



Alaska Department of Transportation & Public Facilities

LEAN SIX SIGMA APPROACH TO ENERGY EFFICIENCY PROJECTS

ENERGY EFFICIENCY NOW:
PUTTING THE PIECES OF THE PUZZLE TOGETHER

DIVISION OF FACILITIES SERVICES
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PRESENTER

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*Applying best practices of Lean Six Sigma Project Management to
Energy Efficiency Projects.*



OVERVIEW

- The DOT&PF Energy Program
- The Project Puzzle
- Why Lean Six Sigma
- The DMAIC Project Approach
- Continuous Improvement Culture
- Vision and Leadership





DOT&PF ENERGY PROGRAM

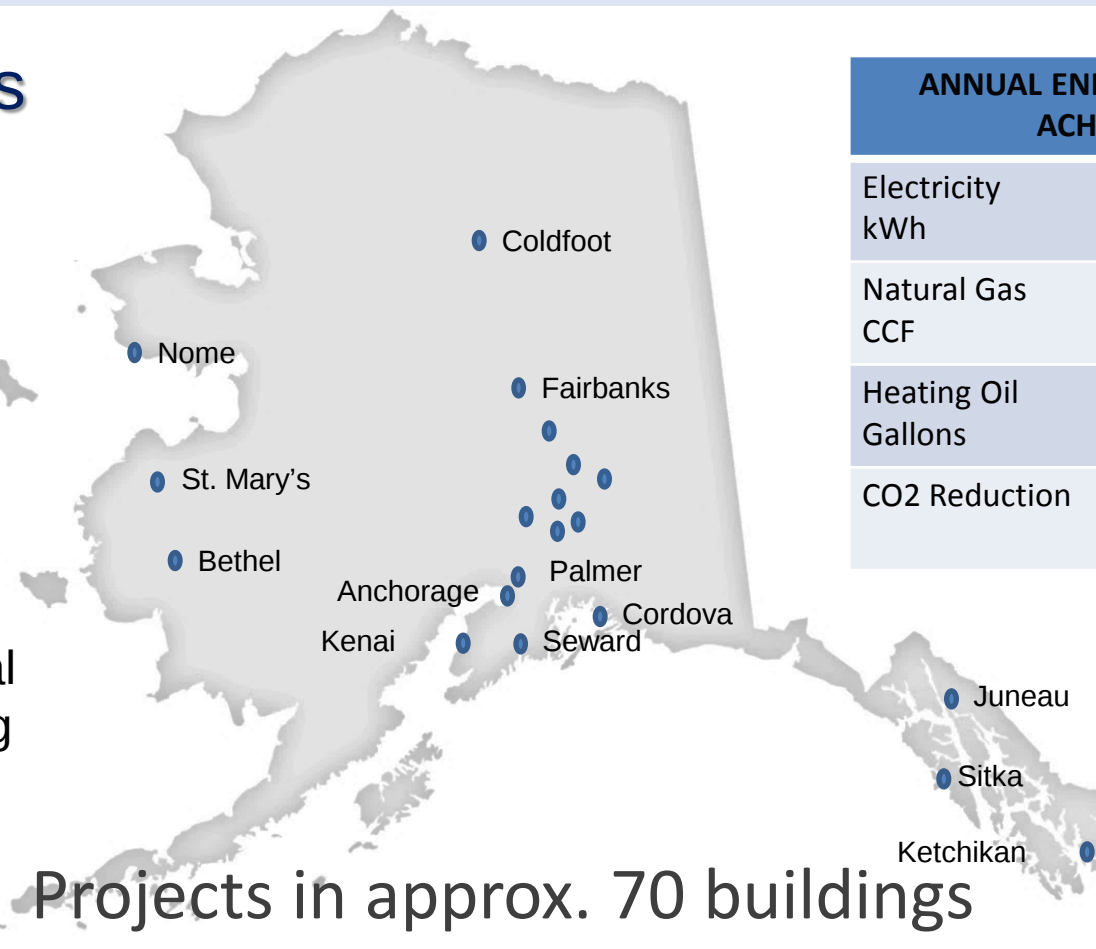
- Provide comprehensive energy efficiency project development, management and implementation services for State and public agencies.
- Manage and execute *Energy Savings Performance Projects* to serve our State Agencies.
- Collaborate with AHFC and other state energy partners to improve statewide energy efficiency.



