Monitoring-Based Commissioning
with Advanced EMIS Analysis

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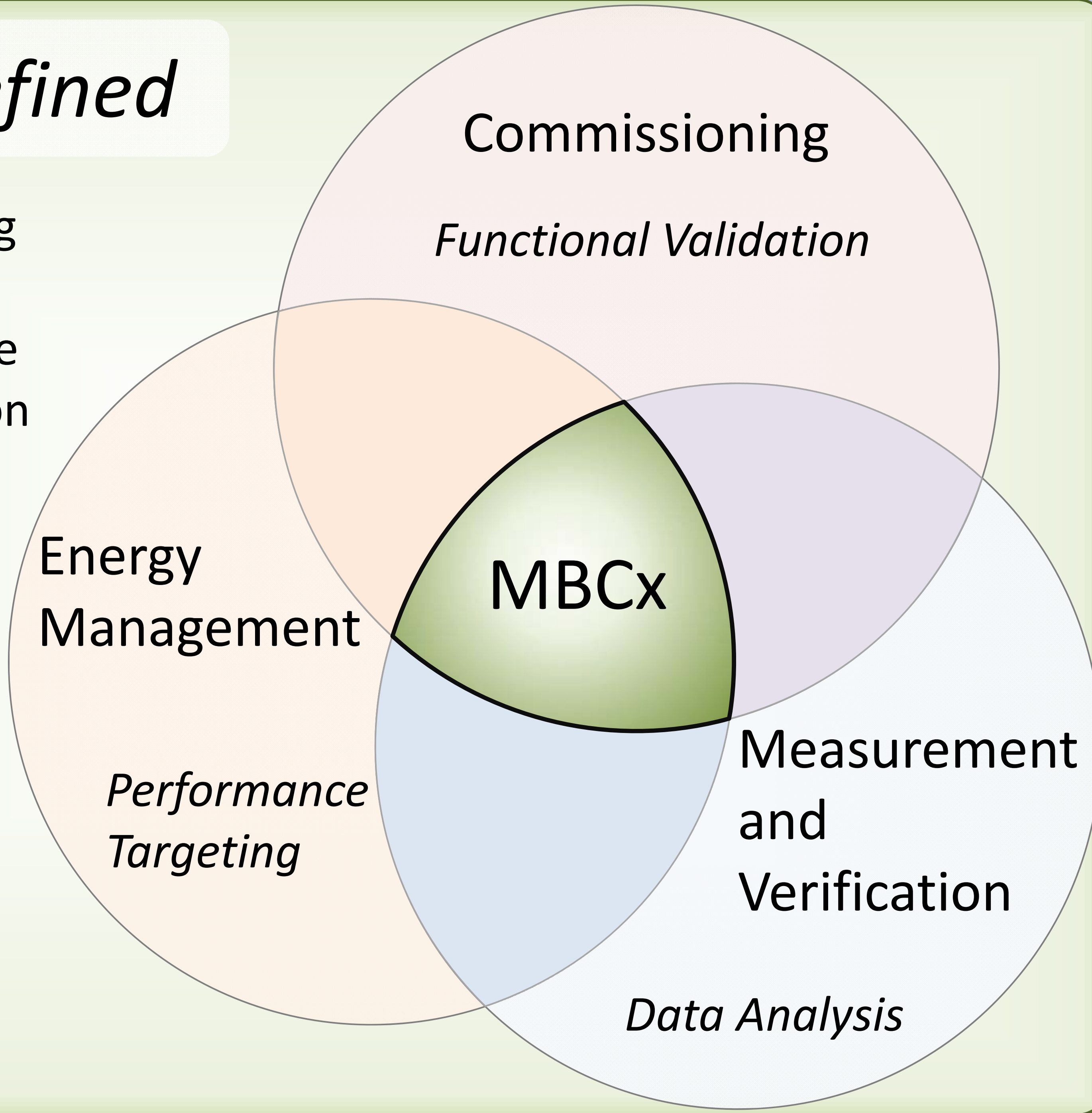
Presentation *Overview*

