



Measurement and Verification Procedures in the Conserve WI Program

Energy Efficiency in State Buildings
Better Buildings Summit for State and Local
Governments

May 30-31, 2013

Megan Levy
Director- Local Energy Programs



CONSERVE WISCONSIN

Energy Use in State-Owned Facilities

- **Program:** Energy Bond Fund and Performance Contracting Program
- **Description:** Since 2008, the Wisconsin Department of Administration (DOA) has operated the state's energy bond fund, which provides financing for **energy savings performance contracting (ESPC)** projects across all state facilities owned by agencies (including universities) that opt-in to the program.
- The fund is capitalized at a total of **\$180 million** and received funding in three waves from the state legislature: \$30 million, \$50 million, and \$100 million.
- The **bonding has a maximum term of 20 years** and with a 5.25% interest rate and 3% energy inflation, **projects must meet a 16-year simple payback.**

CONSERVE WISCONSIN

Goal: Long-term sustainability and effectiveness

Path to success:

- **Identify and Address Market Sector Barriers**
- **Engage key private and public sector stakeholders** including the financial, engineers/architectural, construction communities and utilities
- **Develop and maintain support in state (or local) government.**
- **Plan for long-term ownership of the program**
- **Applicability to other states or local governments:**

Wisconsin's ESPC model offers an example of a state where the performance contracting program is housed outside of the State Energy Office (SEO), which may be a useful consideration for SEOs that might lack the bandwidth or expertise to manage such a program and another state agency is committed to delivering an effective program.

CONSERVE WISCONSIN

Energy Use in State-Owned Facilities

Making Measurement and Verification an Action Item

Establish dynamic feedback on program implementation and process:

Close partnership between ESCO, state agency, institution, and DOA results in dynamic feedback loops.

Establish quality assurance structure:

Each project proposal undergoes significant upfront DOA review for technical and financial soundness. DOA also presents proposed projects to the Building Commission for approval (larger projects require the Governor's approval).

The selected ESCO is responsible for M&V and commissioning in the **first three years**; after that period, the state agency or institution assumes the M&V role. **This provides more investment into metering and dashboard systems with direct institutional involvement rather than outsourcing of annual M&V reports to the ESCO.**



CONSERVE WISCONSIN

M&V Policy



- **“Easy button” test:** Each participating state agency receives the assistance of DOA in managing the project **from selection of the ESCO through establishment of the measurement and verification (M&V).** The DFD assists agencies through the process, so that they are not left alone in negotiating and working with the ESCO.
- The state agency role includes: coordinating site access during audits, assisting in construction coordination (if it chooses to do so), and handling measurement and verification (M&V) after the initial 1-3 year M&V and commissioning period (which is managed by the ESCO).
- The participating agency receives a complete package of services from an ESCO. The ESCO provides a facility energy audit; develops a cost effective proposal; as well as installs, commissions, and conducts the **initial monitoring** of the project and training of facilities staff.

Case Study: Kettle Moraine Correctional Institution (KMCI)



Kettle Moraine Correctional Institution in Sheboygan County near Glenbeulah, Wisconsin consists of 361,612 gross square feet of facilities.

Kettle Moraine Correctional Institute (KMCI) M&V



Correctional institutes have specific challenges.

This project was the first foray into ESPC program with DOC- decided to do a lighting only upgrade.

Small Project was authorized.

Total investment was \$885,097

Projected annual cost savings: \$74, 769

Projected simple payback: 11.84 years

M&V discussed BEFORE, DURING, and AFTER design process. M&V is an action item for the ESCO and Institution.

KMCI M&V Continued



ESCO employed two M&V methods:

- 1.) Standard tables of pre and post energy consumption per ballast/lamp configuration. (Developed by NYSERDA)
- 2.) Physical measurement of the amperage draw by room and lighting circuits to confirm accuracy of the pre and post tables. (IES Recommended Practices were maintained)

As installation progressed, pre and post measurements by circuit were taken and monitored by the ESCO staff.

The M&V effort was completed using best practices for lighting M&V, provided in a Department of Energy plan prepared by Richman, E. (2011). *Standard Measurement and Verification Plan for Lighting Retrofit Projects for Buildings and Building Sites*. Published by the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL), Report Number: PNNL-18173.

