

# Advances in DERs – Empirical Evidence and Barriers

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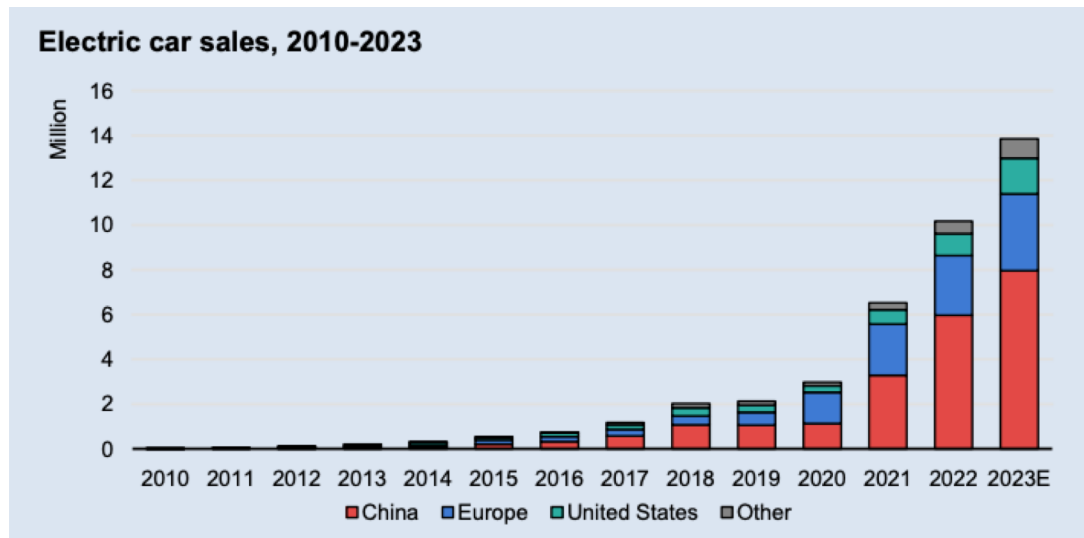
**UNIVERSITY OF ALBERTA**  
FUTURE ENERGY SYSTEMS



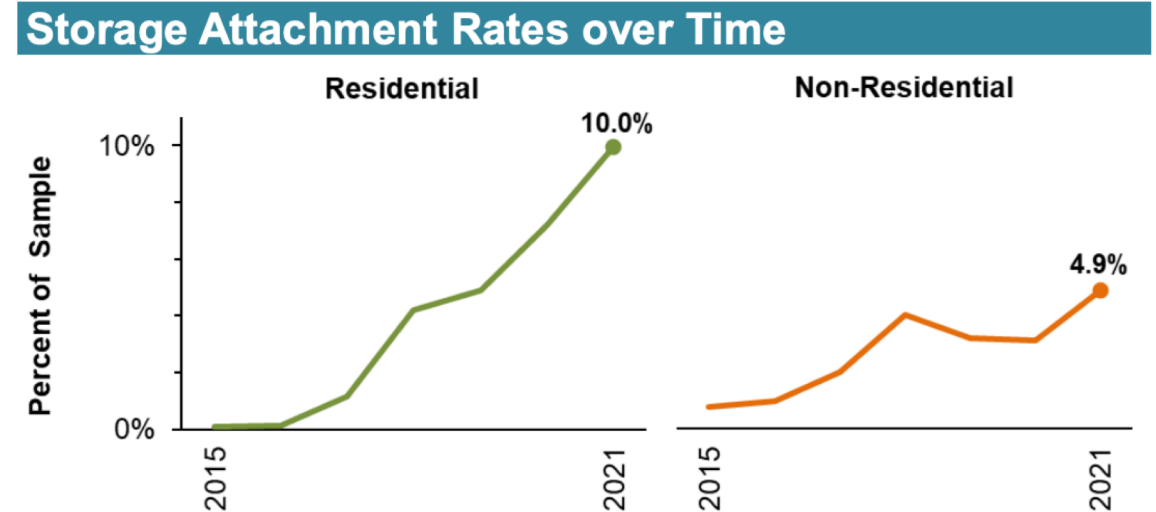
**CAEE**

Canadian Association for Energy Economics

# Rapidly Increasing DER Deployment



IEA (2023)