1. Definition of Monitoring-Based Commissioning (MBCx)
2. The need for and benefits of MBCx
3. The commissioning process with a monitoring-based approach
4. Process and infrastructure for data acquisition and analysis
5. Energy Management and Information System (EMIS) analytical capabilities
6. Types of system faults commonly encountered
7. Case Study – Carson Graham Secondary School
8. Case Study – Abbotsford Collegiate Secondary School

MBCx *Defined*

- Commissioning supported by comprehensive data acquisition and analysis
- A holistic process for optimizing building performance outcomes

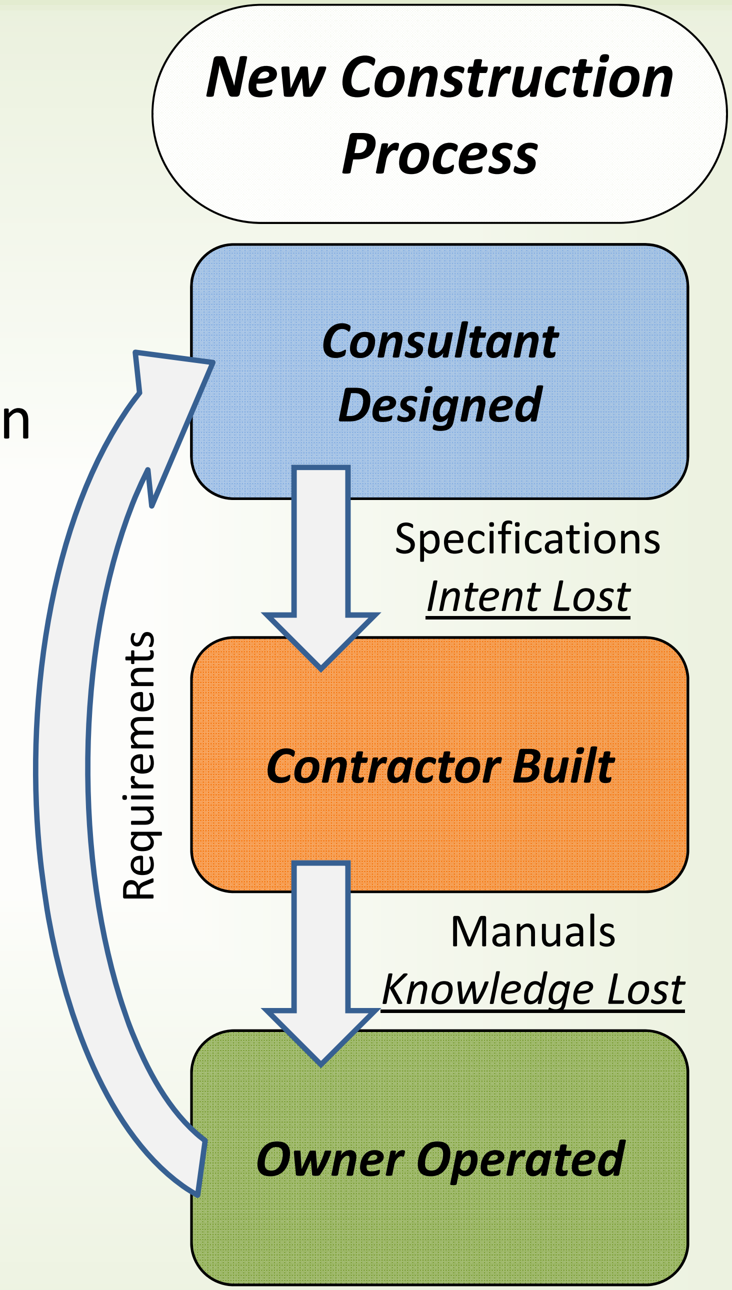


MBCx *Demand*

- Monitoring-Based Commissioning ensures performance objectives are maintained from design into operation

Advantages of MBCx

1. Operational intent is maintained and communicated
2. Systems complexity is managed
3. Operational issues are minimized
4. Energy performance is maximized
5. Improved operator education and support
6. Infrastructure created for long-term performance monitoring and fault detection



MBCx *Process*

Design

- Owner's Project Requirements
- Basis of Design
- Commissioning Plan
- M&V, Metering Plan
- Design Review
- Preliminary Energy Model

Construction

- Installation Checks
- Site Reviews
- Design Energy Model
- Meters, Data Acquisition System Installation