Actual Measurements Conducted at KMCI (Pre and Post)

Location		Pre Fixture Count Per Switch	Post Fixture Count Per Switch	Pre T-12 Lamps Per Fixture	Post T-8 Lamps Per Fixture	Pre AMP Reading	Post AMP READING	Pre FC Reading	Post FC READING (Avg)	IES Recommended Practice
Dorm 16	Kitchen	15	15	2	1	6.6	3.1	108	57	50 min
Unit 1	Mess Hall	8	8	2	1	3.4	1.6	47	34	15-30
Unit 1	Mess Hall	8	8	2	1	3.95	1.6	47	34	"
Admin	RM# 121	4	4	2	1	2.5	0.82	40	27	15-30
Admin	RM# 011	6	6	2	1	3.9	1.07	35	30	"
Admin	RM# 016	4	4	2	1	2.36	0.85	48	26	"
Admin	RM# A141	4	4	2	1	2.77	0.83	42	42	"
Admin	Ted's	1	1	4	1	1.25	0.21	70	37	"
Admin	Ted's	1	1	4	1	1.3	0.4	70	37	"
Admin	RM# A157	4	4	4	1	4.63	0.88	45	29	"
School	RM# D-193	5	3	2	1	3.9	1.18	29	38	20-40
School	RM# D-193	5	3	2	1	3.89	1.28	29	38	"
School	RM# D-193	5	3	2	1	2.4	1.17	29	38	"

Case Study: University of Wisconsin, Milwaukee Phase I



Phase 1 of the University of Milwaukee project

UW Milwaukee

Phase I M&V

1. Phase I financed with \$9,660,554 – project is expected to save \$13,570,691 over the life of the agreement (15 years).
2. Implementation complete June 30, 2011- guarantee period begins July 1, 2011. Verified savings were 65.6% ahead of the guarantee.

Type of Savings	Guaranteed	Verified Savings			Ahead of
	Savings	Construction	Year 1	Year 2	Guarantee
Annual kWh Savings	4,134,801	695,458	4,998,434	0	38%
Annual kW Savings	7,190.4	2,222.3	8,808.2	0.0	53%
Annual Steam Savings (MMBtu)	19,862.3	1,102.8	27,478.5	0.0	44%
Annual Chl Wtr Savings (ton-days)	36,541.5	0.0	49,944.0	0.0	37%
Annual Water Savings (CCF)	2,850.0	2,264.4	4,305.1	0.0	131%
Guaranteed Cost		\$0	\$631,441	\$0	
Verified Cost		\$228,174	\$817,405	\$0	66%

How Did They Do It? UW M Phase I M&V Continued

UW-Milwaukee

Analysis of fan VFD operation to validate the percentage reduction of energy relative to the Trane Trace energy model.

Building: EMS
Unit: AC-2
Serves: North offices tower

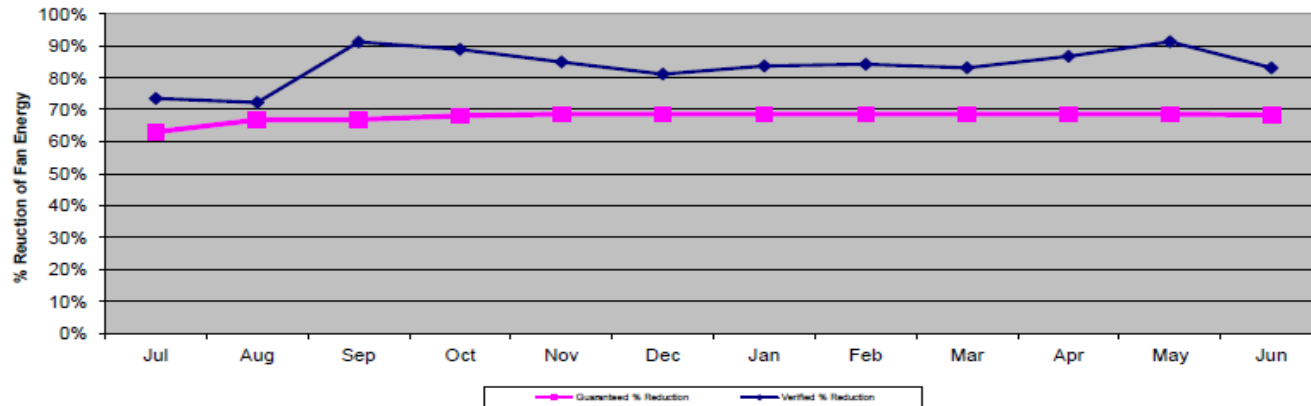
Guaranteed annual hours: 4,370
Pre-retrofit annual hours: 4,884
Air Flow (CFM): 8,821

