DER INTEGRATION – EPCOR'S EXPERIENCE IN EDMONTON

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Ontario Region

EPCOR


DANGER
HIGH VOLTAGE


British Columbia
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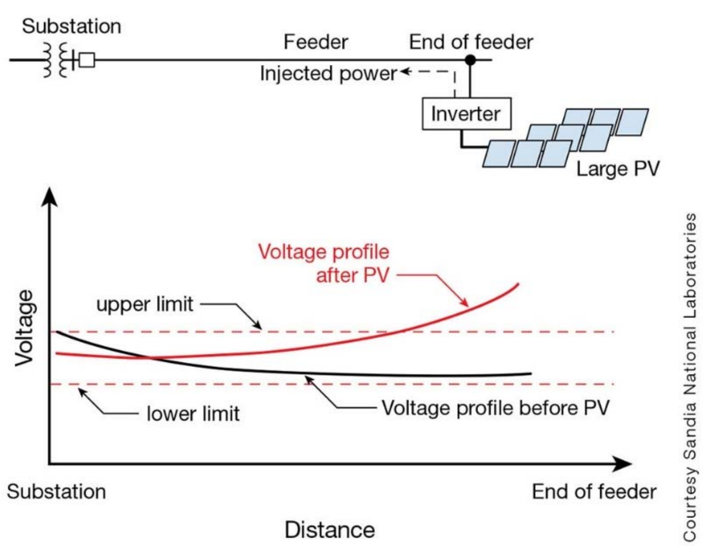
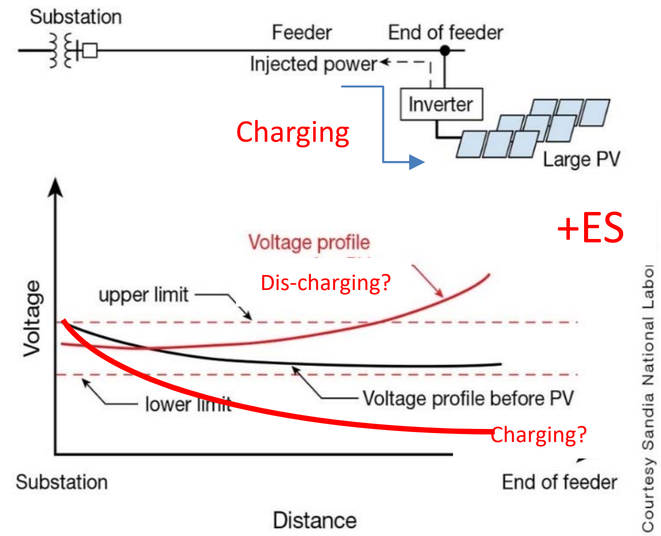
Regina
Toronto
EPCOR OPERATIONS
Electricity
Water
Natural Gas
Drainage
Wastewater
Locations at a glance
Arizona
New Mexico
Texas
Phoenix
Albuquerque
Austin
San Antonio
Houston

The Theoretical Impacts of DG and ES

Classic DG Example:

