CO Codes & Standards Study and Evaluation

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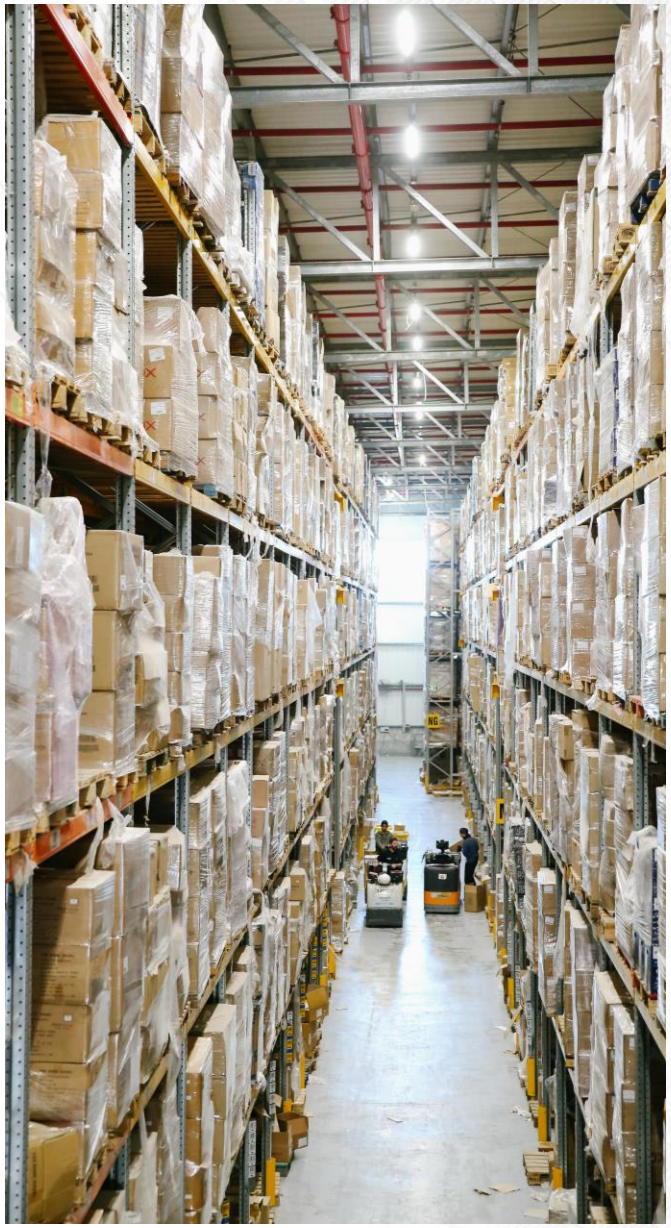
08/10/22 Xcel Energy DSM Roundtable



Agenda

- Project Progress
- Findings from Interviews & Desk Research
- Observations from Field Study
- Lost Energy Cost Savings Preliminary Results
- Next Steps

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Progress Update

CO Codes & Standards Evaluation Progress

Xcel Energy Staff Interviews*

Status: Complete

Verify & Evaluate Compliance Rates in CO Compliance Study

Status: Complete

Desk Review: Best Practices for Technical Savings & Attribution Model*

Status: Complete

Identify & Complete Additional Research where Beneficial*

Status: In Progress

Key Informant Interviews*

Status: Complete

Recommend Process Changes with Special Focus on Data Collection*

Status: In Progress

*These tasks will include a dimension on understanding green code adoption and strategies used to spur beneficial electrification, including identifying opportunities for Xcel Energy to increase support.

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Interviews & Desk Research

Stakeholder Interviews & Desk Research

- 8 Reviewed Relevant Code Compliance Studies
- 15 Interviews*
  - 4 Xcel Energy Staff Interviews
  - 11 Stakeholder / Key Informant Interviews

Organization	Role
ENCOLOR LLC & AESP Board Member (former EMI Consulting)	Primary Product Design Consultant
Build Tank	Principal Thinker
CEO (Colorado Energy Office)	Senior Program Manager for Building Policy
City of Denver	Renewable Energy Specialist
City of Denver	High Performance Building Project Specialist
Salt River Project	Supervisor, Measurement and Evaluation
Salt River Project	Codes Lead
Shums Coda Associates	Implementation Lead for Xcel Energy
SWEEP / CO Energy Code Compliance Collaborative	Senior Buildings Efficiency Program
SWEEP / CO Energy Code Compliance Collaborative	Director, Buildings Efficiency Program
Tierra Resource Consultants LLC (former Arizona Public Service)	Principal
Xcel Energy	Product Developer
Xcel Energy	Product Portfolio Manager
Xcel Energy	Product Portfolio Manager