DOT & PF ENERGY PROGRAM

Annual savings
greater than
\$3.2M

> \$35M in projects
through state, federal
and financed funding



Projects in approx. 70 buildings

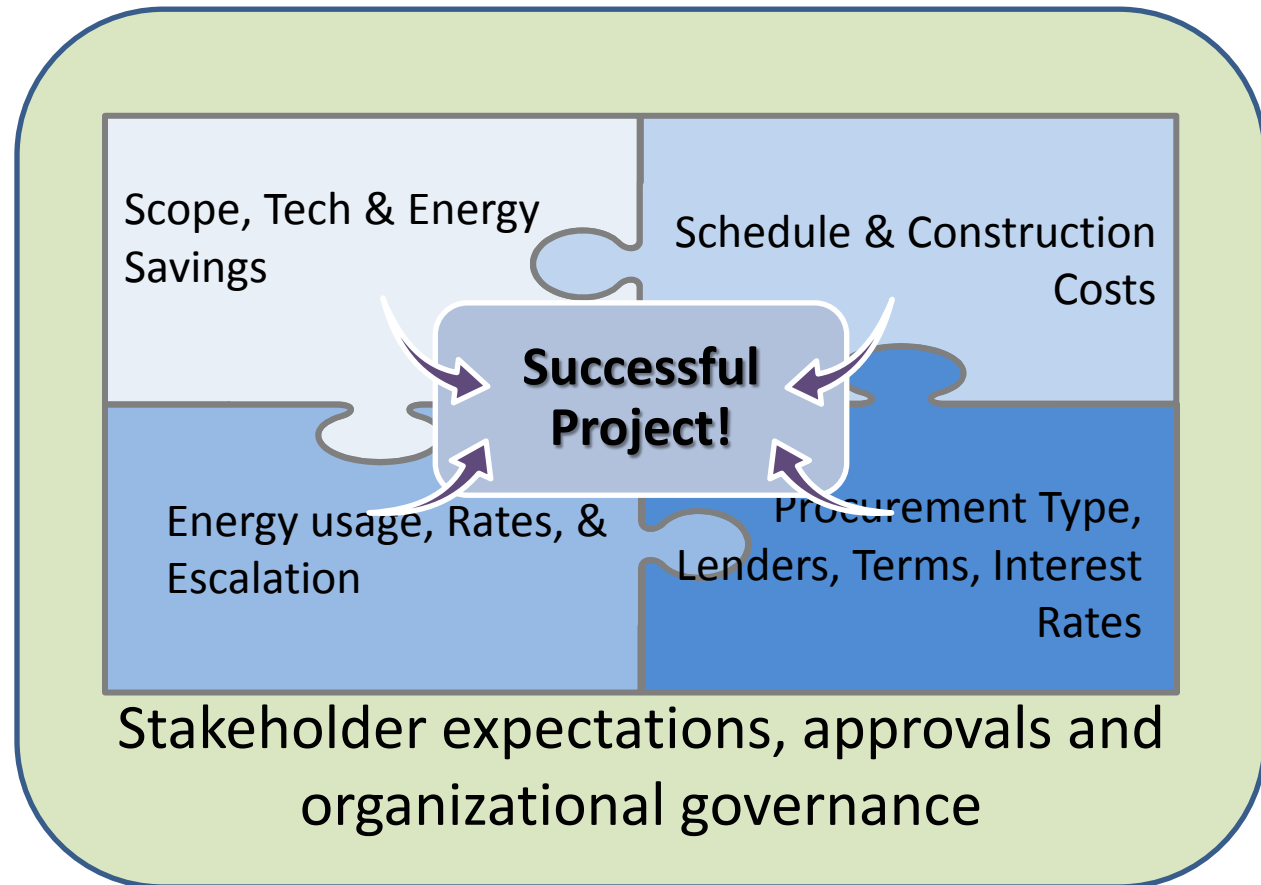
ANNUAL ENERGY SAVINGS ACHIEVED	
Electricity kWh	> 8,115,000
Natural Gas CCF	> 162,000
Heating Oil Gallons	> 261,000
CO2 Reduction	>10,000 Tons