LBNL Tracking the Sun (2022)

# DER Opportunities

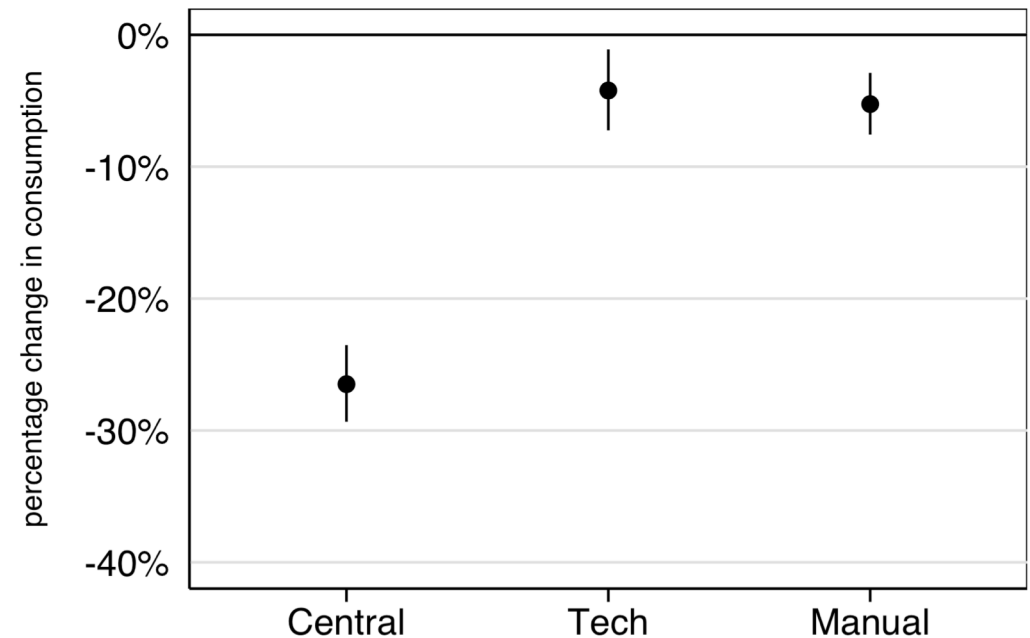
- DERs can be leveraged to provide valuable grid services
- Large number of emerging applications
  - Texas' "Virtual Power Plant" (Battery Storage)
  - Texas' Smart Energy Savers Program (Thermostats)
  - PG&E Smart AC Program (Thermostats)
  - Vermont's Green Mountain Power (Battery Storage)
  - PG&E's WattSaver Program (Hot Water Heaters)
- Leverage technology + automation of devices
- Overcome traditional barriers of inattention, information asymmetries, effort costs



(Andrew Francis Wallace/Toronto Star/Getty Images)

# Evidence from a Field Experiment – Critical Peak Pricing

- Partner with a utility in Canada
- Periodic critical peak pricing events
- Load Controllers on key devices
  - Thermostats, level 2 EVs, hot water
- Assign households to three groups:
  1. **Central** – devices + automation
  2. **Tech** – devices-only
  3. **Manual** – no devices



Bailey, Brown, Shaffer, Wolak (2023)



