



CADMUS



Continuous Energy Improvement Pilot Evaluation

Vermont Public Service Department

2014 – 2015

July 26, 2016

Agenda

1. Pilot Overview
2. Research Objectives
3. Methods
4. Key Findings
5. Conclusions



Pilot Overview



CEI Overview

- Permanently integrate energy management into facility operations and management
- Focus Areas
 - ✓ Capital Upgrades
 - ✓ Process Improvements
 - ✓ Predictive Maintenance
 - ✓ Employee Engagement
- 8 organizations enrolled:
7 industrial, 1 healthcare

Continuous Energy Improvement:
Strategic planning for maximum results

Efficiency Vermont

PARTNER WITH YOUR ACCOUNT MANAGER TO:

- Compare all proposed upgrades to determine the best return on investment
- Involve the purchasing department in the plan
- Evaluate the life cycle costs of all equipment choices

Take your energy management approach to the next level

HVAC, lighting, and other energy saving opportunities are a piece of it, but there's a larger picture. Continuous energy improvement strategies help companies permanently embed energy management into their business model. The result? An energy approach that integrates seamlessly with day-to-day operations, and deeper, more sustainable savings.

- Evaluate current processes
- Take a critical look at each process step
- Set improvement goals and monitor progress

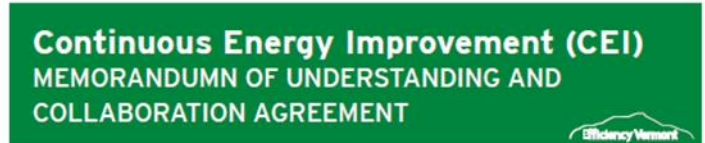
- Tune, clean, and calibrate all equipment regularly
- Replace worn fixtures or parts with energy-efficient models
- Incorporate energy efficiency into regular maintenance protocols

- Empower employees to identify and suggest energy saving ideas
- Provide programs and incentives for employees to save energy at home
- Recognize employee contributions to saving energy

Pilot Design

Typical Participation Process

- Enroll with MOU
- Kick-Off Workshop
- Energy Assessment and Plan Development
- Energy Use Tracking Tool Workshop
- Monthly Energy Efficiency Progress Meetings
- Employee Engagement Workshop
- Employee Engagement Action Plan
- Goal Achievement Report Out



Efficiency Vermont commends _____ (The Customer) for its commitment to Continuous Energy Improvement (CEI), a comprehensive approach to energy management.

By signing this agreement, the Customer agrees to work with Efficiency Vermont towards persistent reductions in energy use and sustained cost reductions in accordance with the criteria listed below. In return, Efficiency Vermont will provide technical assistance and necessary resources to support implementation. We recognize the commitment of both parties, and the time and resources they will devote.

With the support of Efficiency Vermont, the Customer agrees to:

1. Prioritize energy management within its business
 - Assigning a corporate sponsor
 - Creating an energy team responsible for maintaining visibility and metrics
 - Communicating goals and priorities to staff
 - Promoting energy awareness among employees
2. Establish energy management processes and plans
 - Assessing energy management practices toward continued improvement
 - Setting goals with annual performance reviews and updates
 - Identifying additional opportunities for development of an annual implementation plan
3. Collect and track energy performance with respect to goals and metrics
 - Measuring key factors that influence energy use
 - Collecting data and providing it to Efficiency Vermont
 - Analyzing data to support effective decision-making

TERM

This Agreement shall begin upon the date both parties sign the Agreement and shall be reviewed annually by Efficiency Vermont and the company's energy team.

WE THE UNDERSIGNED AGREE TO THIS AGREEMENT.

EFFICIENCY VERMONT

Company: _____

Signature: _____

Signature: _____

Printed Name: _____

Printed Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

This Agreement shall begin upon the date both parties sign the Agreement and shall be reviewed annually by Efficiency Vermont and the company's energy team. Nothing in this agreement will create any contractual relationship between Efficiency Vermont and any of your employees, contractors, or agents. Nor will this agreement create any obligation on the part of Efficiency Vermont to pay or to see to the payment of any monies due from you to subcontractors, employees, agents, or other persons or organizations.

Evaluated Facility Characteristics

Facility ID	Industry/Commercial Building Segment	Fuels	Data Frequency	CEI Beginning Engagement Date
F1	Hospital/Medical Center	Electric	Daily	02/13/2014
F2	Manufacturing	Electric	Daily	02/13/2014
F3	Manufacturing	Electric	Weekly	02/13/2014
F4-E1	Resort: Hotel/Conference Center/Dining	Electric, Propane, Oil	Electric: Daily; Propane: Monthly; Oil: Monthly	02/13/2014
F4-E2	Resort: Private club for events/Dining	Electric, Propane	Electric: Daily; Propane: Monthly; Oil: Monthly	02/13/2014
F4-E3	Resort: Fitness/Pool/Indoor Tennis	Electric, Propane	Electric: Daily; Propane: Monthly; Oil: Monthly	02/13/2014
F5	Manufacturing	Electric	Daily	02/13/2014