THE PROJECT PUZZLE

Many pieces:

- *Energy retrofit scope, savings & technology*
- *Energy Prices, history and fluctuation*
- *Construction costs, logistics and schedules*
- *Lending options, interest rates & terms.*
- *Client expectations & governing authority*





WHY LEAN SIX SIGMA

- Best practice for continuous improvement projects and organizations
 - *Framework of approach, tools and techniques that can be applied to energy efficiency projects*
- Identifies non-value activities, defects and waste
- Uses empirical data to find:
 - Opportunities for improvement
 - **Define and measure success!**
- Energy Efficiency projects have data all around them – *EUIs, energy units, savings, construction costs, deg. days and more...*



THE DMAIC APPROACH

Define

Measure

Analyze

Improve

Control

D: Defines the goal of the improvement

M: Measures existing systems

A: Analyzes ways to improve the system

I: Executes the improvement

C: Controls the new system by monitoring improvements and adjusting policies & procedures

- Every Energy Efficiency project is unique
 - *Location, Building, Systems, Utilities, etc.*
- DMAIC gives a standard approach to problem solving throughout phases of the project
- Focuses on understanding customer requirements and what adds value



DEFINING THE OPPORTUNITY

Define

Creates the shared vision for executive leadership and stakeholders.

A successfully defined energy project will:

- Outlines the business case & quantifiable benefit
 - Executive level Sponsorship and understanding the stakeholders
 - Goals and objective measures of success
 - Customer requirements and critical parameters – *Metrics and Key Performance Indicators*
- Have clear boundaries and measurable goals
 - *Payback, ROI, replace failed equip.*
 - Be aligned with business critical issues
 - Be formed with the right team members
 - Make the customer feel the improvements
 - *Increased comfort, Lighting levels, Better equipment, decreased costs*



DEFINING THE OPPORTUNITY

Define

Creates the shared vision for executive leadership and stakeholders.

Ex: DOT&PF Northern Region Energy Upgrades

- Business Case: *buildings in immediate need of improvements*
 - *No funding in foreseeable future, financing necessary*
- Executive level Sponsorship: *Commissioner Commitment*
- Goals and objective measures of success: *finance with 15-year payback*
- Stakeholder requirements and critical parameters
 - *Secure other means of heat and power for some locations*
 - *Improve systems – envelope, HVAC and lighting*
 - *Increase life of buildings and equipment*
 - *Reduce consumption (EUIs, utility data)*





MEASURING THE DATA

Measure

Only when existing systems and processes are quantified, can meaningful discussion on improvement begin.

- Establishes the baseline
- Defines the systems and processes in need of improvement
- Outlines desired standards of performance with the stakeholders
- Benchmark existing baseline against others
- Establish the key metrics for success

A successful energy project will:

- Have a thorough and current energy audit to:
 - *Identify energy usage, cost of existing systems and issues*
 - *Baseline the energy use intensity*
 - *Establish existing operations*
 - *Benchmark Energy Use Intensity*
- Verify the key metrics for success:
 - *Units of energy saved, EUIs, payback, ROIs*



MEASURING THE DATA

Measure

Only when existing systems and processes are quantified, can meaningful discussion on improvement begin.