# Distribution Network Challenges

Canada's electricity grid isn't ready for a net-zero future: report

Clean Energy Canada | December 1, 2021

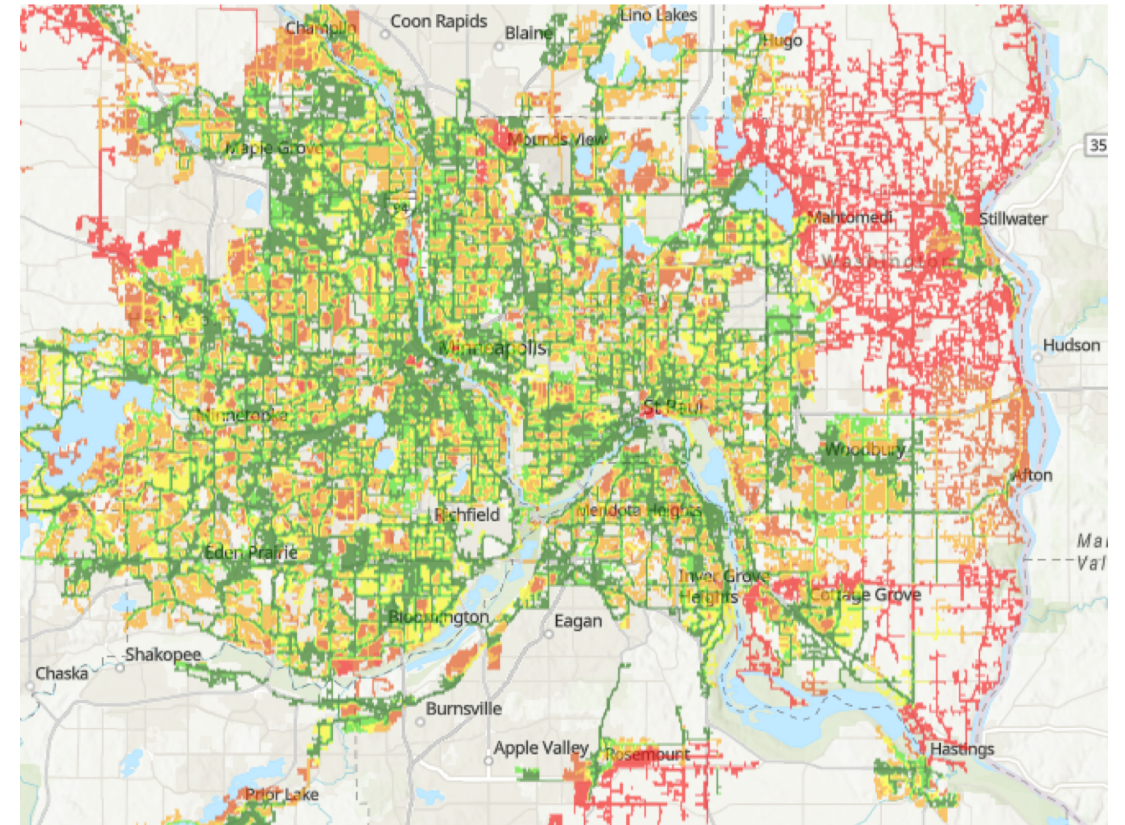
THE ROAD TO ELECTRIC VEHICLES

## Plug-in cars are the future. The grid isn't ready.

By 2035, the chief automakers will have turned away from the internal combustion engine. It'll be up to the grid to fuel all those new cars, trucks and buses.



By [Will Englund](#)



Xcel Hosting Capacity Map (Sept 2023)