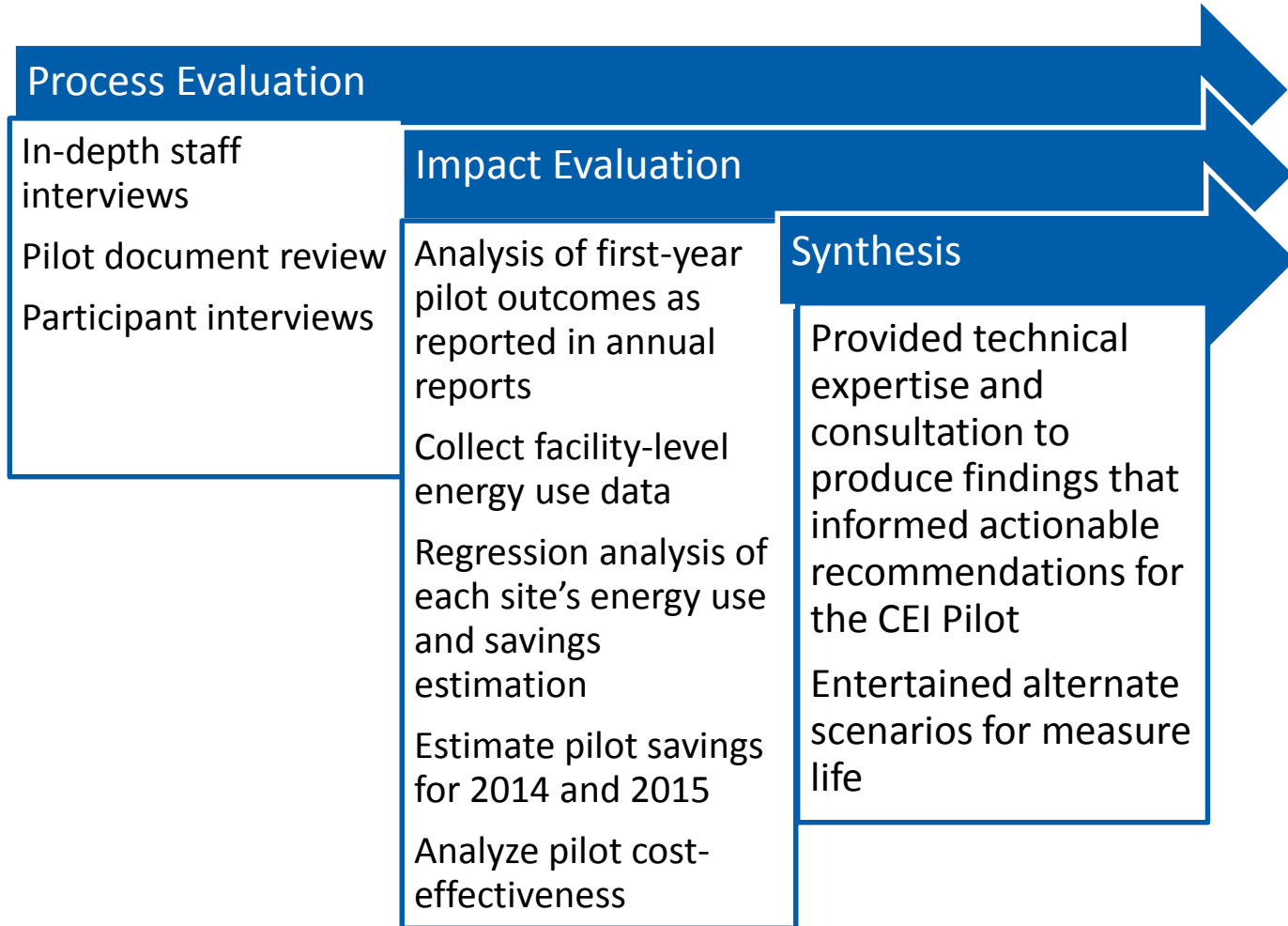
Research Objectives



Research Objectives

- Independently estimate the energy savings for each CEI participant, accounting for the impacts of any capital measures, in 2014 and 2015
- Verify EVT's estimates of site-specific CEI, capital measure, and total Pilot savings.
- Develop recommendations for improving the Pilot data collection, measurement and verification (M&V), and impact evaluation approaches, specifically:
 - Facility data reporting and sub-metering
 - Establishing reliable M&V baseline models
 - Collecting program-related costs and conducting cost-effectiveness testing
 - Identifying potential OM&B savings for future program planning
- Assess program successes and challenges

Evaluation Activities





Methods



In-Depth Interviews

Objectives

- Pilot history
- Pilot objectives and goals
- Pilot design and implementation
- Pilot successes and challenge
- Readiness for Pilot expansion

Interviews

Stakeholders	Number of Interviews	Number of Interviewees
EVT Pilot portfolio manager	2	3
EVT Account Managers	3	3
EVT Energy Consultants	3	3
Total	8	9