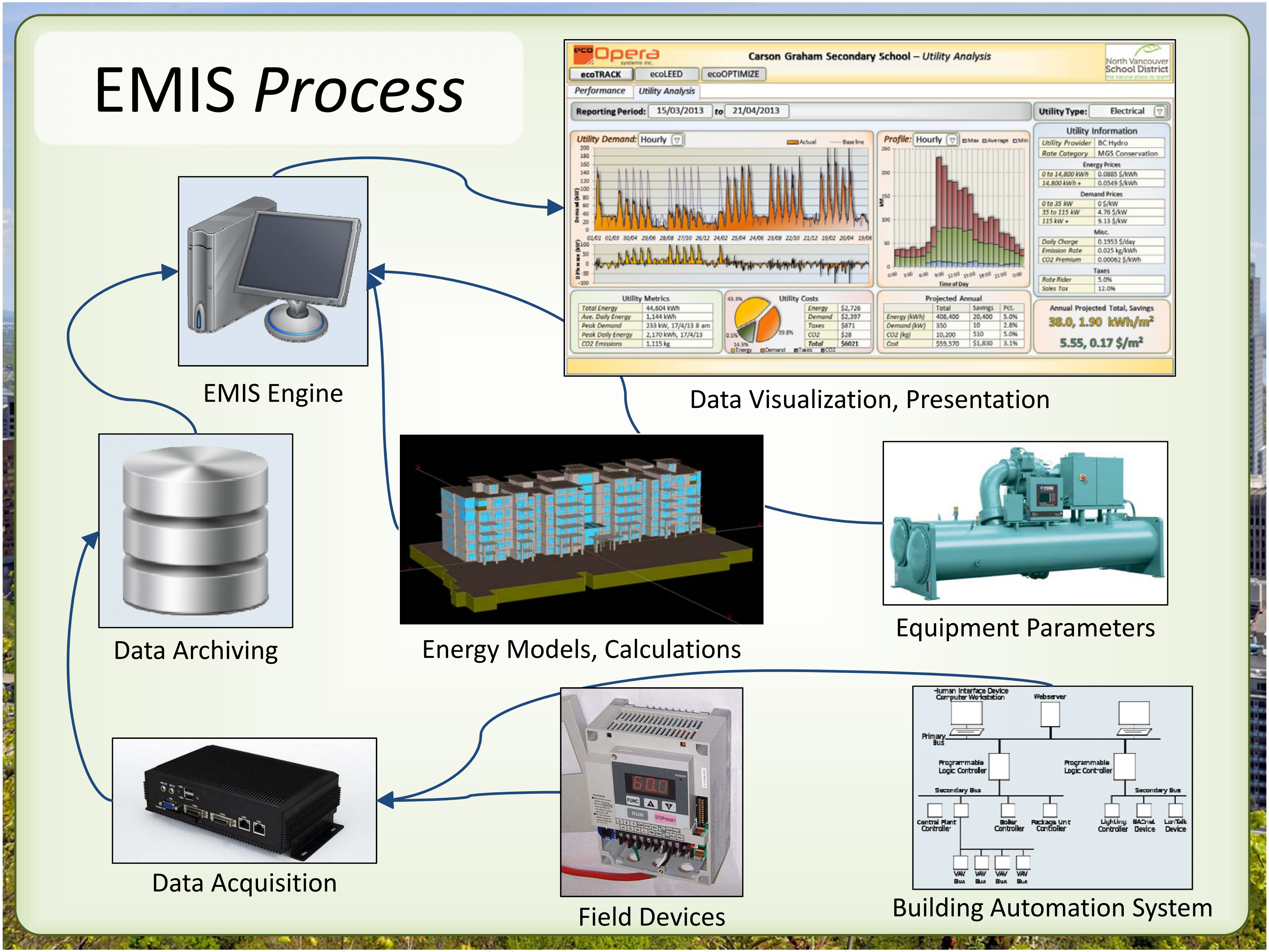
Acceptance

- EMIS Configuration
- Systems Functional Testing
- Operations and Maintenance Manual
- Performance Targeting

1st Year Operation

- Energy Model Calibration
- Operator Training
- Performance Analysis
- Fault Identification
- **Building Optimization**