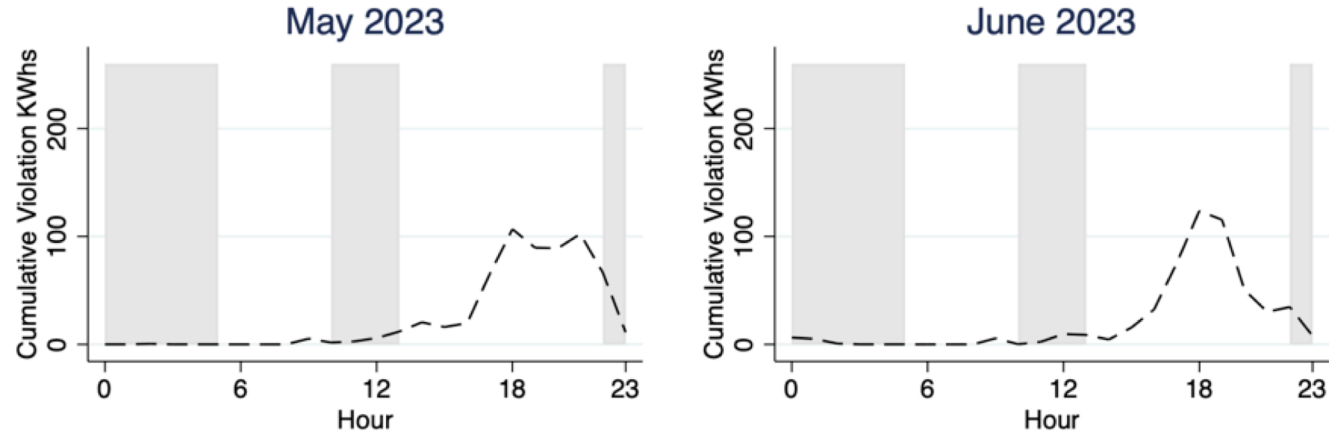
# EV Integration Pilot

- Demand-side management pilot approved by the Alberta Utilities Commission
- FortisAlberta & Optiwatt
- EV Smart Charging Pilot
  - Impacts of EV charging on distribution grid
  - Assess impact of EVs on distribution infrastructure
- Managed Charging vs Time-of-Use (TOU)
- 10 EV Transformer Groups
- Evaluate violation of grid constraints