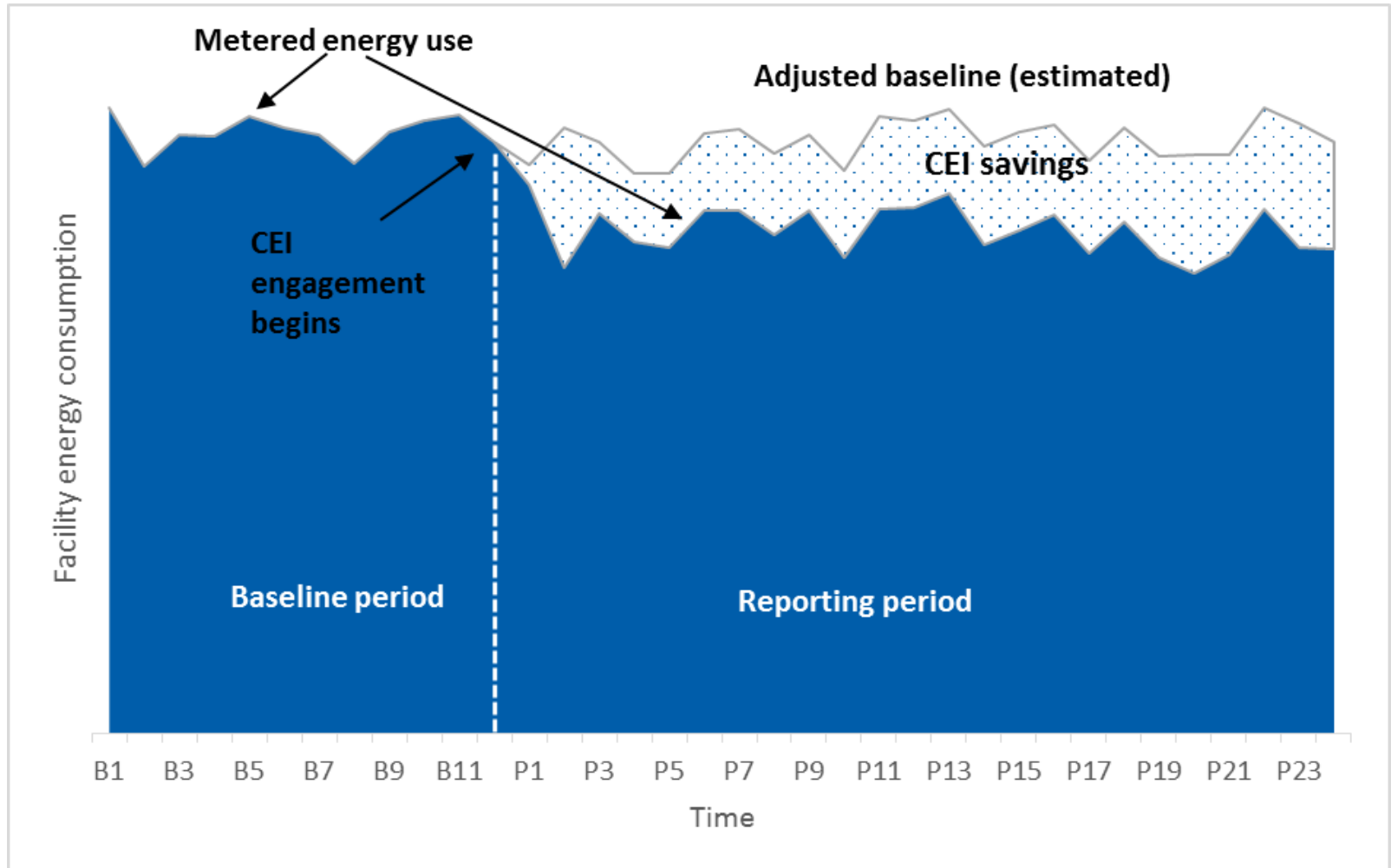
Document Review

Document	Description
2015 MT&R (Monitoring, Targeting, and Reporting) reports	Report describing organization's CEI implementation and data collection
CEI one-pager	Description of program for potential organizations
Statistical tools	Description of benefits of using statistical tools to track energy use
Memorandum of Understanding (MOU) template	Agreement organizations signed at the beginning of their engagement with the Pilot
CEI assessment tool	Tool outlining the program milestones and EVT's scoring procedure
CEI overview PowerPoint presentation	Presentation created by EVT to introduce the program to potential Pilot participants
CEI white paper	Paper describing the benefits of CEI programs
Sample energy plan	Workbook for organizations to track energy reduction activities and ideas

Impact Method

- Review facility MT&R report
- Define the baseline and reporting periods
- Collect facility data on energy use and energy use drivers
 - Output
 - Occupancy
 - Weather
- Build the baseline regression model of energy use
- Estimate facility and CEI savings
 - Facility savings = Adjusted baseline energy – metered energy
 - CEI savings = Facility savings - capital project savings

Estimation of CEI Energy Savings



Cost-Effectiveness Analysis

- Evaluated pilot cost-effectiveness using the Societal Cost Test (SCT)
 - Electricity benefits (energy and capacity)
 - Program administration costs
 - DRIPE
 - Electric externalities (emissions reductions of GHGs, SO₂, NO₂)
 - Non-energy benefits (10% adder)
- Employed Vermont Statewide Cost-effectiveness Screening Tool to perform the analysis