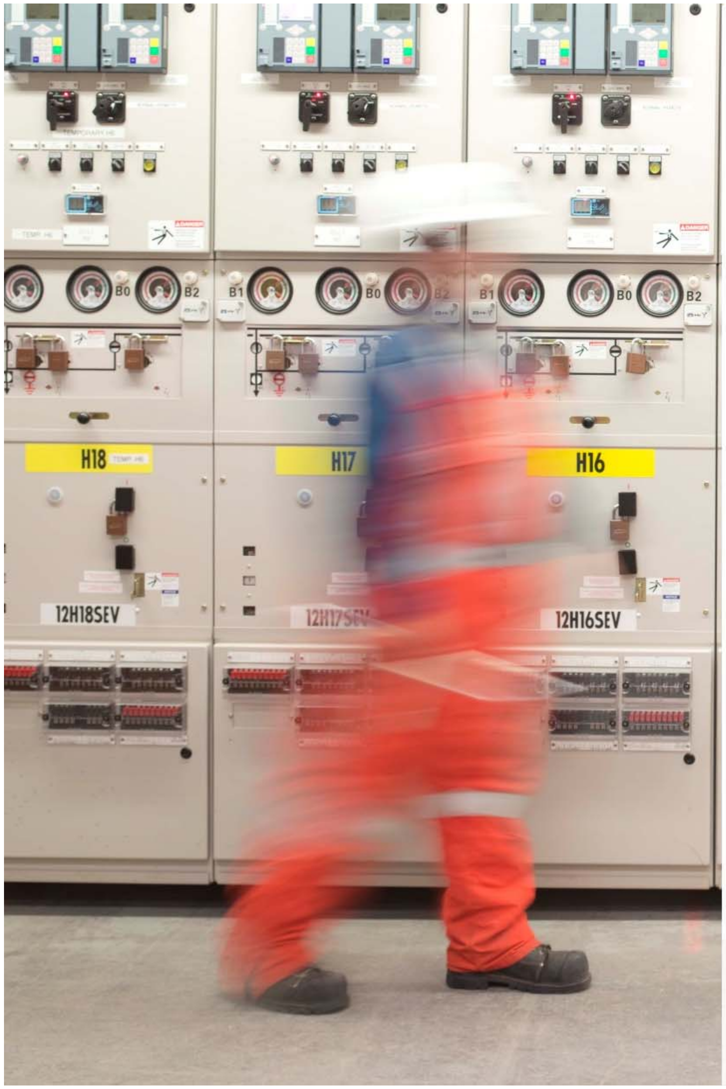


With Battery ES



EDTI's Study with the University of Alberta

- Simulation-based technical study - 2014-2018
- Three-way funding EDTI – U of A - NSERC
- 'Realistic-as-possible' approach:
  - City of Edmonton conditions
  - 39/289 EDTI power system distribution circuit models
  - Capabilities of market-available equipment
  - *Stochastic* approach (Monte Carlo)
- Broadly examine impacts of three classes of *customer-owned* DER:
  - DG: Distributed Generation (e.g. Solar PV)
  - ES: Energy Storage (e.g. Batteries)
  - EV: Electric Vehicle (e.g. Charging)
- Examine effects to the distribution system