Ex: DOC Spring Creek Energy Upgrades II

- Energy usage Baseline and Benchmark performed through the energy audit process.
- Systems discovered which could be improved
 - Ventilation
 - Heating systems
 - Exterior and interior lighting – newer technologies available



DOC/SCCC Facility Summary Baseline Data (2012)

Agency	Facility Name	Gross Square Footage	CBECS Average 50%	2012 Energy Use Index (kBtu/sf²)
Department of Corrections (DOC)	Spring Creek Correctional Center (SCCC)	205,952	128	169.2

Utility Consumption and Expenditures by Facility 2012

Electric Usage (kWh)	Electric Costs (\$)	Blended Rate (\$/kWh)	Fuel Usage (gal)	Fuel Costs (\$)	Blended Rate (\$/Gal)	Propane Usage (gal)	Propane Costs (\$)	Blended Rate (\$/Gal)	Total Energy Costs/Yr
3,535,812	\$600,250	\$0.17	165,168	\$610,522	\$3.70	20.60	\$89.61	\$4.35	\$1,210,862



ANALYSIS

Analyze

Interprets and studies the collected information to identify root causes of inefficiencies and how to improve them.

- Identifies systems and processes in need of improvement
- Analyzes how to improve
- Confirms desired value to the stakeholders
- Identifies waste



A successful energy project will:

- Integrate key stakeholders into process
- Identify the key drivers of deficiencies in the systems and operations
 - *Technology outdated, not maintained, not monitored, not commissioned*
- Focuses the design & engineering on those deficiencies
- Identify multiple ways to improve energy performance of the building
 - *Multiple Energy Efficiency Measures to address various systems*



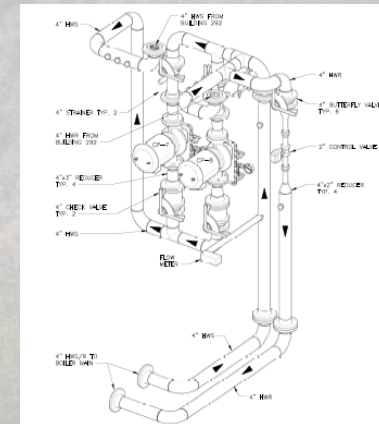
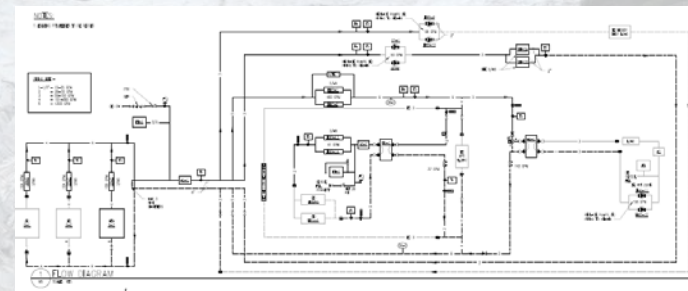
ANALYSIS

Analyze

Interprets and studies the collected information to identify root causes of inefficiencies and how to improve them.

Both DOT&PF and DOC Project Examples

- Identified deficiencies and waste – *over lit areas, no temperature setbacks, inefficient use of systems, envelope deficiencies*
- Multiple Energy Efficiency Measures
- A **focused** engineered design for the improvements. As you manage the design, does it:
 - Specifically tied back to the metrics for success – Metrics of accomplish energy savings, reduced operating costs, increased comfort or lighting levels*
 - Improve the ability of the stakeholders and customers to accomplishing their mission.*





EXECUTING THE IMPROVEMENTS

Improve

Selecting the improvement ideas and implementing them.

- Prioritizes the opportunities for improvement
- Sets forth how to go about implementing them
- Establishes how to measure key metrics

A successful energy project will:

- Select the EEMs most able to contribute to holistic project success
 - *EEMs tie back to the key metrics*
 - *Address stakeholder requirements*
- Carefully consider the most appropriate procurement methods and terms
 - *Design-bid-build, Design/Build, ESPC, etc., interest rates, financing terms*
- Have a management plan for measuring project outcome.