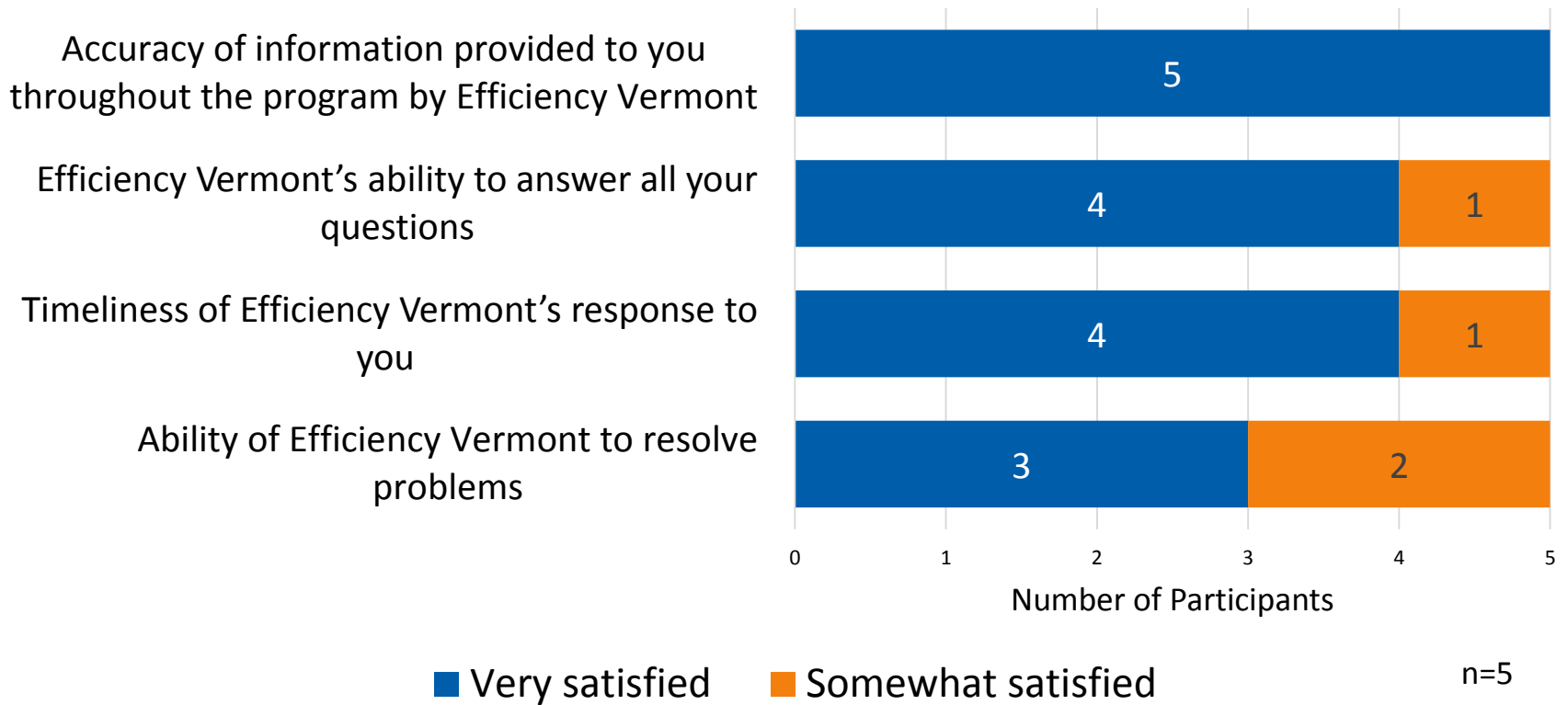
Key Findings



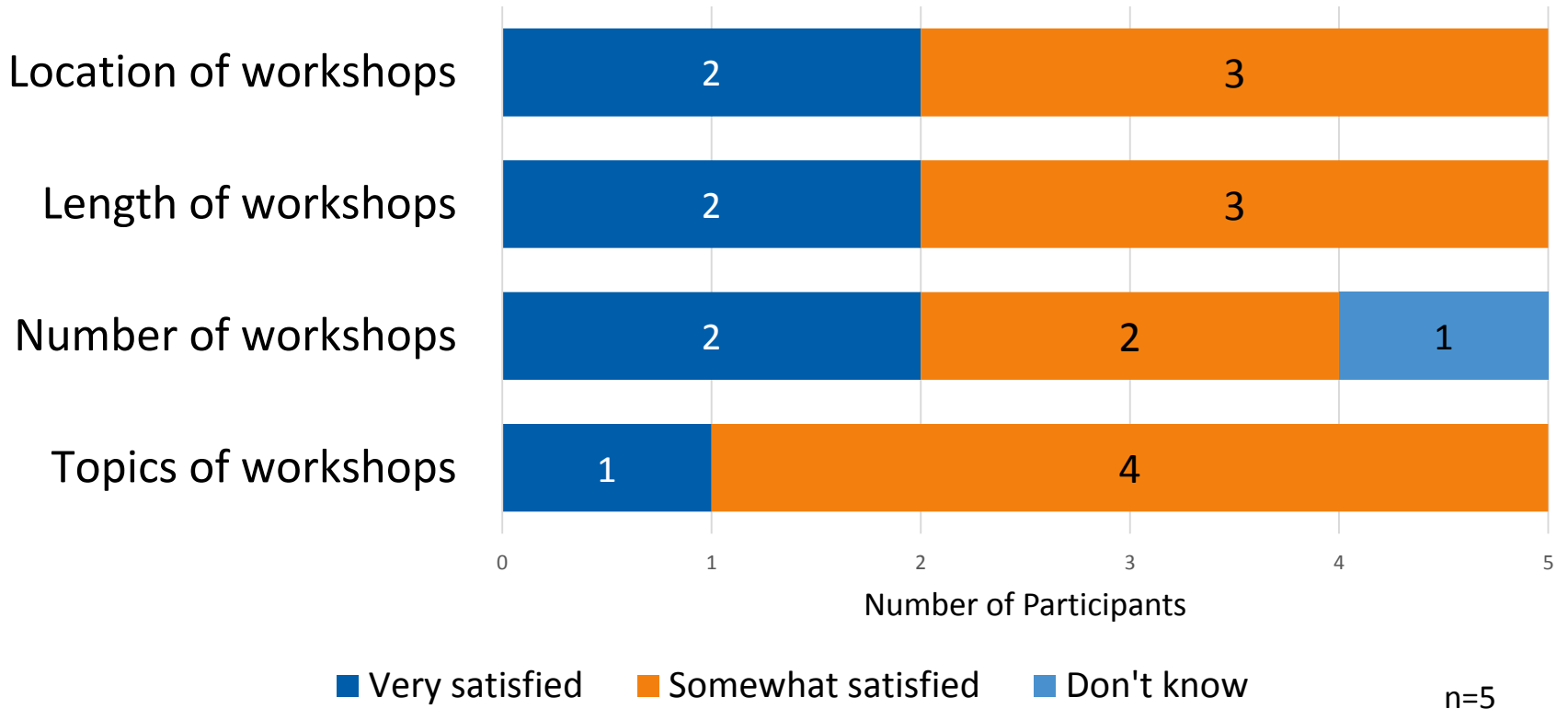
Pilot Successes

- Peer-to-Peer Interaction most valued program element
- Success with implementing CEE minimum elements
 - ✓ Customer commitment
 - ✓ Planning and implementation
 - ✓ Systems for measuring and reporting
- Communication and partnership with EVT

Satisfaction with EVT



Workshop Satisfaction



CEI Tools

Component	Implementing in 2016 (n=5)	Notes
Energy team	5	2 meet bimonthly with energy team 3 meet monthly with energy team
Employee engagement activities	4	1 does not planning any as they have no more low- or no-cost activities to implement
Energy action plan	5	2 review biweekly 2 review quarterly 1 reviews semiannually
Energy Management System (EMS)	5	4 use SENSEI 1 uses SkySpark
Energy tracking	5	4 review weekly 1 reviews monthly

Challenges (from participants)

- Finding time—both as energy champion and in engaging employees
- Creating and maintaining cross-functional team; agreeing on priorities across departments
- Gaining corporate level commitment
- Time and distance required for workshop attendance
- Making business case for sub-metering, competing priorities, identifying appropriate variables, accurately quantifying savings