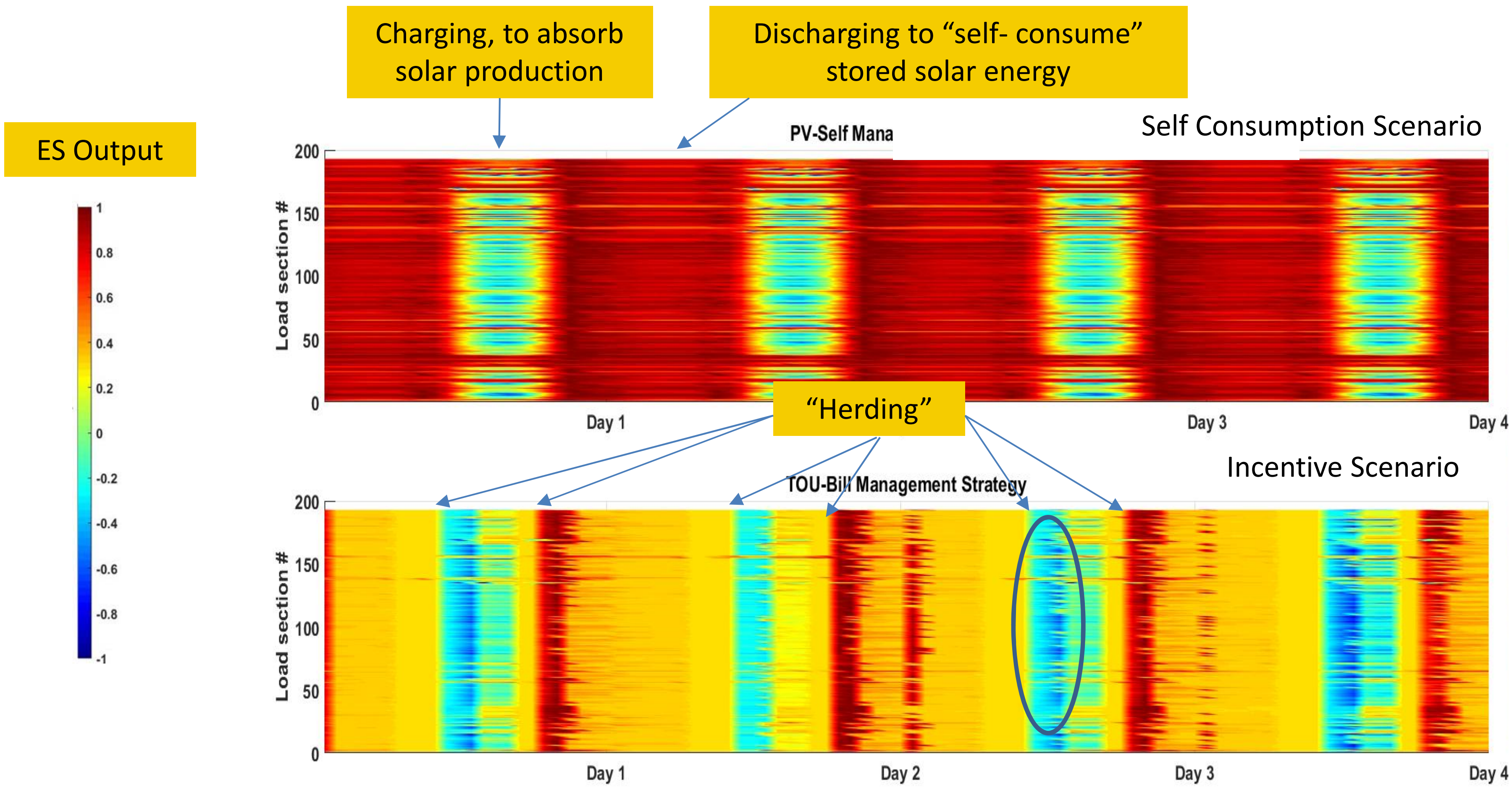
Key Findings Distributed Generation

- IF customer PV systems are in-line with Alberta microgen regulation, ~80% of EDTI circuits should only experience outlier problems
- Circuits with voltage outliers still have decent capacity to integrate PV

Energy Storage

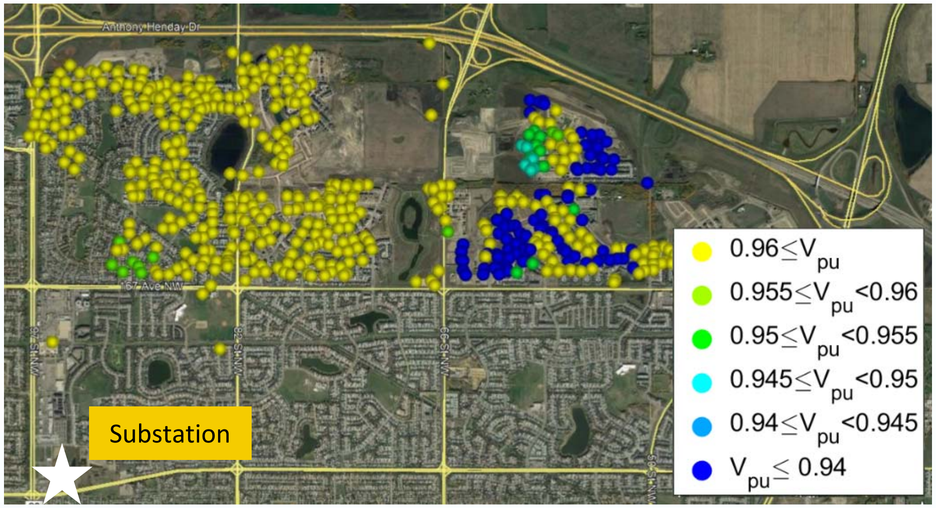
- All ES modelled with co-located PV
- Two behaviours modelled
  - Self-consumption
  - On peak discharge, off peak charge
- Min load when generating, peak load when charging – worst case