* 1 interview conducted with 2 key informants (14 total interviews)

Stakeholder Interviews & Desk Research Findings

Topic	Findings
Best Practices for Codes Products	• Implementer known by community • Targeted trainings for contractors and building officials • Consistent methodology
Lessons Learned for Codes Products	• EE codes are as important as health/safety codes • Include all communities during outreach and trainings • Don’t launch until you have the resources you need to succeed
Implications of Home-Rule Policy in Colorado	• Customize the program for each community • It is taxing to track and serve multiple jurisdictions • Some jurisdictions exceed the code. There is always room for a stretch code.

Stakeholder Interviews & Desk Research Findings (Cont.)

Topic	Findings
Positive Experiences with Xcel Energy's Codes Product	• Interviewees were positive about Xcel Energy's code product • Interviewees familiar with the program were confident in Shums Coda
Areas of Improvement for Xcel Energy's Codes Product	• Xcel Energy needs a clear stance on electrification codes • Consider a website that included all trainings and resources from the Xcel Energy Codes product

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Observations from Field Study

Field Study Methodology – Sampling

- Study capped at 50 site visits due to budget
- Guidehouse removed small strata due to low expected energy consumption
- Guidehouse reflected total new construction percentage breakdowns by building type, energy consumption, and square footage

Building Type	Total Site Visits	Small Strata Site Visits	Medium Strata Site Visits	Large Strata Site Visits
Multifamily	13	-	3	10
Office	11	-	3	8
Warehouse	6	-	2	4
Retail	14	-	4	10
Education	6	-	2	4
Totals	**50**	**0**	**14**	**36**

Field Study Observations

- Majority of jurisdictions were evaluated to the 2018 or 2015 codes – depending on what was adopted

- Buildings evaluated by
  - Compliance path (prescriptive, performance, ASHRAE 90.1)
  - Occupancy type
  - Size
  - Climate zone
  - Type of mechanical equipment

- Did not look at every code requirement
  - Mainly focused on medium and high impact items

Field Study Observations (Cont.)

Areas for Improvement	Positive Findings
Compliance documentation in field	Better energy code plan reviews
Commissioning of lighting controls	Lighting power density always met
Commissioning of mechanical equipment	HVAC efficiencies exceeded minimums
COMcheck and Performance Report reviews	More buildings starting to go performance and get tested
Daylighting and skylights	Putting in better windows
Not a lot of energy inspections	More jurisdictions on newer codes

Field Study Observations (Cont.)

Areas for Improvement	Positive Findings
Equipment sizing / Load calculations	Better overall compliance than expected
Mechanical and lighting were the only options chosen	Large improvement from last commercial study in 2016
Elevator lighting / fans	People want to learn where they can do better. Nobody sets out to do a bad job.
Equipment efficiencies not on plans	**Regularly exceeding code requirements**
Glazing U-factors and SHGC verification	

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Lost Energy Cost Savings Preliminary Results

Lost Energy Cost Savings Methodology

- PNNL developed a spreadsheet-based calculation tool to estimate present value of lost energy cost savings by measure and total by building – when measures were not in compliance with the energy code. PNNL used 2020 EIA values of $0.1039/kWh and $0.5855/therm.*
- Tool uses prototype building energy simulations to estimate lost energy savings for a range of possible conditions that could be found in the field for each code measure. From those results, regressions are developed that can be applied to any found field condition to estimate lost energy cost savings.
- Tool is populated with data collected during site visits conducted by Shaunna Mozingo, Mozingo Code Group.

* EIA rates are calculated from total $ sales and total consumption, so account for any demand charges. PNNL used a weighted average by consumption over a prior 12-month period to help smooth any short-term rates volatility. Results by measure for cooling measures (peak demand coincident) may be understated by using the single average rates; while non-coincident measures may be overstated.