Impact Evaluation Findings

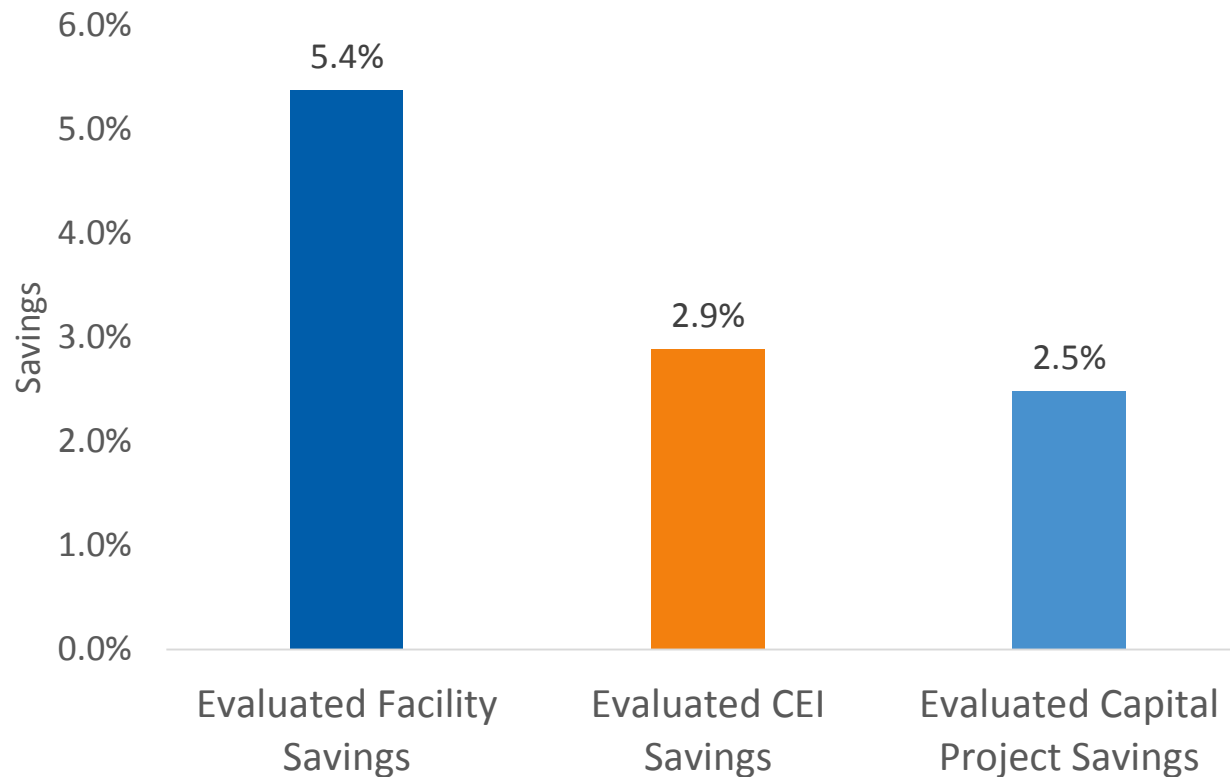


Evaluated CEI Electricity Savings 2015

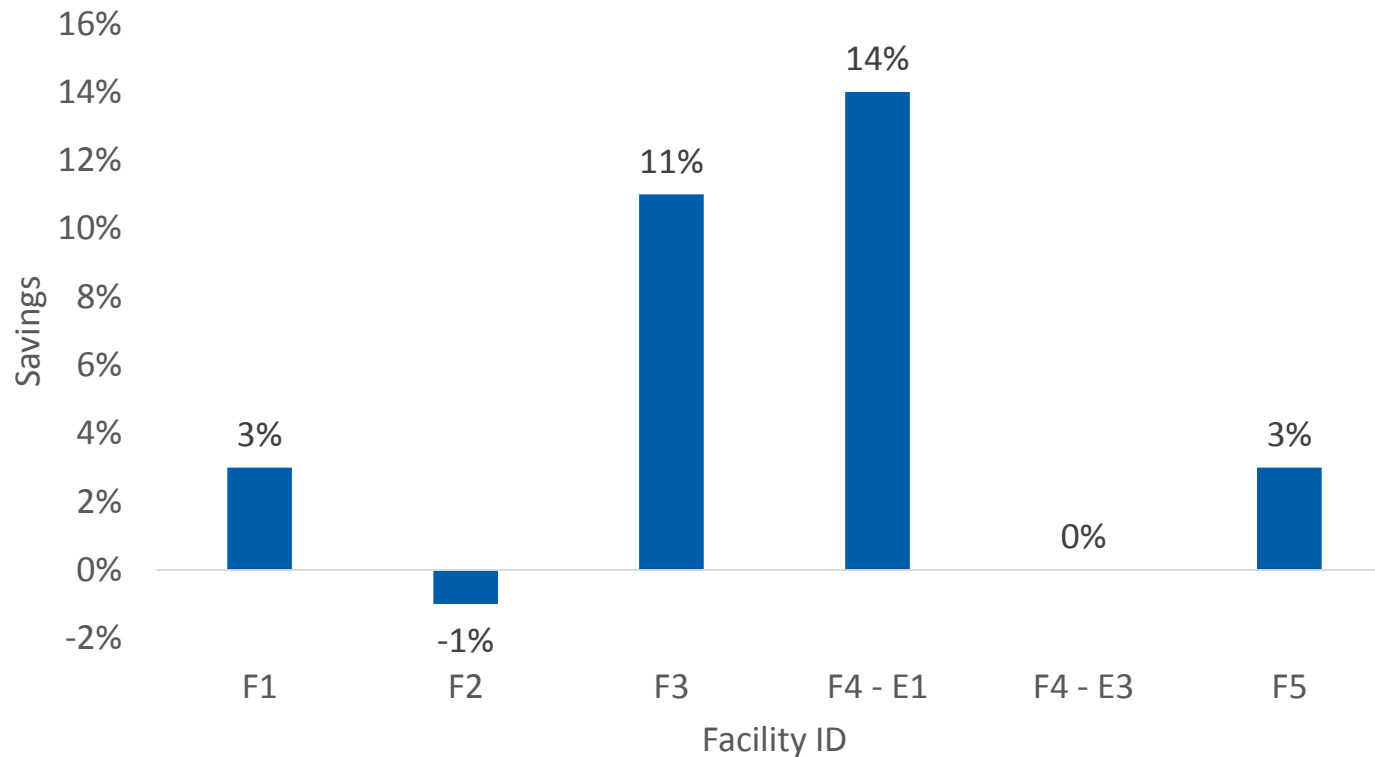
Fuel Type	Evaluated Facility Savings	Lower Bound 90% Confidence Interval	Upper Bound 90% Confidence Interval	Evaluated Capital Project Savings	Evaluated CEI Savings	Reported CEI Savings	Realization Rate
Electricity (MWh/year)	1,877.8	1,718.1	2,037.5	868.6	1,009.2	1,109.7	91%

Notes: Evaluated facility savings equaled Cadmus' point estimate of facility savings based on regression analysis. Evaluated capital project savings were savings for capital projects receiving incentives from other EVT programs and were obtained from EVT's database. Evaluated CEI savings equaled the difference between the evaluated facility savings and the evaluated capital project savings. Reported CEI savings were CEI savings reported by EVT. The realization rate was the ratio of the evaluated CEI savings to the reported CEI savings.