Energy Storage (from the perspective of the ES)

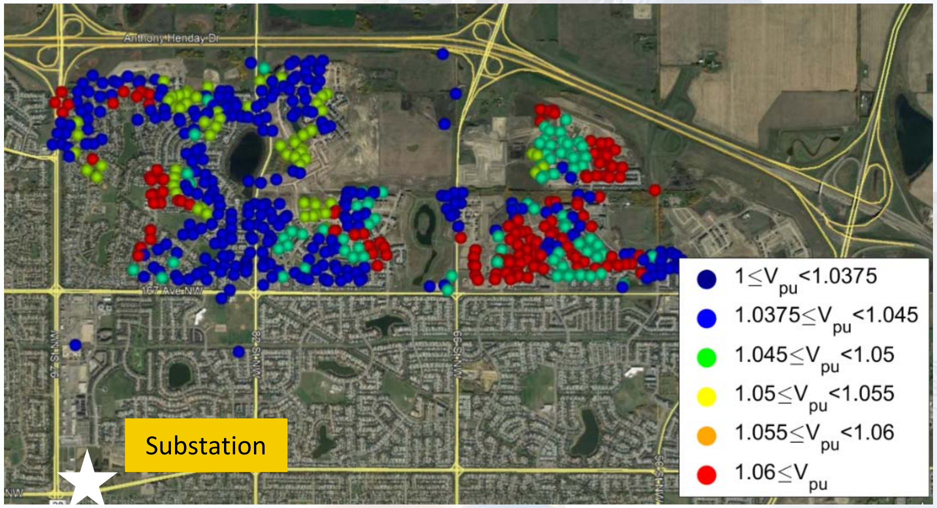


Impacts to a Distribution Circuit – TOU Scenario

Under-voltage, as a result of ES Charging



Over-voltage, as a result of excess PV generation



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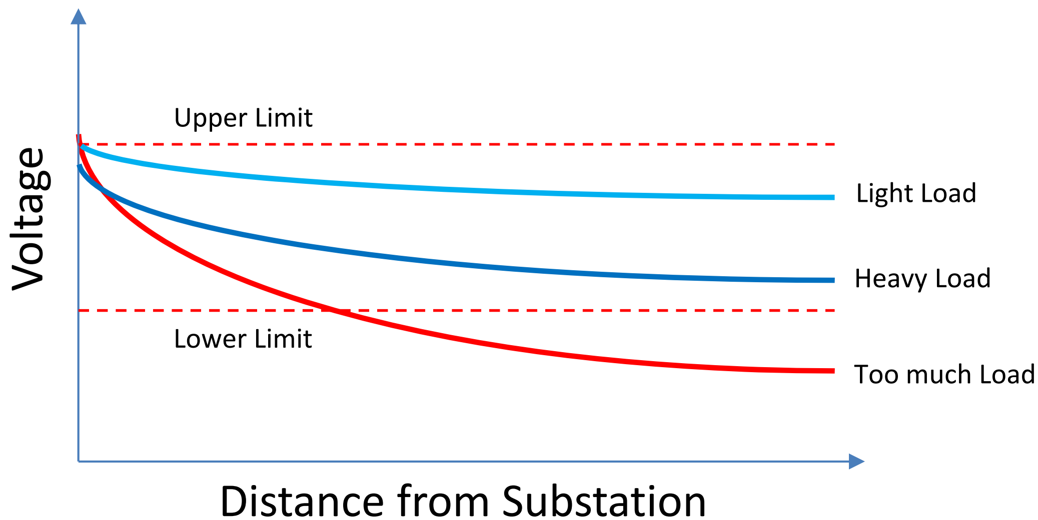
Key Findings Energy Storage

- Simulated self-consumption scenario had less impact than incentive scenario
- Mismatch to site demand and co-located generation could lead to over voltage and under voltage impacts – hard to predict
- Potential to exacerbate and or alleviate strain on distribution infrastructure
- More study is needed

The Impacts of Electric Vehicles

- What makes EV load any different?