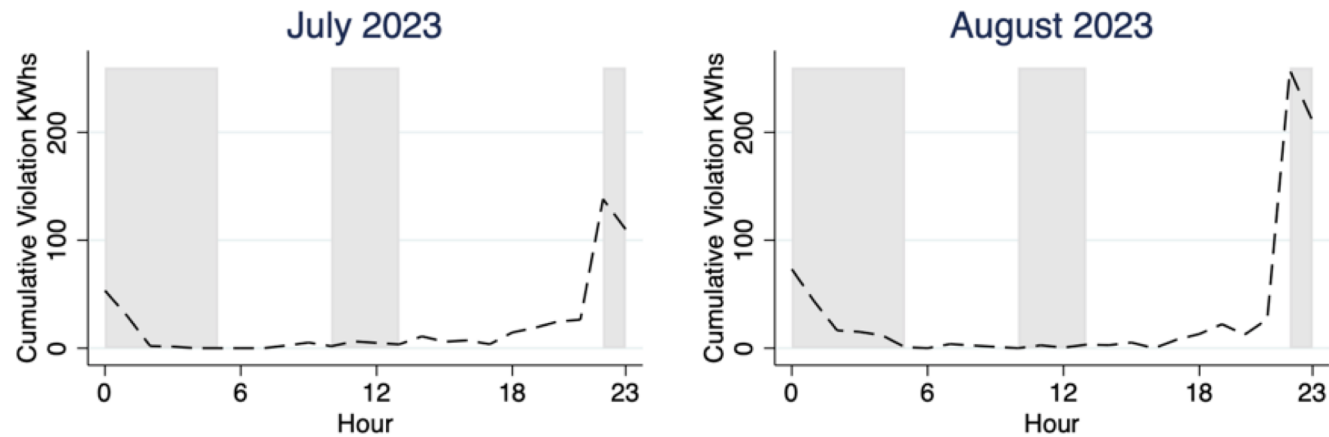


# Preliminary Evidence – TOU Group

No \$ incentive



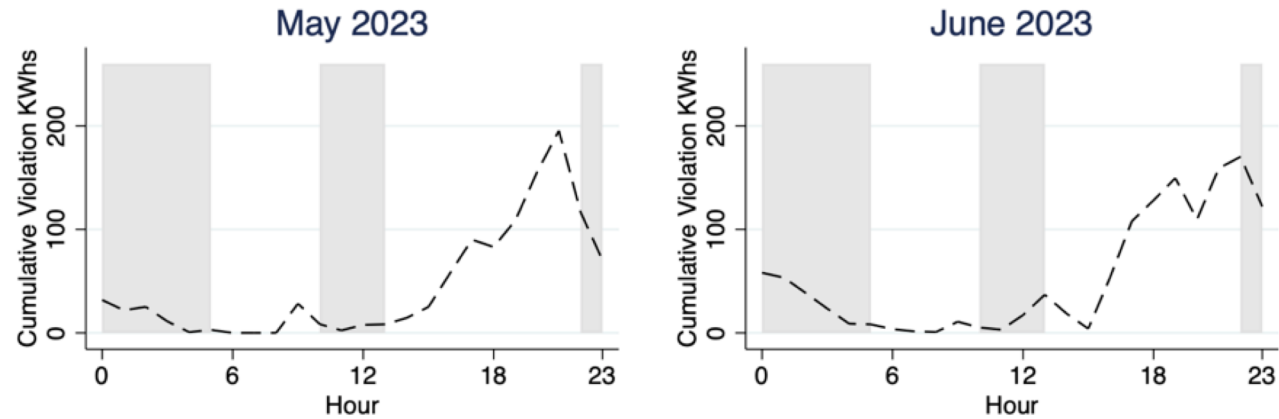
\$ incentive



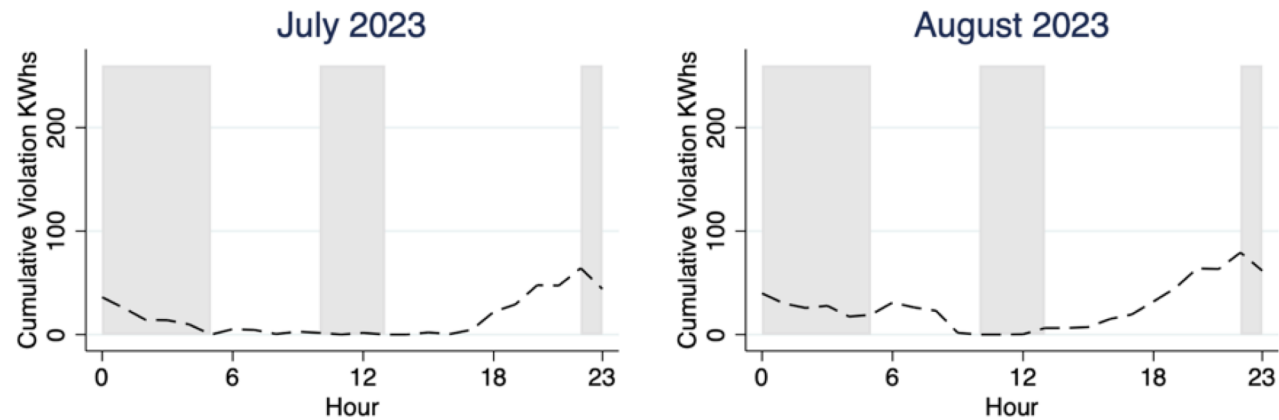
Bailey, Brown, Myers, Shaffer, Wolak (2023)

# Preliminary Evidence – Managed Charging

No \$ incentive



\$ incentive



Bailey, Brown, Myers, Shaffer, Wolak (2023)

# Unlocking DERs Potential (and Reducing Integration Costs)

1. Acceptance of automation/management (or responding to prices)
2. Retail tariff design
  - Efficient intensive (use) and extensive (adoption decision) margins
  - Equity concerns
3. Regulation and market design/governance

# Regulated Distribution Utility

## Benefits

- Economies of scope
  - Leverage information and expertise
- Fewer changes to existing market structure

## Challenges

- Motivate utility to identify cost-effective DER alternatives
  - Role for incentive regulation
- Incentive for market foreclosure
- Integrating competitive procurement of DERs
- Heavy regulatory burden
  - Hundreds of thousands of assets

# Distribution Network Owner and Operator

## Benefits

- Competitive procurement of DER/DSM services
  - Expected lower cost
  - Innovation
- Economies of scope on network operation

## Challenges

- Significant change in market structure/framework
  - How do we get there?
- Structural unbundling difficult
- Design of remuneration to operate network
  - Reduce network costs + procure least-cost resource
  - Equalize OPEX and CAPEX?

# Wrapping Up

- Considerable opportunities to leverage emerging DER technologies
- Enhanced automation + flexibility may reduce cost of integration
  - EVs – large demand (7+ KWs) & differential timing between use and charging
- Industry faces significant regulatory changes and decisions
  - Decision on separation of market structure
  - Design of incentives to motivate dist. utility action