



# Procastinator Workshop

## December 11, 2014

### Lifecycle Cost Analysis

**“Ideas and Practice to  
Improve Your Bottom Line”**

Matt Carpenter – ARCADIS  
Ohio Major Market Manager

# Today's Presenter



Matt Carpenter, P.E.

Matt is the Ohio Major Market Manager. He provides leadership for business strategy and client development for ARCADIS's Ohio water clients.

Matt has over ten years of municipal utility background that has ranged from Operations Support to Engineering to Executive Management.

Matt's expertise is in Financial Analysis, Master Planning, Asset Management, and Utility Management.

# Health & Safety Moment



## Preparing for the Road

Avoid distractions while driving by using these tools and practicing these techniques BEFORE you start driving:

- Inspect the vehicle
- Adjust mirrors, seat, & steering wheel
- Plan & know your route in advance
- Properly secure all loose items (bags, sunglasses, electronics)
- Engine On, Mobile Off (#X)
- Eat and drink in advance of your trip
- Carry an emergency kit

# Learning Objectives



1. Understand Utility Business Drivers
2. Quantify Opportunities
3. Understand Lifecycle Cost Analysis
4. Make Better Decisions
5. Sell Your Ideas
6. Hit Your Targets

# Utility Business Drivers



**Opportunities**

# Why is Financial Analysis Important?

*Political willingness to raise rates is perhaps the greatest threat to sector financial stability over the near-term. – Fitch Ratings*



# What is Lifecycle Cost Analysis?

Tool to determine the most cost-effective option among different competing alternatives to purchase, own, operate, maintain and, finally, dispose of an object or process



# Varying Levels of Complexity

- Range of options – simple to complex
- Scale the effort to the magnitude of the situation
- Simple Payback
- Advanced Cash Flow Analysis
- Business Case Evaluation – Triple Bottom Line





# Simple Payback

- Up Front Costs ÷ Annual Savings = Simple Payback
- Good for simple situations with few variables
- Example:  
Buying a new lab instrument vs. outsourcing testing

$$\$50,000 \div \$10,000 = 5 \text{ years}$$

Cost of New  
Instrument

Cost of  
Testing

Simple  
Payback

# Simple Payback

## Pros

- Quick and Easy – “Low Hanging Fruit”
- No special software
- Easy to explain
- Good for simple, low-cost situations

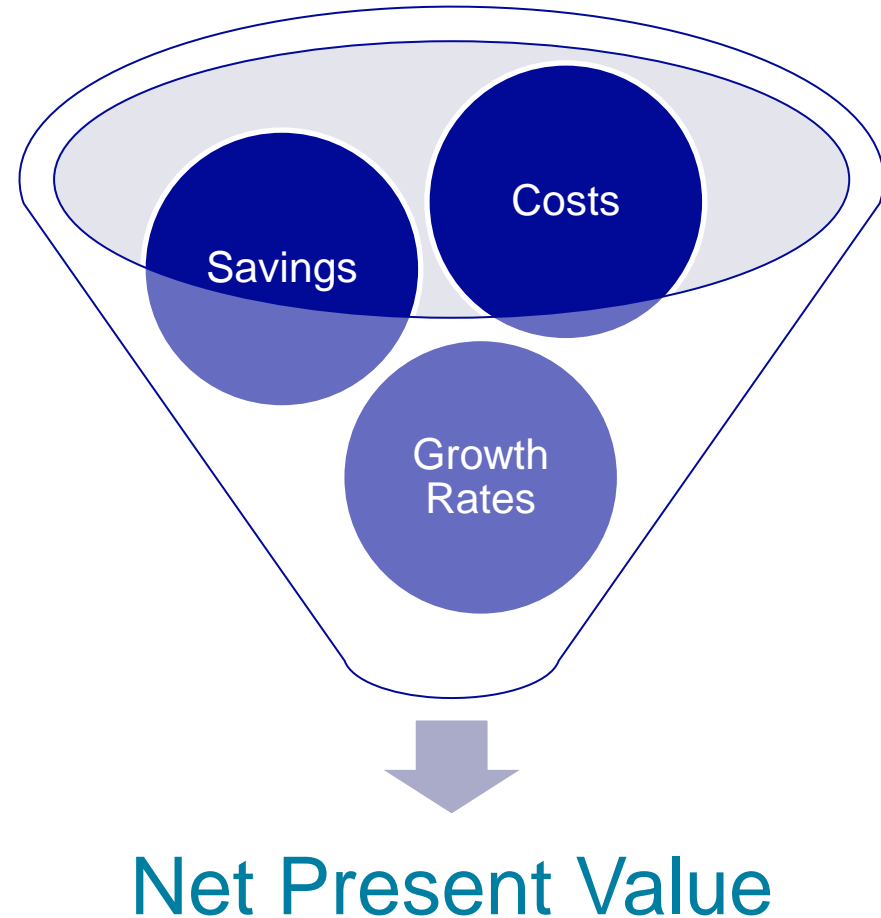


## Cons

- Limited to very basic situations
- Doesn't address variability in costs and savings
- Doesn't reflect long-term conditions
- Doesn't consider the time value of money

# Advanced Cash Flow Analysis

- Compare Various Alternatives
- Capital and O&M
- Savings and Revenue Generation
- Varying Inflation Assumptions
- Long Term Analysis
- Example:  
Selecting biosolids disposal options