Continuous Optimization


EMIS Process
EMIS Engine
Data Visualization, Presentation
Data Archiving
Energy Models, Calculations
Equipment Parameters
Data Acquisition
Field Devices
Building Automation System
Carson Graham Secondary School – Utility Analysis
ecoTRACK
ecoLEED
ecoOPTIMIZE
Performance
Utility Analysis
Reporting Period: 15/03/2013 to 21/04/2013
Utility Type: Electrical
Utility Information
Utility Metrics
Utility Costs
Projected Annual
Annual Projected Total, Savings
38.0, 1.90 kWh/m²
5.55, 0.17 $/m²
Human Interface Device
Computer Workstation
Webserver
Primary Bus
Programmable Logic Controller
Secondary Bus
Central Plant Controller
Boiler Controller
Package Unit Controller
Lighting Controller
BACnet Device
LonTalk Device
VAV Box

EMIS *Analysis*

Analysis-Type	Building Level	Systems Level
Data Collected	• Total electrical energy • Total gas energy • District energy meters	• Energy sub-meters • Thermal/Btu meters • BAS Data points – equipment status, speed, temperature, flow, position, etc.
Analysis Conducted	• Primary energy benchmarking • Measurement and verification of savings • Energy trending (daily, weekly, monthly profiles)	• Full energy end-use breakdown • Equipment performance – efficiency, run-times, cycling, average operating conditions • Systems faults
Pros/Cons	• Relatively inexpensive • Easy quality control • Cannot directly uncover optimization opportunities • Limited insight into building operation	• Full operation visibility • All key optimization opportunities can be identified • Sub-meters add cost • Data quality management • Limited EMIS vendors

System *Faults*

HVAC Systems

- Over-enabling/unoccupied run-time
- Deficient pressure/fan speed reset
- Sub-optimal SAT reset
- Over-ventilation
- Simultaneous heating and cooling
- Faulty, disconnected zone sensors

HVAC Plants

- Equipment rapid cycling
- Sub-optimal equipment sequencing
- Lack of or deficient SWT reset
- Lack of pressure/pump speed reset
- Pump over-enabling

Lighting

- Excessive unoccupied use
- Unresponsive occupancy sensor switching
- Faulty photocells

- ➢ Complex systems give rise to more points of failure
- ➢ Occupant comfort may be maintained while faults persist, wasting $$$

Case Study 1

Carson Graham Secondary School

Performance Features

- 9,300 m^2, targeting LEED Gold
- High performance envelope
- BAS-integrated lighting with occ-sensor and photocell control
- VAV Energy-Recovery-Ventilators with VFDs and occ-sensor enabling
- Reversible ASHPs with condensing boiler backup and VFD pumping

Deficiencies Identified

- Systems over-enabling
- Deficient air system pressure reset
- ASHPs greatly under-utilized
- No HW temperature reset
- VFD pumps at 100% continuously
- Pump false-starting
- MUA continuous operation

Performance Metrics	
Baseline Projected EUI*	102
NRCan Database EUI	180
Proposed Energy Model EUI	82
Reference Energy Model EUI	121
Proposed EUI After MBCx	88
Baseline Annual Utility Cost	$83,000
Life-Cycle Savings NPV (30 yr)	$334,000

*kWh/m2/year

Case Study 2

Abbotsford Senior Secondary

Performance Features

- 10,700 m^2, targeting LEED Gold
- Extensive lighting controls via occ-sensors and photocells
- VAV Energy-Recovery-Ventilators with VFDs and occ-sensor enabling
- WSHPs served by an reservoir with condensing boiler backup
- Distributed water-loop heat-pumps

Deficiencies Identified

- Systems over-enabling
- Deficient hydronic pressure reset
- ASHPs greatly under-utilized
- Deficient SWT reset
- Pumps enabled continuously
- Continuous exhaust fan operation

Performance Metrics	
Baseline Projected EUI*	89
NRCan Database EUI	180
Proposed Model EUI	85
Reference Model EUI	128
Proposed EUI After MBCx	81
Baseline Annual Utility Cost	$79,000
Life-Cycle Savings (30 year)	$222,000

*kWh/m2/year

MBCx with Advanced EMIS Analysis

Thank You!

Questions?