Real Life Options for New Construction Evaluation

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Task: Calibrated energy model approach for a NC (and sometimes retrofit) project

working

Problem: No ᵛ Model

What you probably already know:

- Energy savings from building models
- Energy models and their problems
- Alternate verification strategies (A/B/C)

If you don't know:

- How do we get verified savings?

Savings = Baseline Energy Use – Post Energy Use ± Adjustments

IPMVP and UMP

Building Simulation Guidance

- IPMVP option D uses a simulation to predict baseline or post-install usage
- UMP NC measure classified as:
  - Newly Constructed Buildings
  - Additions to Existing Buildings
  - Major Renovations to Existing Buildings

Why not another approach?

- In NC, there's no baseline, no established load profile
- What typically happens?
  - Pass through savings?
  - Verification only?
  - Eliminate savings from individual measures if not fully verified?

So, why no model?

Where's the model?

Why can't we get it?

What do we do?

Verify Equipment?

Create a model?

Is it already calibrated?

Compare to bills?

Adjust outputs?

What's the problem?

- The evaluator receives the model…

  Incompatible software

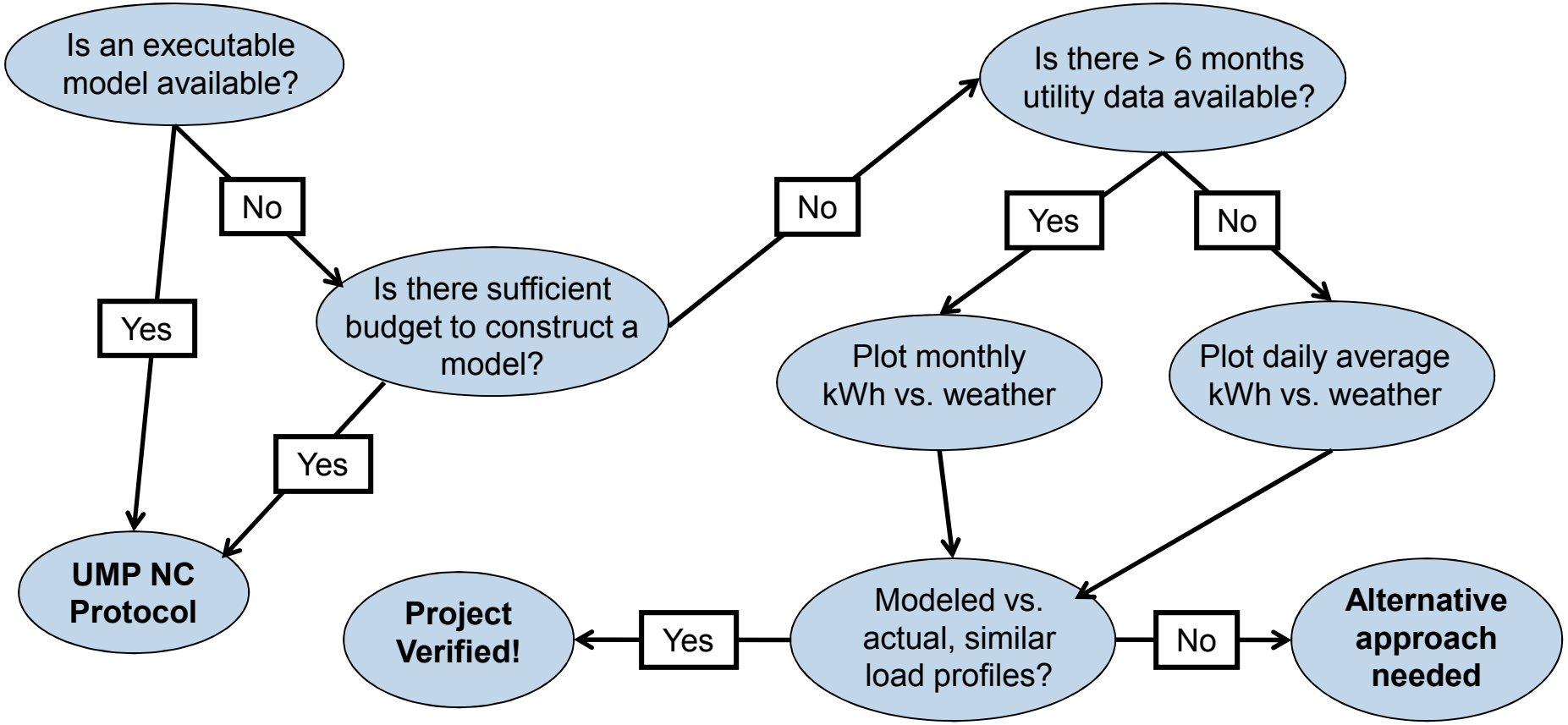
  Model details not easily verifiable

  Numerous measures / systems

  Missing supplemental files

  Original model incorrect or incomplete

Developing an Approach



NC Evaluation Method

- So, we need an alternative approach
  - A method to assess ex-ante model adequacy

    or…

  - A systematic approach to adjust ex-ante savings

Guidelines

1. View post-installation model results by end-use
2. Compare model outputs to utility bills to identify likely errors
3. Inspect equipment and collect any available trend data
4. Make end-use-level or measure-level adjustments to model outputs

Example: Middle School

- New Construction (other building existed on site previously)
- Appendix G baseline
- No executable model available, only outputs
- No baseline utility data, >1 year post utility data

Example: Middle School

Other issues:

- Wrong baseline (NG available, they used electric heating baseline)
- Overestimated summer occupancy
- Equipment modeled and not installed

Example: Middle School

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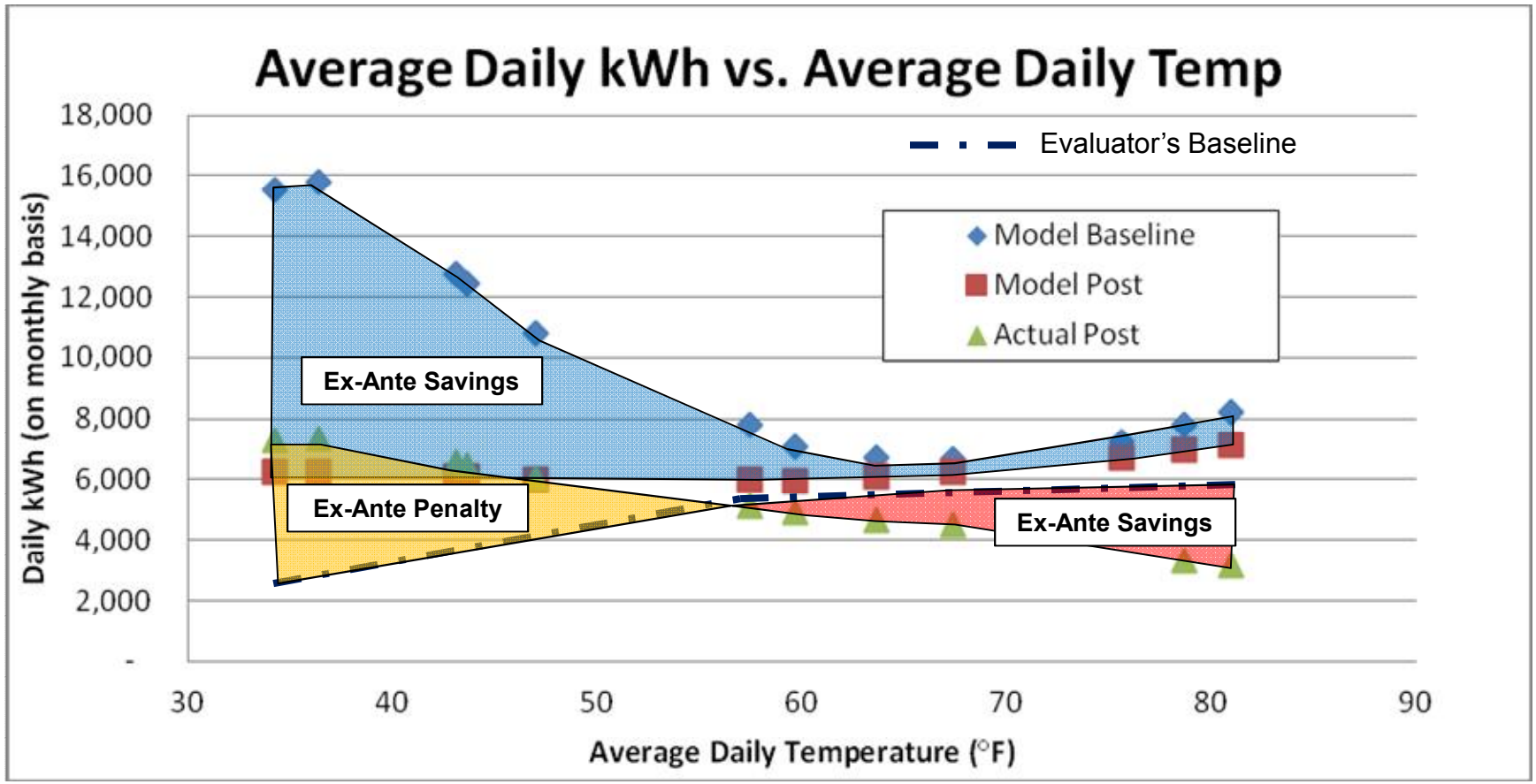
Example: Middle School

		LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE
EM1	ELECTRICITY												
	KWH	486137.	0.	776702.	1137731.	324614.	14909.	157145.	261284.	0.	1978.	0.	22743.
EM2	ELECTRICITY												
	KWH	0.	0.	5184.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FM1	NATURAL-GAS												
	THERM	0.	0.	2228.	793.	0.	0.	0.	0.	0.	0.	3171.	0.

Example: Middle School



Example: Middle School

- Verified electric savings were negative
- There was net gas savings, which could be claimed by the program
- Gas savings offset electrical penalty, realization rates were bad, but incentive level was reasonably accurate

Example: Manufacturing Facility

- Existing building with VFD installation
  - VFDs used to reduce flow of CV units
- Ex-ante savings inaccurate, model estimations were incorrect:
  - Post fan kW higher than anticipated
  - No model access, an alternate approach was needed

Example: Manufacturing Facility

Other issues:

- Limited post-installation data
- Interactive effects
- Sensitive production facility

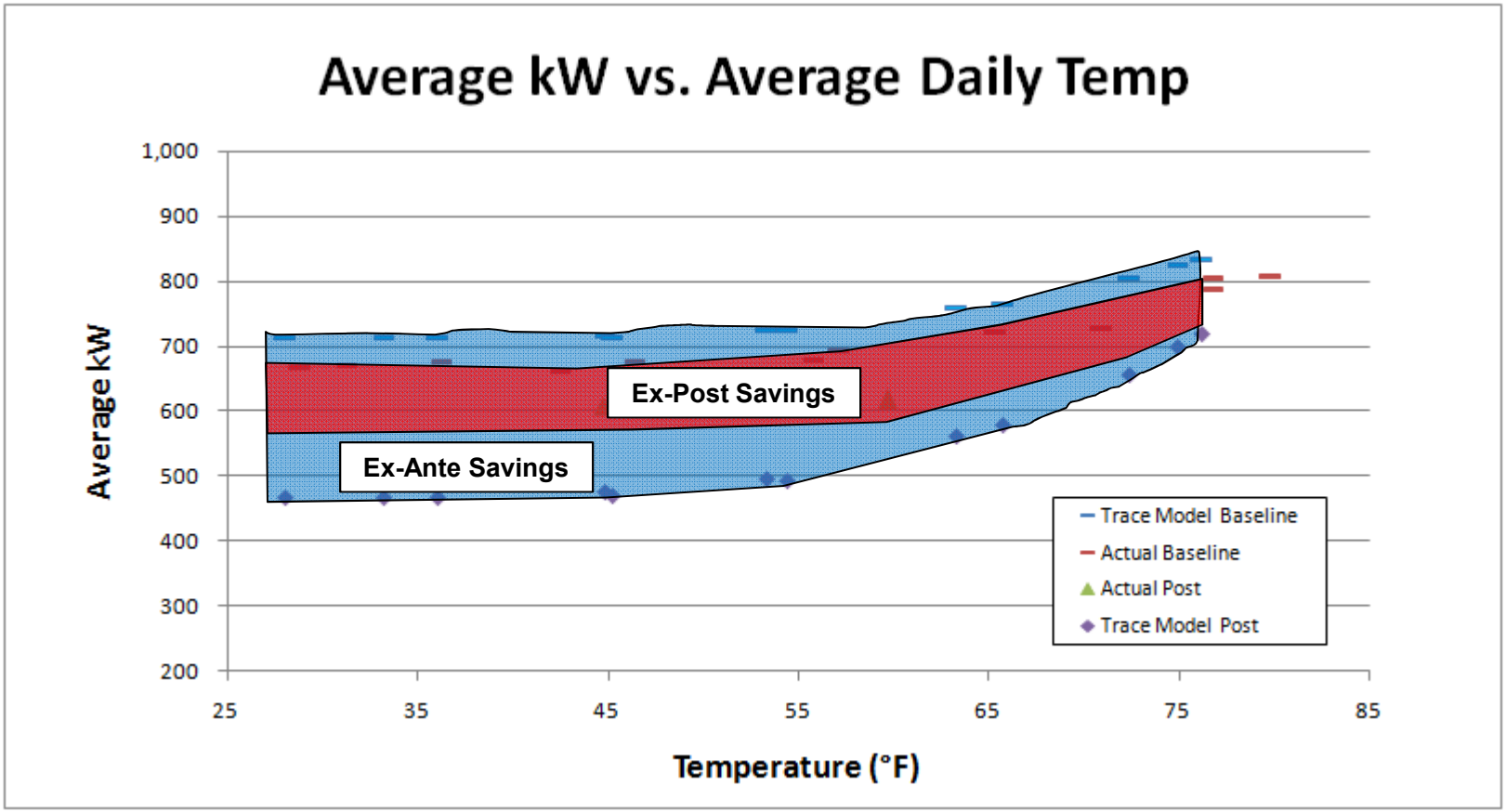
Example: Manufacturing Facility

How did we achieve verified savings?

- Ex-post BL kW lower than ex-ante
- Ex-post actual flow was higher than anticipated

	Modeled (Ex-Ante)				Observed (Ex-Post)		
Unit	Ex-Ante Baseline Design CFM	Ex-Ante Post Design CFM	Post Average CFM (60% of Design)	Ex-Ante Average CFM Saved	Actual Observed CFM	Ex-Ante Baseline Design CFM - Actual Observed CFM	Difference between Ex-Ante Post Design CFM and Actual Observed CFM
AHU-1 SF	14,000	6,386	3,832	10,168	11,160	2,840	(4,774)
AHU-2 SF	23,700	15,449	9,269	14,431	10,000	13,700	5,449
AHU-3 SF	18,450	8,048	4,829	13,621	10,100	8,350	(2,052)
