Environmental
Protection

Beyond the ECM Pro-active Energy/GHG Reduction Measures

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GOAL

Ensure that the energy and GHG emissions implications of all [construction] projects are fully considered and factored into the overall decision-making process from conceptual design to operations.

GOALS AND EXPECTATIONS

Continued Sustainability

Energy Analysis

- Benchmark
- Baseline
- Identify Viable ECMs

Energy Conservation Measures

- Design
- Build
- Operate

Establish Institutional Controls

- **Energy SOP for Designs**
- **Energy Operations & Design Policy**
- **Construction**
- **Energy O&M and Training**

Typical Design Evaluations

- Reliability
- Vendor/Manufacturer Reliability
- Operation Complexity
- Maintenance Requirements
- Durability
- Expense (including lifecycle)

Energy Considerations Added

- GHG Emissions vs. Lifecycle Costs
- Level of GHG emissions
- Energy Consumption vs. Lifecycle Costs
- Criteria Pollutants

SOP and Policy Development

- Develop **<u>Energy Conservation and GHG reduction SOPs</u>** for all construction projects

- Develop **<u>Energy Operations and Design Policies</u>**: Design kick-off meetings, BODR, 30%/ 90% deliverable milestones, and RFP

Design Phase

- Require Energy Analysis during BODR and design to show:
  - Current energy use and GHG emissions
  - Design alternatives analysis of energy/GHG changes
  - Economic Analysis of energy for alternatives

Construction to Operations

- Continue Energy Priority through Construction (i.e. Change Orders)

- Maintain Energy Optimization/GHG reduction in Operations through O&M manual and staff training

ITS NOT JUST MORE EFFICIENT MOTORS AND PUMPS

Policy Objectives

- Energy/GHG reductions from electro-mechanical processes
- Facility Layout (i.e. minimize pumping distances, blowers near discharge, etc.)
- Maximize ADG production and use
- Control/Operational Strategies (pumping, DO control)
- Energy Source Conversion (heat recovery, preheating sludge with digester effluent)
- Process emissions and energy (side stream treatment)

Evaluation Metrics

- Capital Cost per unit Energy Saved and metric ton of CO_2(e) avoided
- Annual energy savings
- Percent change in energy consumption and GHG emissions
- Simple payback
- Lifecycle Costs (incl. O&M, escalation, and useful life)
- Net Present Value
- Cash Flow Evaluation