Total Lost Energy Cost Savings by Building Type

- This roll-up includes the concept of applicability, as lost energy cost savings are not estimated where a measure is not applicable
- These results are minimum lost energy cost savings, as most but not all applicable measure instances were able to be verified by field observation

		Lost Energy Cost Savings from Non-compliance			
Building Type n = # of buildings	**Average conditioned area, sf**	**Sum of $/yr**	**Sum of PV $**	**Sum of $/year/ksf**	**Sum of PV $/ksf**
Office, n = 11	151,450	$8,086	$114,661	$80	$1,214
Retail, n = 14	137,421	$33,928	$576,355	$432	$6,926
School, n = 6	176,819	$6	$80	$0	$0
Multifamily, n = 13	287,187	$4,134	$102,121	$79	$2,020
Warehouse, n = 6	191,305	$7,124	$104,847	$58	$904
Grand Total or Weighted Average	196,170	$53,278	$898,064	$649	$11,065

Total Lost Energy Cost Savings per Site

	Lost Energy Cost Savings per Site		
	$/yr	**PV $**	**PV $/ksf**
Minimum	$0	$0	$0
Median	$69	$1,454	$6
Average	$1,066	$17,961	$221
Maximum	$16,012	$244,032	$4,576

Top 15 Lost Energy Cost Savings by Measure

Measure	# of Measures		Lost Energy Cost Savings		
	Appl.	Verified	$/year	$/yr/ksf	PV$/ksf
Energy recovery requirement	13	4	$8,617	$167	$2,715
Building shall meet continuous air barrier requirements	50	31	$2,280	$65	$1,770
Mechanical Commissioning	44	13	$5,668	$84	$1,089
Demand control ventilation	23	10	$4,582	$71	$1,057
For large, high-bay spaces total daylight zone under skylights at least 1/2 of floor area	9	6	$9,481	$75	$951
Skylight to roof ratio shall meet maximum limits	4	4	$7,658	$37	$792
Opaque rollup doors shall meet U-factor requirements	26	24	$988	$18	$451
Lighting Testing or Commissioning	43	14	$1,652	$31	$404
Roofs shall be insulated to meet CZ requirements	60	56	$1,821	$15	$369
Manual lighting control	40	34	$542	$21	$334
Above grade frame walls shall be insulated to meet CZ requirements	67	58	$796	$8	$215
Night fan control	35	17	$3,077	$12	$163
Thermostat cooling setback	46	26	$1,866	$12	$161
Window-to-wall ratio shall meet maximum limits	30	30	$929	$6	$126
Occupancy sensor control	44	36	$434	$9	$115

Key: Appl. = Applicability; Verified = Measure could be identified and verified, not a metric to identify compliance

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Next Steps

Next Steps

Recommendations

Recommend process changes with a special focus on data collection and share with implementation team

Additional Research

Identify & complete additional research – particularly as related to understanding green code adoption and strategies used to spur beneficial electrification, including identifying opportunities for Xcel Energy to increase support

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Appendix

Colorado Code Compliance Study

List of Code Studies Reviewed

Colorado and Nevada Residential Building Energy Efficiency Field Studies, The Mozingo Code Group (for NASEO), methodology at: https://www.energy.gov/sites/prod/files/2018/06/f52/bto-Res-Field-Study-Methodology-060618-2.pdf

Arizona and Utah Residential Building Energy Efficiency Field Studies, IMT | SWEEP | Nexant | AE3Q | SRP, *final results not available*

Illinois Residential and Commercial Energy Code Compliance, Baseline Studies, Final Report MEEA, Cadmus, Madison Engineering, PNNL, December 31, 2019

2019 Oregon New Commercial Construction Code Evaluation Study, NEEA, October 16, 2019, https://neea.org/img/documents/2019-Oregon-New-Commercial-Construction-Code-EvaluationStudy.pdf

Residential Building Energy Efficiency Field Studies: **Low-Rise Multifamily**, Final Report, Ecotope, Slipstream, Center for Energy and Environment, June 24, 2020, https://www.energycodes.gov/sites/default/files/documents/LRMF_Studies_final_report_2020-06-24.pdf

Single-family Residential Field Study: Phase III Data and Findings, 2019 National Energy Codes Conference. Jeremy Williams, Building Technologies Office

Commercial Energy Code Compliance – Just the Facts, Ma'am. 2017-2020, July 18, 2021 Conference Paper. The Mozingo Code Group (for IMT), NBI, PNNL, U.S. DOE, March 31, 2020. 2020 ACEEE Summer Study on Energy Efficiency in Buildings, August 2020. Link to report: https://newbuildings.org/wp-content/uploads/2020/11/CommercialEnergyCodeCompliance.pdf

Final Report, Attributing Building Energy Code Savings to Energy Efficiency Programs
February 2013. Cadmus, Energy Futures Group, NMR, Optimal Energy
https://neep.org/sites/default/files/resources/NEEP_IMT_IEE_Codes%20Attribution%20FINAL%20Report%2002_16_2013.pdf