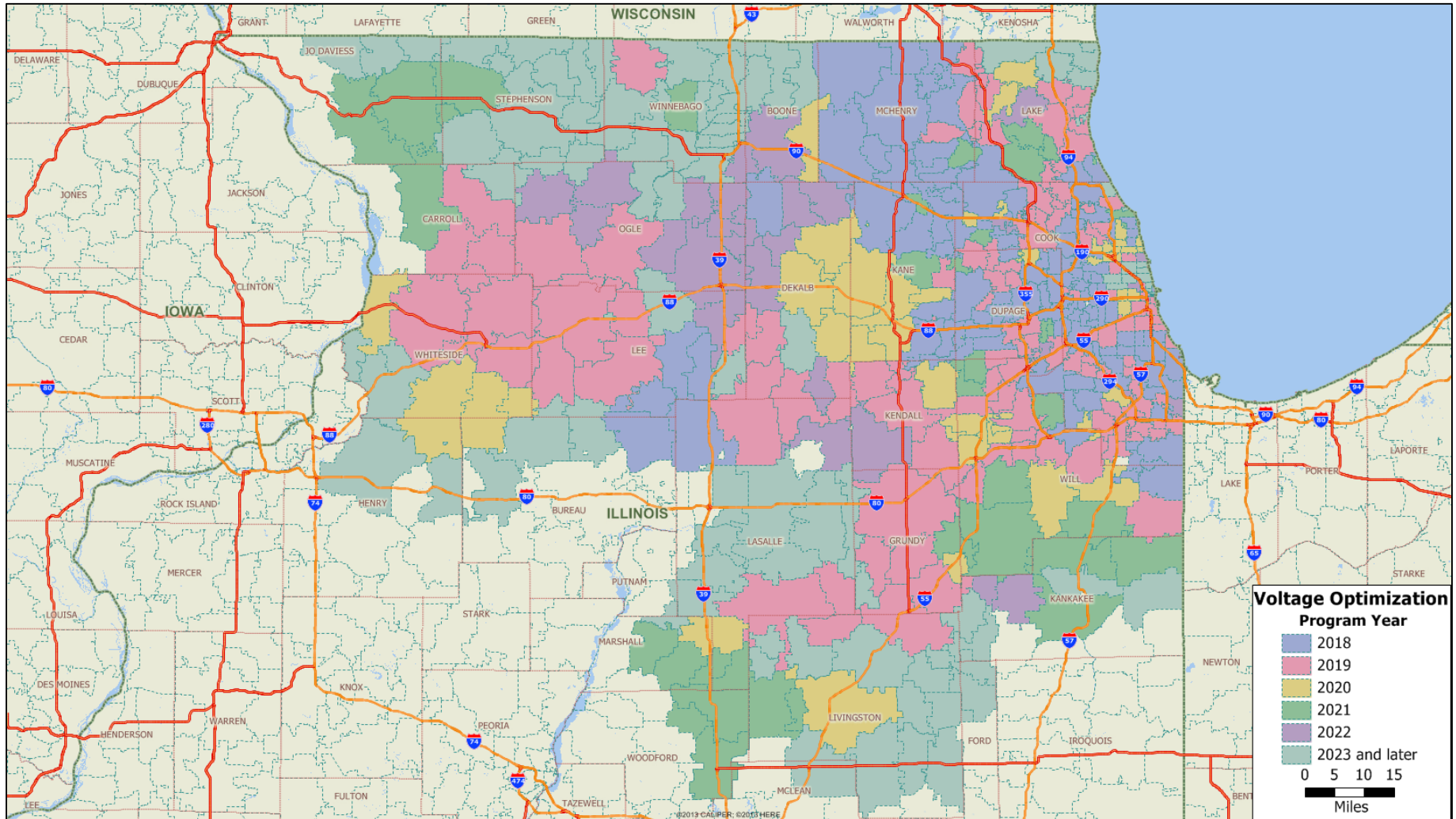


Substations and associated feeders by zip code

Preliminary Draft - Subject to Review and Modification



Complete Voltage Optimization Plan



Substations and associated feeders by zip code