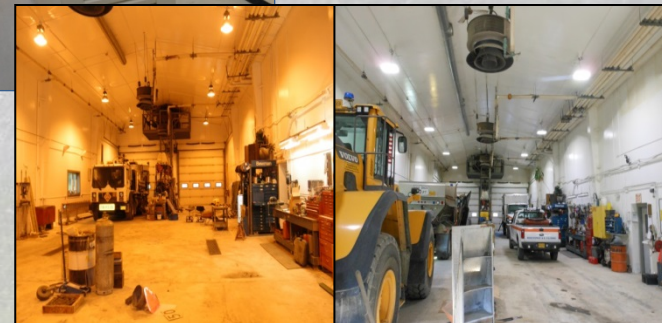
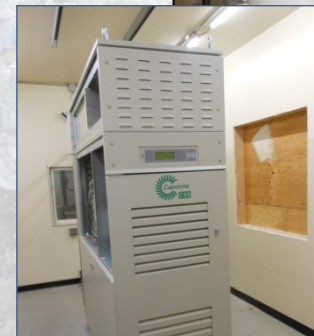
EXECUTING THE IMPROVEMENTS

Improve

Selecting the improvement ideas and implementing them.

Both DOT&PF and DOC Project Examples

- Energy Efficiency Measures were focused –
 - reduced waste, improved reliability, increased efficiency and renewed systems.
- Energy Savings Performance Contracting Methodology was selected
- A Measurement and Verification Plan created for measuring the metrics of project success.





MONITORING & CONTROLLING THE OUTCOME

Control

Validate that the new improvements meeting the objectives and benefits sought through the project.

- Use metrics to determine whether project goals have been obtained.
- Implement the control plan or policies and procedures to institutionalize the improvements.
- Document project findings and lessons learned

A successful energy project will:

- Measure the project outcome of the key metrics.
- Identify methods to correct systems should outcome of the metrics fall short of the goals.





MONITORING & CONTROLLING THE OUTCOME

Control

Validate that the new improvements meeting the objectives and benefits sought through the project.

Both DOT&PF and DOC Project Examples

- A structured Measurement & Verification plan to validate performance of installed EEMs
 - Key metrics – *units of energy saved, savings, EUIs, payback*
- Review the outcome
- Make adjustments if necessary
- ***Report the success!***

Table 2: Results EEM Summary

EEM #	FACILITY	EEM DESCRIPTION	ELECTRIC SAVINGS \$	EXPECTED ELECTRIC SAVINGS kwh	DEMAND SAVINGS \$	EXPECTED DEMAND SAVINGS kW	FUEL OIL SAVINGS \$	EXPECTED FUEL OIL SAVINGS GALLONS	O&M SAVINGS \$	TOTAL EXPECTED ANNUAL SAVINGS \$	IMPLEMENTATION COST \$	SIMPLE PAYBACK YEARS	CO2 REDUCTION LBS
1.00	All	High Mast and Exterior Lighting	\$65,349	396,758	\$40,394	2,036	\$0	0	\$1,222	\$106,965	\$356,655	3.3	583,545
1.01	All	Interior Lighting	\$53,436	381,310	\$16,924	853	\$(516)	(240)	\$1,788	\$71,632	\$850,107	11.8	552,957
2.00	APS	Central Plant Boiler Upgrades	\$4,622	36,962	\$0	0	\$32,385	15,063	\$0	\$37,008	\$1,151,793	31.1	391,763
2.01	Housing	Central Plant / DDC Optimization	\$21,948	175,512	\$0	0	\$21,470	9,986	\$0	\$43,418	\$397,910	9.2	482,755
5.01	APS	DDC Optimization	\$16,267	130,078	\$0	0	\$8,017	3,729	\$0	\$24,284	\$246,151	10.1	275,579
5.02	Motor Pool/Warehouse	DDC Optimization	\$41	324	\$0	0	\$33,037	15,366	\$0	\$33,077	\$57,121	1.1	344,429
-	APS	Kitchen Sanitizer Generator	\$0	0	\$0	0	\$0	0	\$32,657	\$32,657 ¹	\$0 ²	0.0	0
Commissioning, Correction Period, DOL Fee, M&V Guarantee											\$138,055		
Energy Project Total			\$161,663	1,120,944	\$57,318	2,889	\$94,394	43,904	\$35,667	\$349,041	\$3,197,162	9.2	2,616,833