2015 CEI Electricity Percent Savings

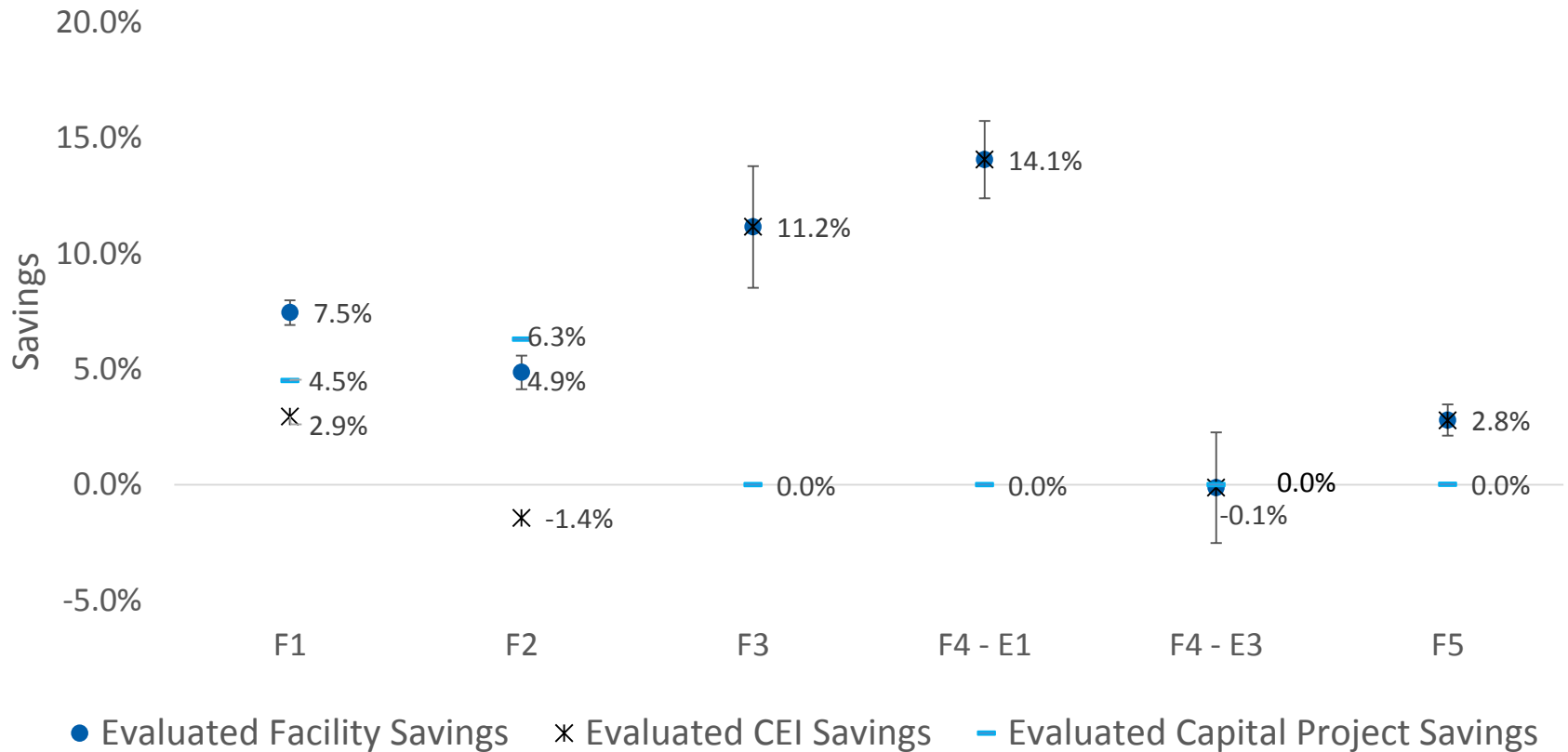


Evaluated CEI Electricity Savings by Facility

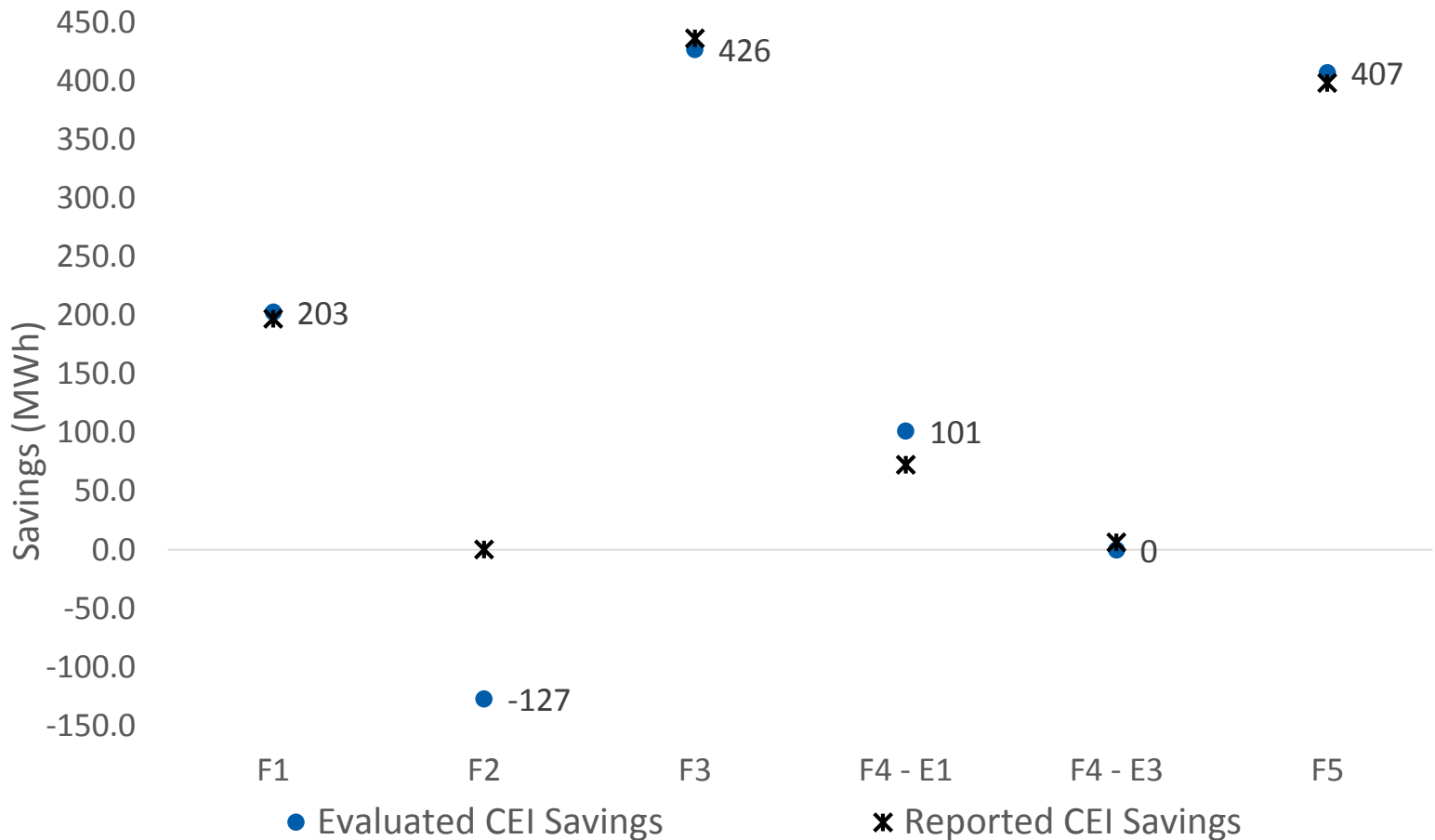


Note: Savings estimated as a percent of facility electricity consumption.

Evaluated Facility, Capital Project, and CEI Electricity Savings



Comparison of Evaluated and Reported CEI Savings by Facility



Notes: Data labels are evaluated MWh savings.

Cost Effectiveness

Parameter	One Year Measure Life	Two Years Measure Life	Three Years Measure Life	Five Years Measure Life
Benefits	\$158,223	\$306,255	\$449,194	\$698,866
Costs	\$350,042	\$350,042	\$350,042	\$350,042
Net Benefits	(\$191,819)	(\$43,787)	\$99,151	\$348,824
Benefit / Cost Ratio	0.45	0.87	1.28	2.00
Levelized \$/kWh	\$0.347	\$0.196	\$0.133	\$0.082

Notes: 2015 pilot cost-effectiveness estimates based on societal cost test.

Pilot proved cost-effective for measure life equal to or greater than three years



Conclusions



Energy Savings

Conclusion

CEI pilot achieved 3% electricity savings in 2015

Recommendation

- Continue to evaluate this cohort to track savings persistence

Pilot facilities achieved a range of savings from -1% to 14%

- Future evaluations should attempt to understand causes of differences between facilities

MT&R Savings Estimates

Conclusion

Evaluation verified reported CEI savings.
Savings realization rate = 91%

Recommendation

- EVT should continue to follow existing savings estimation approach
- Evaluation has few suggestions for improvements

Difference between reported and evaluated savings was due to different reporting conventions for “negative savings”

- EVT should report negative savings estimates → yields more accurate estimate of pilot savings

CEI Cost Effectiveness

Conclusion

Pilot proved cost-effective
for measure life ≥ 3 years



Recommendation

- Reassess pilot cost-effectiveness for 2016 to determine if cost-effectiveness has improved
- Conduct additional research to determine appropriate cost-effectiveness assumptions for Vermont CEI

Implementing CEI Elements

Conclusion