Residential sites in Edmonton:

- 100 or 150A Service
- @ 240V, 20-80A per EV

Variables:

- Base load?
- Where will cars plug in?
- When will they plug in?
- How long will they charge?
- What is the maximum load?

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Residential Transformers

DFO's provide **capacity** to non-instantaneous (i.e. system average) **peak load**

Per 37.5kVA Transformer:

- Per house: Average, peak load 2-3kW
- Transformer average peak: 24-36kW
  - >20,000 installed 37.5kVAs in Edmonton

EV Charging Levels:

- Per EV: Charging Demand 3.2-19.2kW
  - Average ~ 7.2kW
- Concurrent charging: two Tesla's at 19.2kW -> 38.4kW

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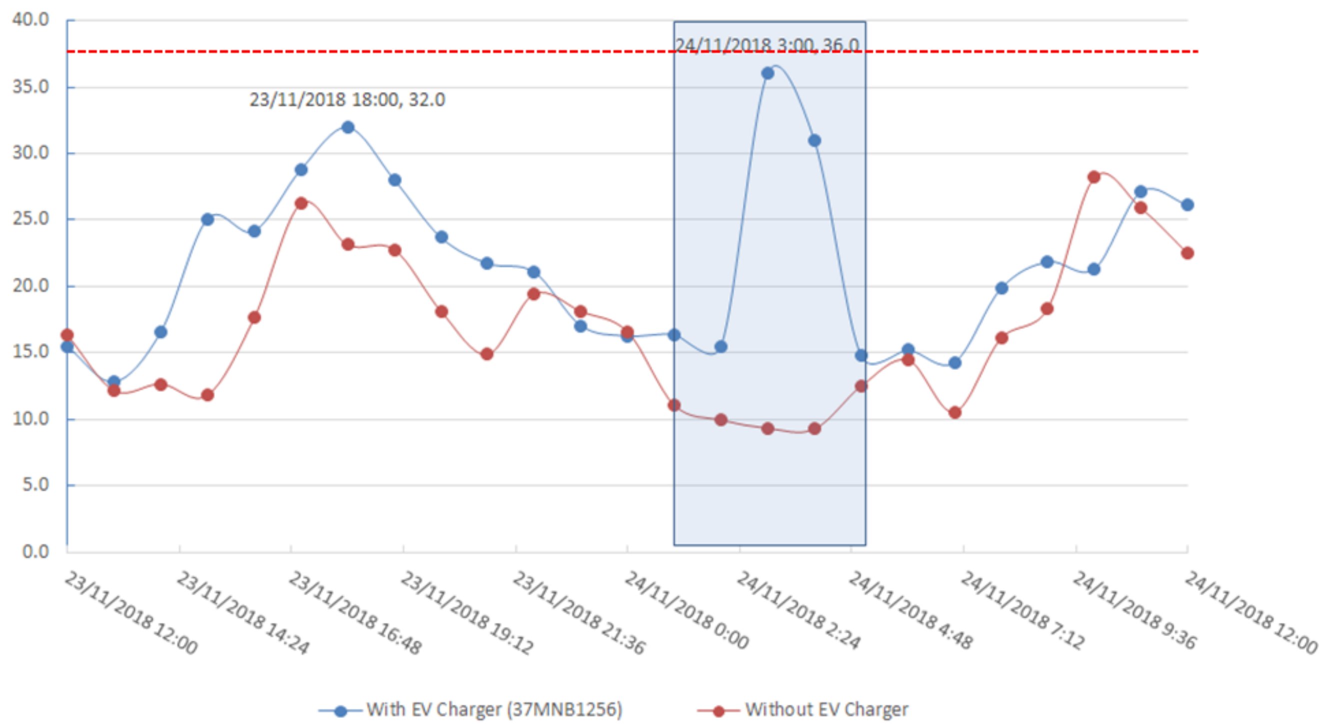
Transformer Load With & Without an EV