AHU-4 SF	11,500	5,783	3,470	8,030	8,300	3,200	(2,517)
AHU-5 SF	12,950	8,625	5,175	7,775	12,583	367	(3,958)
AHU-6 SF	17,000	7,970	4,782	12,218	11,140	5,860	(3,170)
AHU-7 SF	2,650	3,497	2,098	552	2,650	-	847
AHU-8 SF	16,950	7,710	4,626	12,324	11,750	5,200	(4,040)
AHU-9 SF	18,500	7,710	4,626	13,874	12,000	6,500	(4,290)
AHU-10 SF	7,200	2,816	1,690	5,510	6,500	700	(3,684)
AHU-11 SF	7,200	5,600	3,360	3,840	7,400	(200)	(1,800)
AHU-12 SF	6,500	6,500	3,900	2,600	12,200	(5,700)	(5,700)
AHU-13 SF	16,850	5,142	3,085	13,765	9,200	7,650	(4,058)
AHU-14 SF	16,850	5,142	3,085	13,765	8,400	8,450	(3,258)
AHU-15 SF	16,850	5,142	3,085	13,765	11,400	5,450	(6,258)
AHU-16 SF	16,850	5,142	3,085	13,765	12,100	4,750	(6,958)
Sum	224,00	106,661	[redacted]	160,00	156,883	[redacted]	(50,222)

Example: Manufacturing Facility



Example: Manufacturing Facility

- Verified Savings were 25% of ex-ante savings
- Using actual data, we were able to correct the model baseline
- Using the model, we were able to expand the actual post

Our Approach

- When modeled outputs inaccurately reflect actual operations, alternate approach may be needed
- Make educated adjustments to end-use level outputs

Our Approach

- Our examples:
  - Allow for adjustment with limited resources/time
  - More accurate than “verification only”

Does It Work?

- Our solution:
  - Based on original model
  - Feasible without an operable model
  - Uses site specific observations/data
  - Viable for new construction and retrofit projects
  - Can improve on customer submitted models
  - More rigorous than simple verification

Thank you!

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