Weekly fall-sp hours: 84
Weekly summer hours: 84
Measured SF kW: 8.9

Number of Rooms: 55
Total Room Area: 8691 sq ft
Missing Data

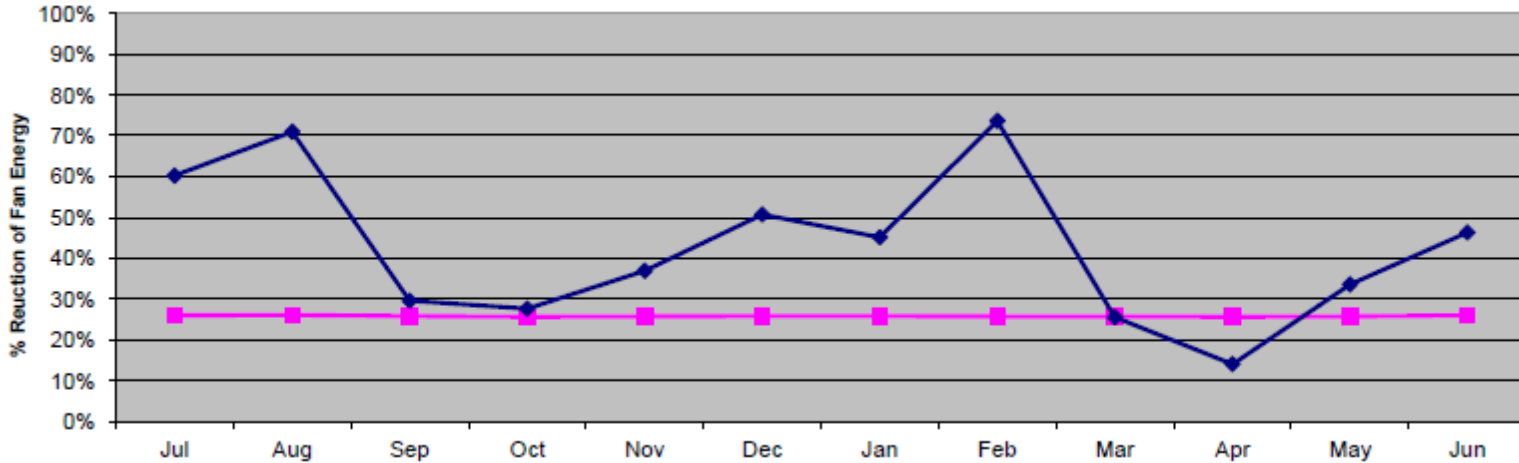
	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	TOTAL
Actual Run Hours	298	260	329	353	400	430	400	400	400	402	325	260	4,258
Est. Guar. Run Hours	372	372	359	371	359	371	371	335	371	359	371	360	4,370
Deviation	-20%	-30%	-8%	-5%	11%	16%	8%	19%	8%	12%	-12%	-28%	-3%
Pre-Retrofit kWh	2,650	2,314	2,932	3,143	3,558	3,827	3,560	3,560	3,560	3,582	2,894	2,318	37,898
Post-Retrofit kWh	702	642	258	350	536	723	581	562	601	476	253	392	6,077
kWh Savings	1,948	1,672	2,674	2,793	3,022	3,104	2,979	2,998	2,959	3,106	2,641	1,926	31,821
Verified % Reduction	74%	72%	91%	89%	85%	81%	84%	84%	83%	87%	91%	83%	84%
Guaranteed % Reduction	63%	67%	67%	68%	69%	69%	69%	69%	69%	69%	69%	68%	68%
Projected % Reduction	87%	92%	92%	94%	95%	95%	95%	95%	95%	95%	95%	94%	93%
Guaranteed													
Electric (kWh)	2,754	3,173	2,917	3,150	3,051	3,098	3,239	2,827	3,260	2,994	3,175	3,123	36,761
Steam (MMBtu)	12	15	17	19	17	9	9	8	15	18	19	15	172.7
Chilled Water (Ton-days)	70	89	73	61	0	0	0	0	0	4	22	73	391.9
Verified													
Electric (kWh)	2,573	2,399	3,652	3,914	4,206	4,248	4,261	4,143	4,258	4,242	3,701	2,747	44,343
Steam (MMBtu)	11	11	21	23	24	12	12	12	20	25	22	13	206.9
Chilled Water (Ton-days)	66	67	91	76	0	0	0	0	0	5	26	64	395.3