CONTINUOUS IMPROVEMENT CULTURE

Define

Measure

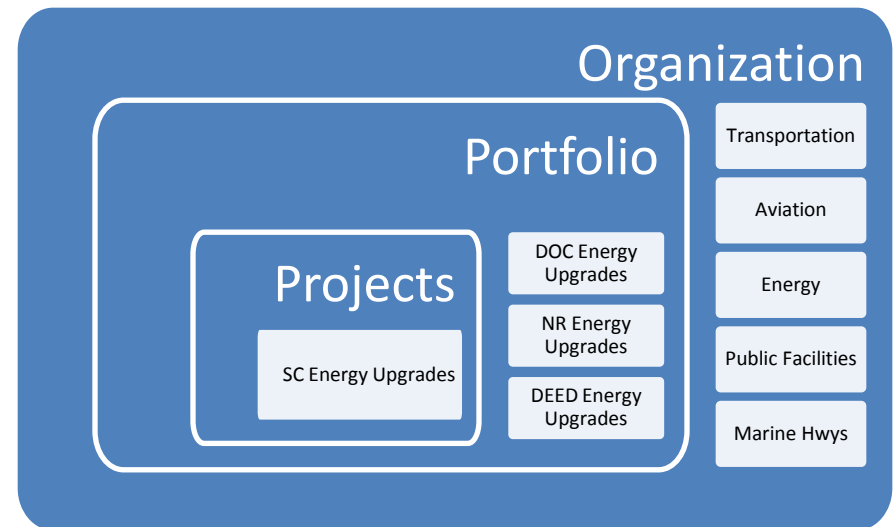
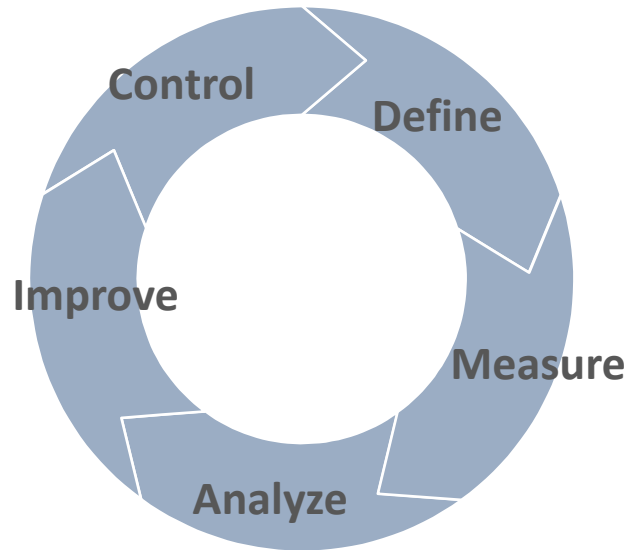
Analyze

Improve

Control

This structured approach:

- Allows for *project management agility* that can be applied to any individual energy project, your portfolio and throughout the organization, creating a culture of continuous improvement.





VISION AND LEADERSHIP

- The Lean Six Sigma continuous improvement approach will:
 - *Define* the **Vision** for your executive leadership into tangible objectives by using the data and performance metrics.
 - *Define* success for the projects to be reported back to the organization.
 - *Reveal* further efficiency opportunities for organizational **Leadership** to pursue and support.



THANK YOU FOR THIS OPPORTUNITY

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