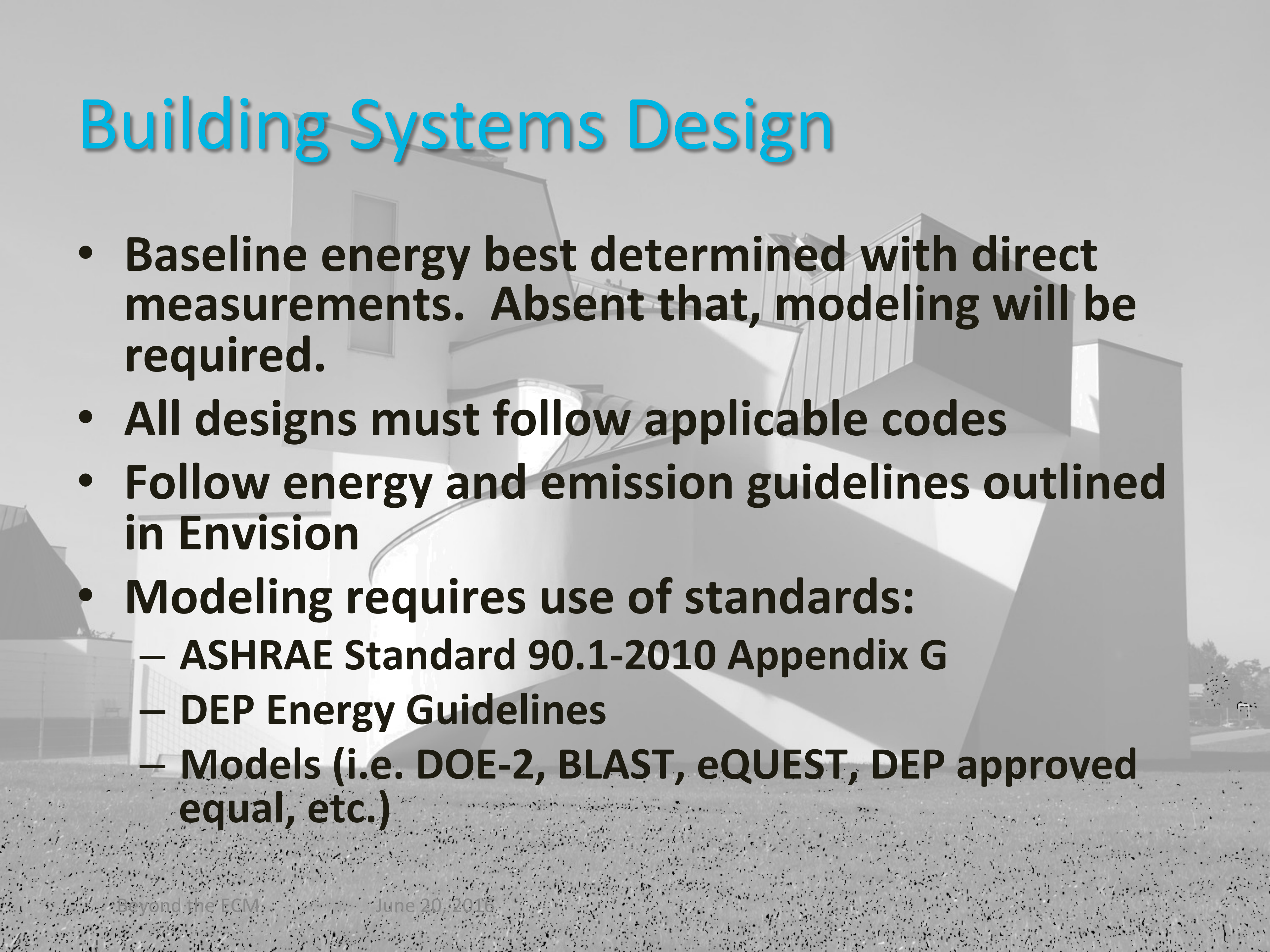
Design Services Goals

- Develop design options that consider energy
- Generate an energy profile report
  - Baseline current condition energy consumption and GHG emissions
    - Using direct measurements
    - Modeling
  - Predicted Future energy conditions via modeling
  - Perform an economic analysis for each option

Process Systems Design

- Baseline energy best determined with direct measurements. Absent that, modeling will be required.
- Modeling requires use of standards:
  - Manufactures pump/blower curves
  - Most recent electrical and steam GHG emission factors (i.e. LGOP, IPCC, etc.)
  - Acceptable and typical engineering formulas
  - Standard variables and constants (Moody's, kinetic constants, etc.)
  - Report findings in standard units like MMBtu or KWH/d