Participants engaged with implementing minimum CEI elements, resulting in greater EE awareness within organizations

Recommendation

- Continue tracking implementation of CEE/CEI minimum elements at each facility

Some participants found too much time was required for implementation and attending workshops

- Consider reducing number of on-site workshops and consider alternate modes or formats for delivering content

Organizational Culture Change

Conclusion

Recommendation

High satisfaction with peer-to-peer interaction, EVT support
Employee engagement challenging to maintain on an ongoing basis

- Consider developing more materials designed to increase employee engagement
- Checklist for common energy saving activities
- Share workshop topics and tips through newsletters

Participants are already invested in corporate sustainability efforts

- Look for synergies with carbon disclosure or Global Reporting Initiative to dovetail energy savings with other sustainability reporting requirements

Program Resources

Conclusion

EVT account management software presented challenges for tracking CEI program tasks and costs

Recommendation

- Enhance training to make querying CEI tasks and recording staff time easier

The pilot is high-touch (by design), requiring significant staff time

- EVT could consider study to streamline program to focus on steps and touchpoints most critical to success

QUESTIONS/DISCUSSION

Evaluated Electric Energy Savings

Facility ID	Evaluated Facility Savings (MWh)	Lower Bound 90% Confidence Interval	Upper Bound 90% Confidence Interval	Evaluated Capital Project Savings (MWh)	Evaluated CEI Savings (MWh)	Reported CEI Savings (MWh)	Realization Rate	CEI Percent Savings
F1	512.1	475.4	548.9	309.5	202.6	197.0	103%	3%
F2	430.3	366.2	494.5	557.5	-127.2	0.0	N/A	-1%
F3	426.5	325.8	527.1	0.0	426.5	436.0	98%	11%
F4 ¹	100.7	86.6	114.9	0.0	100.7	78.7	128%	13%
F4 - E1	101.1	89.0	113.1	0.0	101.1	72.4	140%	14%
F4 - E2 ²	Not Evaluable							
F4 - E3	-0.4	-7.8	7.1	0.0	-0.4	6.3	-6%	0%
F5	408.2	309.7	506.7	1.6	406.6	398.0	102%	3%
Total	1,877.8	1,718.1	2,037.5	868.6	1,009.2	1,109.7	91%	3%