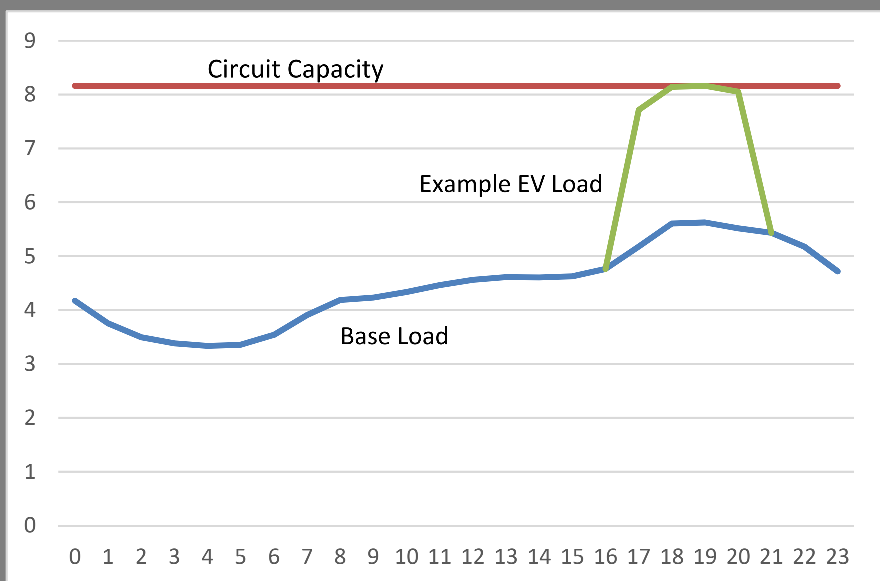
- A real example from EDTI's system:



Impacts to Planning & Forecasting

- DFO's provide **capacity** to non-instantaneous (i.e. system average) **peak load**

Peak demand (MW), 15kV residential circuit



EV Charging Levels:

- This circuit peaks at 5.6MW
- 2.5MW of remaining capacity which is the equivalent to:
  - 132 EVs @ 19.2kW or
  - 793 EVs @ 3.2kW
- 5,500+ customers on circuit

Key Findings

- Unprecedented demand - 2x to 10x addition of load compared to a house
- Granularity is needed – all the way down to the transformer
- Charging demand is what matters
  - Only 1 EV can overload standard service transformer
  - A small number of EVs could lead to circuit overloads

Navigating the EV Challenge

- Fundamental mismatch between existing capacity and future demand
- Will require additional distribution infrastructure
- Potential ways of deferring, delaying, reducing capital investment
  - Smart chargers?
  - Utility visibility / control (DERMS)?
  - Incentives?
  - New rules? New Legislation?
  - Co-located ES, to buffer the power demand?
  - Demand-side technologies?
- For each of these, must consider
  - Impact to customers
  - Complexity of deployment
  - Extent of mitigating effect on utility cost of service

