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ELECTRIFICATION COSTS IN THE MIDWEST

Two Approaches from Chicago and Minneapolis

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Agenda

- Background
- Chicago Bill Impacts Case Study
- Minneapolis Beneficial Electrification Study



Modeling the Economics of Electrification

- The economics of electrification are dependent largely on local factors
- Savings are governed by a combination of rates, fees, weather, behavior, and building details
- Collecting this information for use in modeling or forecasting efforts can be a complex and challenging endeavor
- The dependence on site-specific details also makes it challenging to model electrification impacts on the scale of building types and populations











Research Questions

- What do we need to get customer bill impacts estimates right?
- What are the primary levers for bill savings for electrified homes?
- Which building types present the easiest path to savings?
- How do we balance costs and emission savings?
- How do these variations inform electrification strategies?

Electrification Projects

- ComEd EEE Bill Impacts Calculator
 - Looks at customer-specific bill impacts
 - Used to produce case studies of several customer types, modeling several system, fuel, and rate scenarios
- Minneapolis Beneficial Electrification Study
 - Estimate upfront and ongoing energy costs of electrifying 1-4 unit buildings in Minneapolis
 - Identify how and why costs vary across building stock
 - Use technical results to inform an electrification roadmap (barriers, opportunities, priorities, and strategies)



Chicago Bill Impacts Case Study



Chicago Bill Impacts Case Study

- This study uses the EEE Bill Impacts Calculator tools developed for ComEd by CEE to model the economics of partially and fully electrifying a single home in Chicago
- The tool uses building-specific energy, weather, rate, and system information to model the effects of electrifying space conditioning, cooking, water heating, and clothes drying for this example customer type
- Measure calculations are based on the IL TRM and have been modified to align with CEE's field work and expand functionality

Variable Speed Air Source Heat Pump

Input	
Yes	
77,096,290	Btu
9,472,579	Btu
10%	
Hourly - 2020	
Regular	
2020	
2019	
Natural Gas	
Ameren	
High	
Ameren	
High	
Dual Fuel	
15	°F
4,087	kWh
Furnace	
Yes	
80%	
64%	
13	
10	
6	
20	
0.1	KW
3	
Good	
1.97	
	Input Yes 77,096,290 9,472,579 10% Hourly - 2020 Regular 2020 2019 Natural Gas Ameren High Ameren High Dual Fuel 15 4,087 4,087 5 4,087 5 4,087 5 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 4,087 15 15 15 15 15 15 15 15 15 15

Example Case Study Results – Whole Home Electrification





- Eliminating natural gas fixed costs can be a major lever for savings in whole-home electrification scenarios
 - In some cases, gas customers in ComEd territory can pay comparatively high fixed fees for gas service
 - Chicago case study results show fixed gas fees exceeding \$600 a year for some utilities
 - In comparison, typical fees of about \$100 a year in Minneapolis do not drive savings of whole-home electrification
- Propane customers can see sizable savings in every scenario
 - Propane can be over 3x the price of gas in ComEd territory
 - High propane costs drive large electrification savings



- As can be expected, customer bill impacts of electrification display extreme sensitivity to electric rates
- This is particularly prevalent with partial electrification and dual-fuel heat pump systems where savings from the elimination of gas fixed costs are not possible
- In cost-sensitive scenarios, there is often a payoff between environmental benefit and customer costs

Minneapolis Beneficial Electrification Study



Minneapolis Electrification Study

- Minneapolis seeks to decarbonize by ~2042
 - The 88,441 1-4 unit buildings are a very large fraction of current emissions
- Identify pathways and build roadmap to decarbonize these buildings
 - Estimate cost and scope of decarbonizing city's largest building sector to facilitate planning
 - Incorporate city and external stakeholder input on decarbonization pathways
 - Compare upfront and ongoing costs of decarbonization for different rates, technologies, and strategies



Modeling the Minneapolis Building Stock

- Develop building stock model from city data and CEE energy audit data
- Estimate energy loads and electrification requirements for all 88,441 buildings
- Estimate costs and savings from decarbonization pathways as a function of building stock
 - E.g. Age, type, cladding, size, location, and building performance data (wall, attic insulation, air leakage)



Electrification Measures

 95%+ of natural gas use in these buildings is for heating, hot water, clothes drying, and cooking

Breakdown of climate emissions reduction potential from all electric and dual fuel retrofit scenarios



ASHP Weatherization Hot water Appliance Remaining*

*Assorted fuel using equipment such as garage, lawn, pool equipment, and unknown natural gas use

Weatherization:

- Wall insulation
- Attic insulation
- Air sealing
- Rim joist insulation
- Continuous exhaust ventilation

Electrification:

- Electric service panel upgrades
- Level 2 EV charging circuit
- Cold climate air source heat pump (ccASHPs) in either all-electric or dualfuel configurations
- Heat pump water heaters (HPWH)
- Heat pump clothes dryers (HPCD)
- Induction ranges

Upfront Measure Cost Distributions



Costs of Electrification

- Upfront costs vary across building stock
 - Baseline spending \$12,000 / bldg
 - Upfront costs range \$24,000 \$30,900 / bldg
 - Incremental cost \$12,000 \$18,900 / bldg
- Customer bills vary across building stock
 - Weatherization is critical to lowering bills
- Electrification strategies considering upfront and ongoing costs are key to accelerating early savings and meeting equity goals





- It's all about the heat pump! 75% of the energy/emissions impact and 80% of the cost is from space heating loads
- Electrification is cheaper than switching to decarbonized natural gas
- At current (1.05 \$/therm) natural gas prices, electrification still yields slightly higher energy bills (+4%)
 - Weatherization is required; weatherization measures provide heating savings potential of 31%, offsetting 85%+ of the potential increase in customer bills due to space heating electrification
 - Special all-electric rates enable median bill savings of 16% and yield savings for 84% of buildings today
 - Special dual-fuel rates have flexibility to trade emissions savings for additional bill savings







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