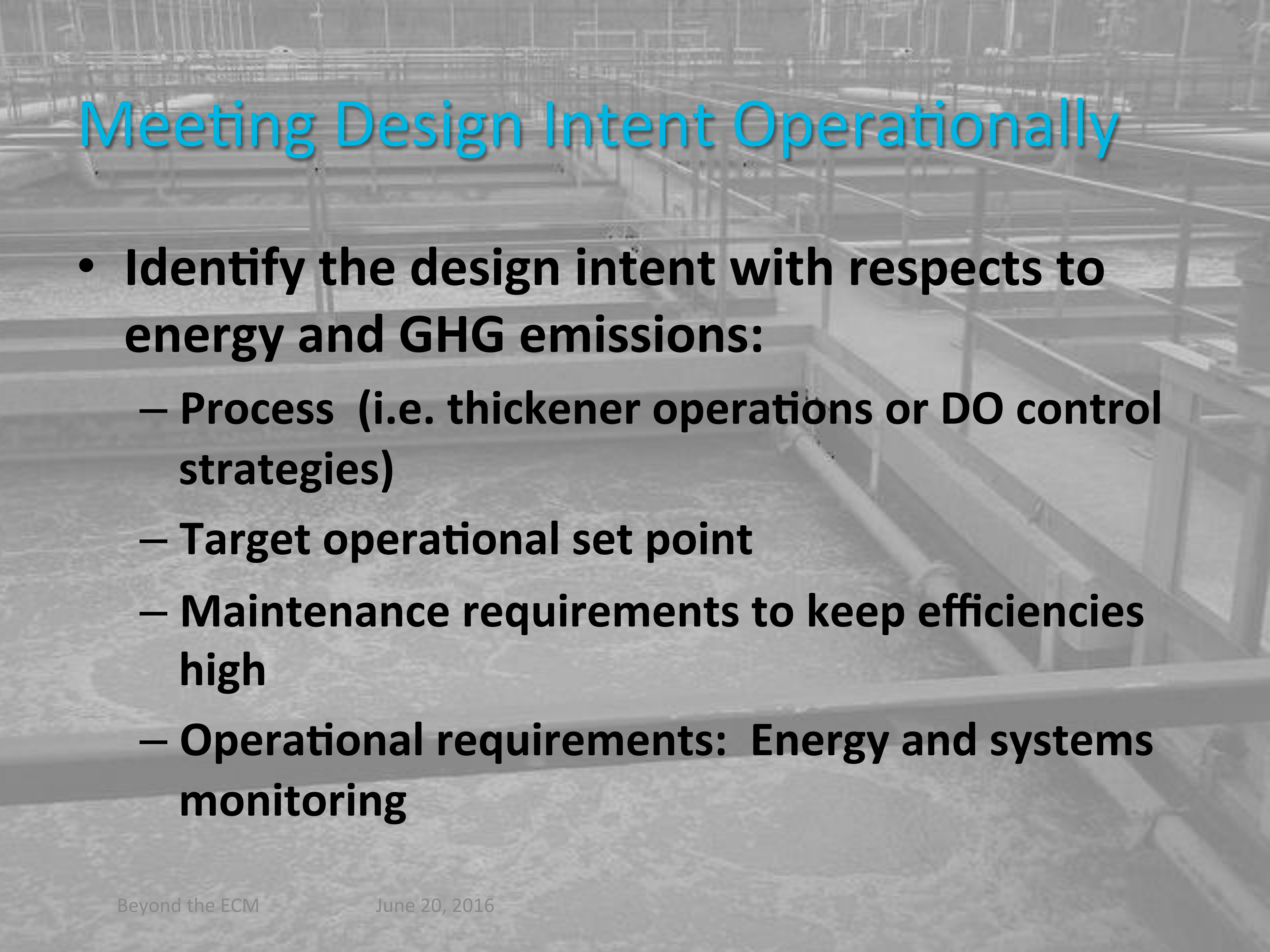
Building Systems Design



- **Baseline energy best determined with direct measurements. Absent that, modeling will be required.**
- **All designs must follow applicable codes**
- **Follow energy and emission guidelines outlined in Envision**
- **Modeling requires use of standards:**
  - **ASHRAE Standard 90.1-2010 Appendix G**
  - **DEP Energy Guidelines**
  - **Models (i.e. DOE-2, BLAST, eQUEST, DEP approved equal, etc.)**