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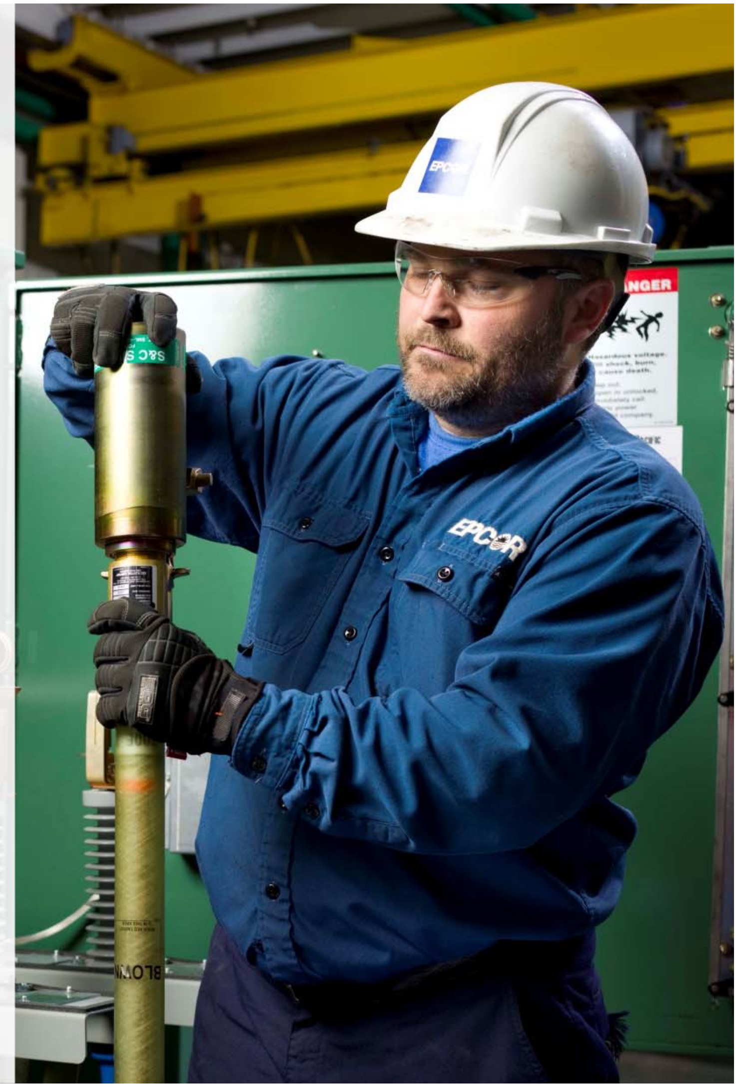

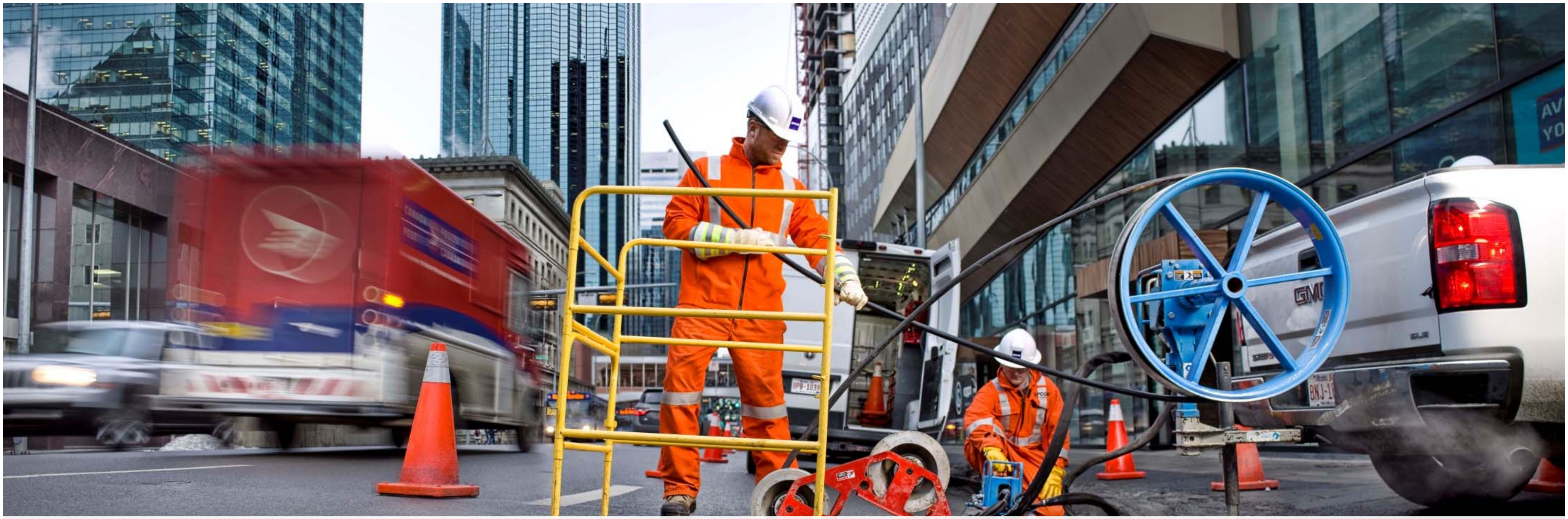

THANK YOU