Annual VFD Performance Profile

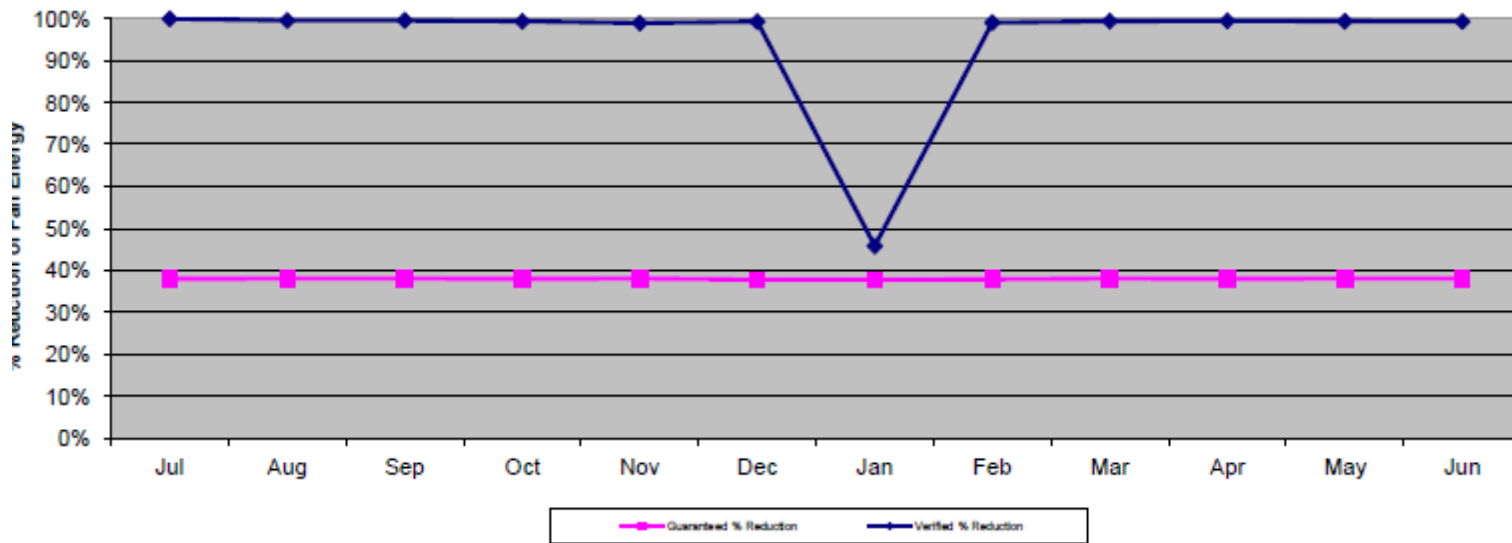


M&V – Teachable Moments

Annual VFD Performance Profile

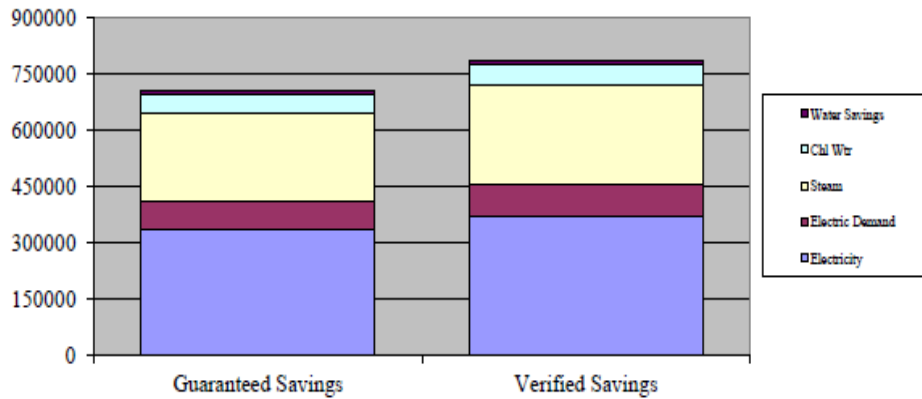
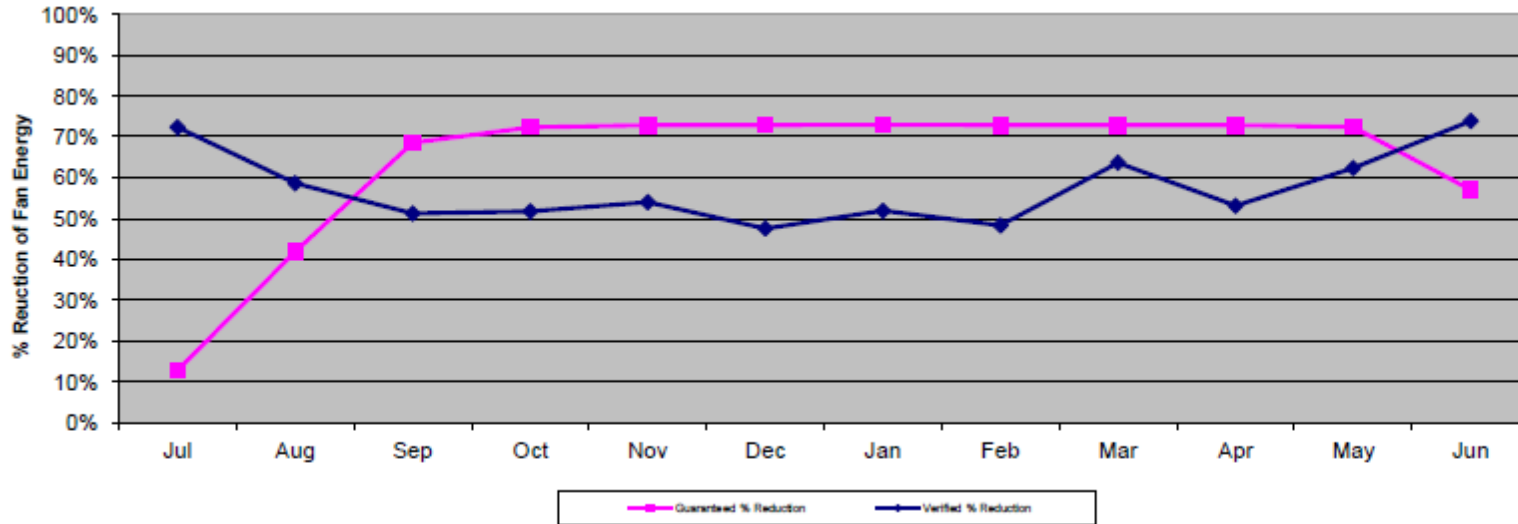


Annual VFD Performance Profile



M&V – Teachable Moments

Annual VFD Performance Profile



Cost Savings Summary	Guaranteed Savings	Verified Savings
Electricity	\$246,103	\$297,507
Electric Demand	\$84,451	\$103,453
Steam	\$233,699	\$323,310
Chl Wtr	\$58,101	\$79,411
Water Savings	\$9,086	\$13,725
Total	\$631,441	\$817,405



Conclusion

- Third Party M&V provided by private A/E firms – involves initial review and familiarity with scope, input (recommending meters/dashboards/controls)
- Institutions still provide best M&V- they know their buildings.
- Students can provide M&V in University Buildings- UW M has made a competition out of it.
- Limit the M&V provided by ESCO to 3 years- no real value past the warranty period.
- Questions?