Construction Phase

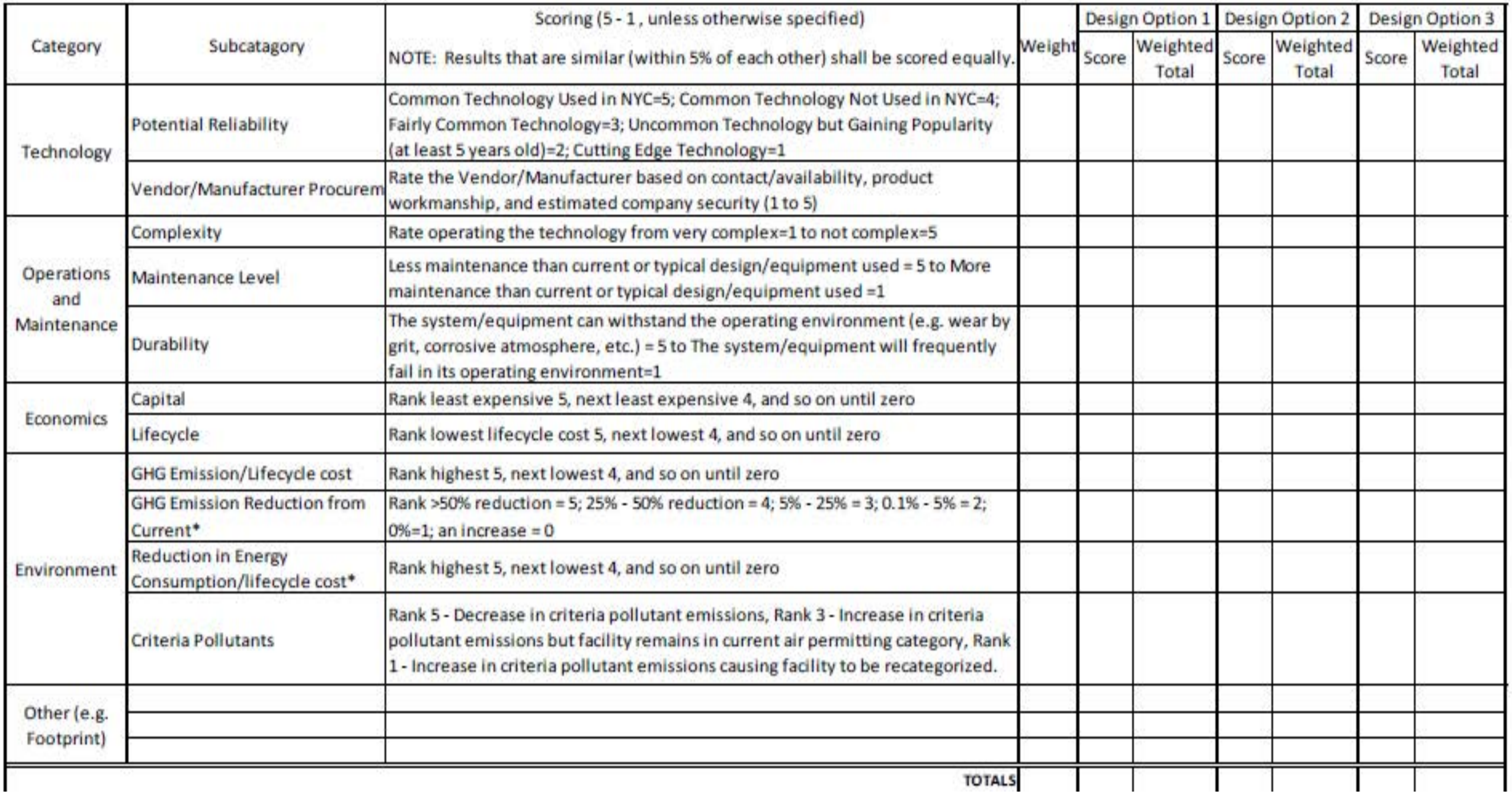
- Mindful of change orders
  - Identify modification that will affect energy/GHG emissions
    - Existing analysis
    - New additions not previously investigated
  - Increases in energy or GHG emissions should be 0 unless otherwise justified



Meeting Design Intent Operationally

- **Identify the design intent with respects to energy and GHG emissions:**
  - **Process (i.e. thickener operations or DO control strategies)**
  - **Target operational set point**
  - **Maintenance requirements to keep efficiencies high**
  - **Operational requirements: Energy and systems monitoring**

Score the Options



Category	Subcatagory	Scoring (5 - 1 , unless otherwise specified) NOTE: Results that are similar (within 5% of each other) shall be scored equally.	Weight	Design Option 1		Design Option 2		Design Option 3	
				Score	Weighted Total	Score	Weighted Total	Score	Weighted Total
Technology	Potential Reliability	Common Technology Used in NYC=5; Common Technology Not Used in NYC=4; Fairly Common Technology=3; Uncommon Technology but Gaining Popularity (at least 5 years old)=2; Cutting Edge Technology=1							
	Vendor/Manufacturer Procurem	Rate the Vendor/Manufacturer based on contact/availability, product workmanship, and estimated company security (1 to 5)							
Operations and Maintenance	Complexity	Rate operating the technology from very complex=1 to not complex=5							
	Maintenance Level	Less maintenance than current or typical design/equipment used = 5 to More maintenance than current or typical design/equipment used =1							
	Durability	The system/equipment can withstand the operating environment (e.g. wear by grit, corrosive atmosphere, etc.) = 5 to The system/equipment will frequently fail in its operating environment=1							
Economics	Capital	Rank least expensive 5, next least expensive 4, and so on until zero							
	Lifecycle	Rank lowest lifecycle cost 5, next lowest 4, and so on until zero							
Environment	GHG Emission/Lifecycle cost	Rank highest 5, next lowest 4, and so on until zero							
	GHG Emission Reduction from Current*	Rank >50% reduction = 5; 25% - 50% reduction = 4; 5% - 25% = 3; 0.1% - 5% = 2; 0%=1; an increase = 0							
	Reduction in Energy Consumption/lifecycle cost*	Rank highest 5, next lowest 4, and so on until zero							
	Criteria Pollutants	Rank 5 - Decrease in criteria pollutant emissions, Rank 3 - Increase in criteria pollutant emissions but facility remains in current air permitting category, Rank 1 - Increase in criteria pollutant emissions causing facility to be recategorized.							
Other (e.g. Footprint)									
		TOTALS							

Design Guidelines

Location	***BWT Facilities***
Unit Process	***RAS Pump Controls – Energy Consideration***
Date Issued	***08/30/2013***

Design Evolution:

Energy conservation and greenhouse gas (GHG) reductions are a New York City-wide initiative. The following design guidelines have been prepared in efforts to achieve these goals through the use of variable speed drives and system monitoring.

Lessons Learned:

This is the initial issuance of this design guideline and no City-specific experience with this specific design guideline exists at this time.

Overall Design Philosophy:

RAS pump controls shall be constructed to monitor energy consumption and minimize energy use.

Constructability Issue for Design Consideration:

None at this time.

Operational Issues for Design Consideration:

In many instances, two or more RAS pumps will be operated simultaneously. The total speed or flow rate for all pumps shall be set based on wet well operating targets; however, the operational speed or flow for each individual pump shall be set to consume the least amount of energy in total.

Design Guidelines

Approved Manufacturers:	
Not Applicable	
Detailed Design Criteria	
Component:	System Control
Criteria:	System control shall be variable speed
Component:	System Monitoring
Criteria:	The RAS pump control system shall monitor the following at a minimum: • Instantaneous energy/or power draw (KWH) • Totalized energy draw (KWH/d) • Run time • Instantaneous flow (gpm) • Totalized flow (gpd)
Component:	Programming
Criteria:	The control program shall include energy set points/goals that sets the pumps total flow rate based on incoming flow (i.e. maintaining wet well elevations) while setting each individual pumps speed at a point that will minimize energy consumption for all pumps in total.
Component:	Archive
Criteria:	All control data collected shall be retained for at least three years and must be archivable.

Design Consideration: Example 1

Design: 200 ft pipe run with 15 ft lift at 400 gpm

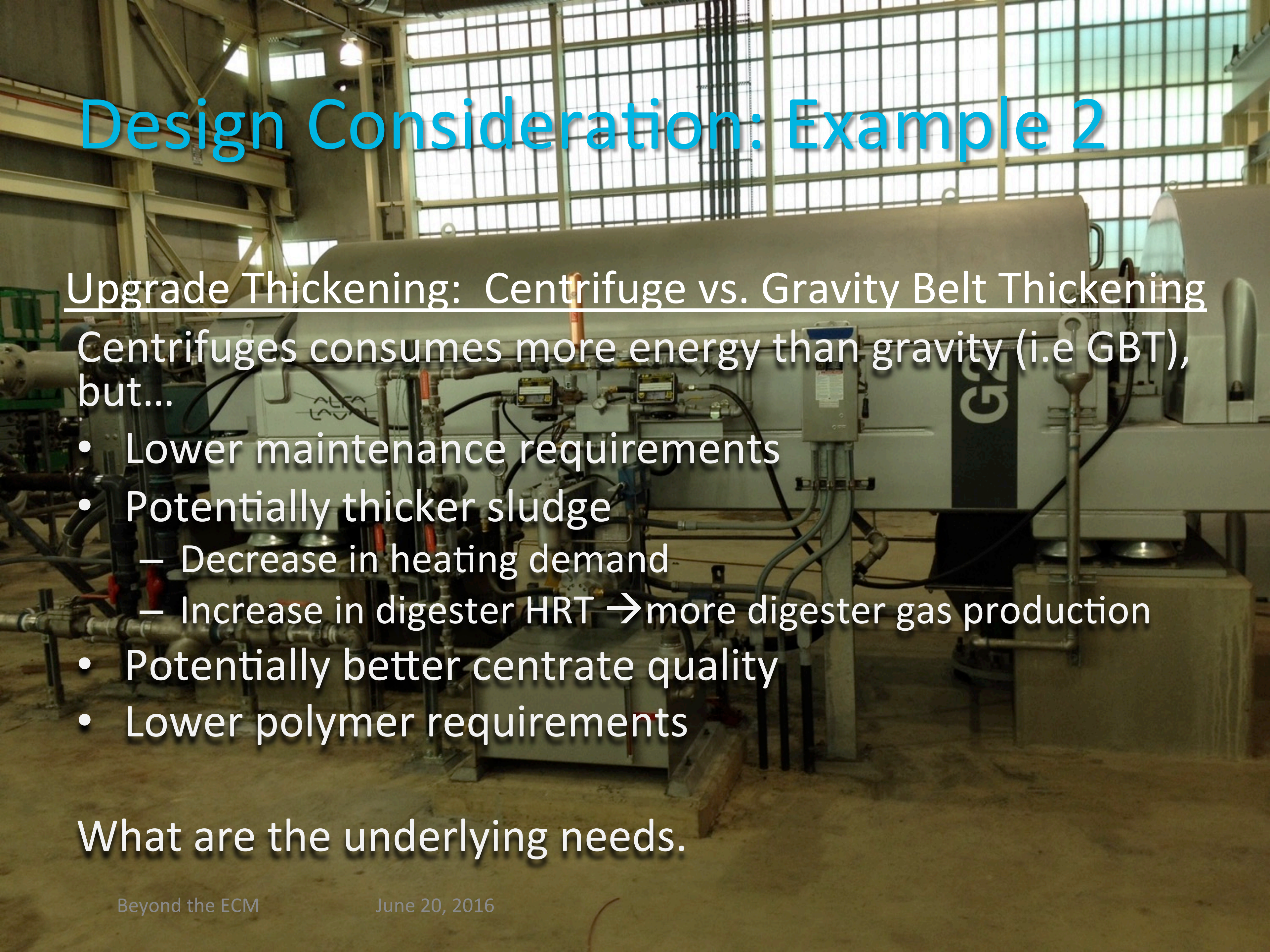
Consideration: 4” vs. 4.5” pipe – same pump

	4”	4.5”
Pipe Cost	$16,890	$18,540
Energy Cost ($0.11/kwh)	$2,813/year	$2,200/year

Savings: Over $600/year

Simple Pay Back: Under 4 years

Design Consideration: Example 2



Upgrade Thickening: Centrifuge vs. Gravity Belt Thickening

Centrifuges consumes more energy than gravity (i.e GBT), but…

- Lower maintenance requirements
- Potentially thicker sludge
  - Decrease in heating demand
  - Increase in digester HRT →more digester gas production
- Potentially better centrate quality
- Lower polymer requirements

What are the underlying needs.

Case Study

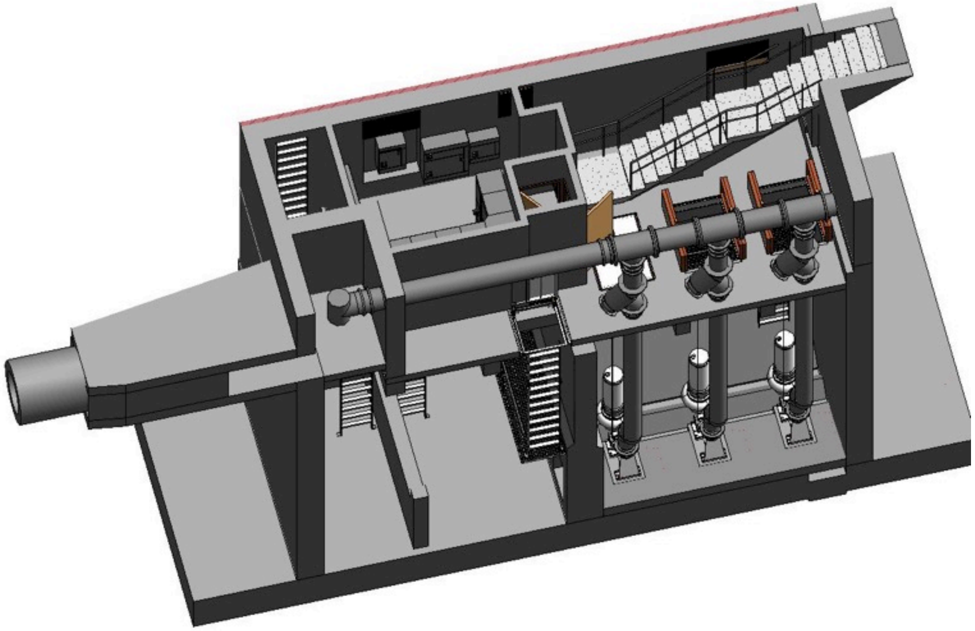
Rehabilitate an old Stormwater Pump Station

Initial construction in 1950's – 9.8 MGD

Case Study

Work:

- Replace three axial flow pumps with submersible pumps
- Improve lighting (LED)
- Install electrical room
- Improve pump station access



Case Study

	Future			Current			Change		
Storm Return Period	Electric Consumed	GHG Emissions	Cost	Electric Consumed	GHG Emissions	Cost	Electric Consumed	GHG Emissions	Cost
Year	kwh/event	lb CO2e	$/event	kwh/event	lb CO2e	$/event	kwh/event	lb CO2e	$/event
1	43	28	$ 7.78	29	19	$ 5.31	14	9	$ 2.48
2	52	34	$ 9.34	35	23	$ 6.37	17	11	$ 2.97
10	69	46	$ 12.45	47	31	$ 8.49	22	14	$ 3.96
25	86	57	$ 15.57	59	39	$ 10.61	28	18	$ 4.95
50	104	68	$ 18.68	71	47	$ 12.74	33	22	$ 5.95
100	121	80	$ 21.80	83	54	$ 14.86	39	25	$ 6.94

Future - Current (+ is increase/- is decrease)

	Future			Current			Change		
	Power	GHG Emmission	Cost	Power	GHG Emmission	Cost	Power	GHG Emmission	Cost
Asset	kwh/yr	tons CO2e/year	$/yr	kwh/yr	tons CO2e/year	$/yr	kwh/yr	tons CO2e/year	$/yr
Fan	13,065	4	$2,352	8,165	3	$1,470	4,899	1.6	$882
Unit Heaters	86,880	29	$15,638	76,020	25	$13,684	10,860	3.6	$1,955
Total HVAC System	99,945	33	$17,990	84,185	28	$15,153	15,759	5.2	$2,837

Future - Current (+ is increase/- is decrease)

Case Study

The design needs in this case justified an increase in energy costs. Due to the need to improve climate conditions particularly for the electrical components: A less efficient submersible pump as opposed to a centrifugal pump was needed to facilitate footprint.

Change from Current Operations to FSD	
Estimated Annual Electrical Consumption	16,035 KWH/year
Estimated Annual GHG Emissions	5 tons CO2e/year
Estimated Annual Operating Costs	$2,886/year
Future - Current (+ is increase/ - is decrease)	

QUESTIONS?

THANK YOU