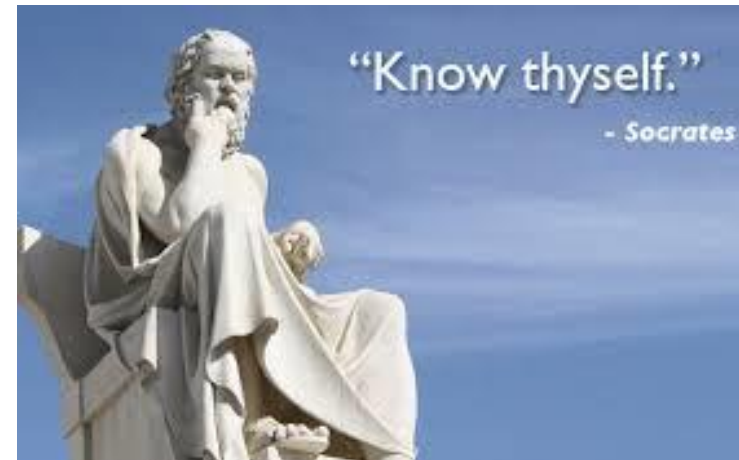
# Advanced Cash Flow Analysis

## Pros

- Use readily available software
- Account for complex situations
- Considers variability in costs and inflation
- Considers long-term conditions
- Considers the time value of money

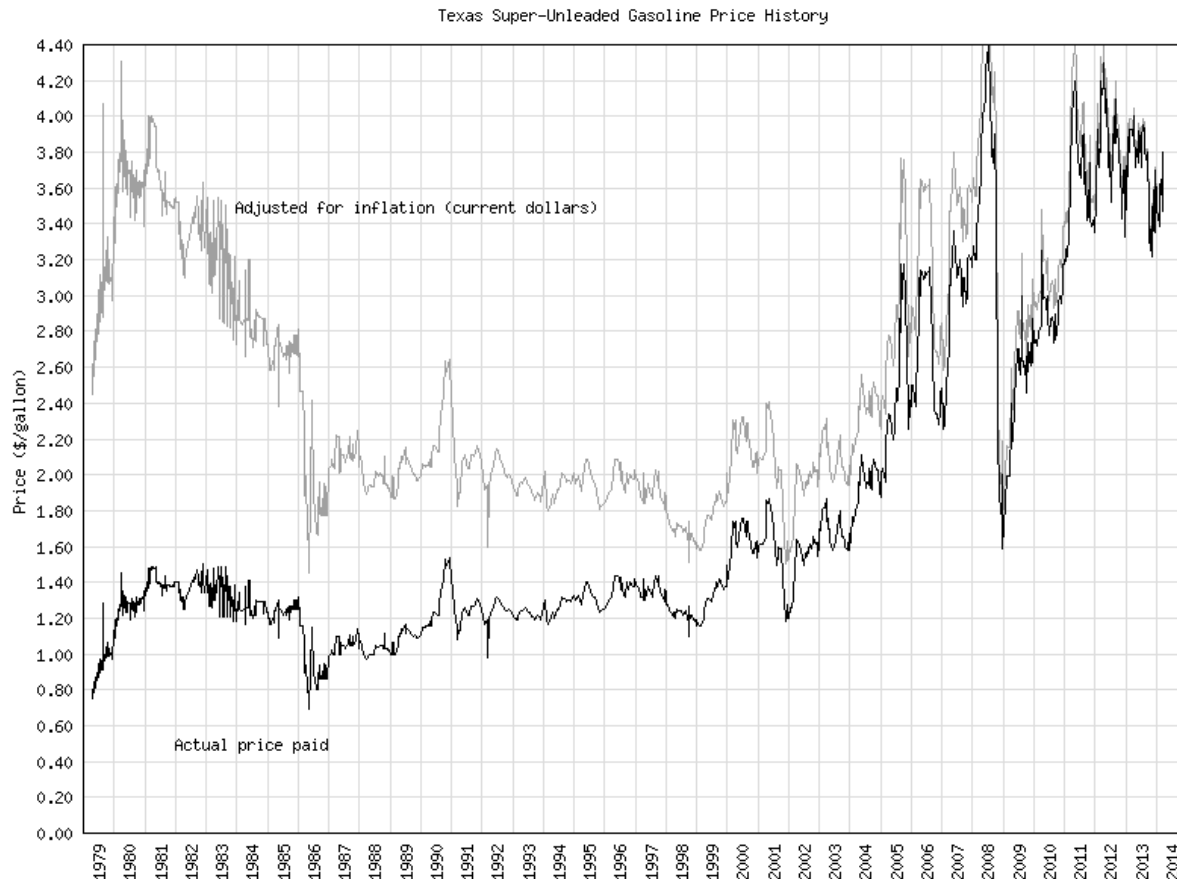
## Cons

- More time and data required to prepare – “Know Thyself”
- Doesn't consider non-cost factors
- Potentially confusing terms (NPV, Discount Rate)



# Net Present Value (NPV)

NPV allows you to consider the time value of money



# NPV Discount Rate

Discount Rate represents your “Opportunity Cost”



# Business Case Evaluation (BCE)

## Triple Bottom Line:

Consider the most important and measurable project costs and benefits including economic, social, and environmental

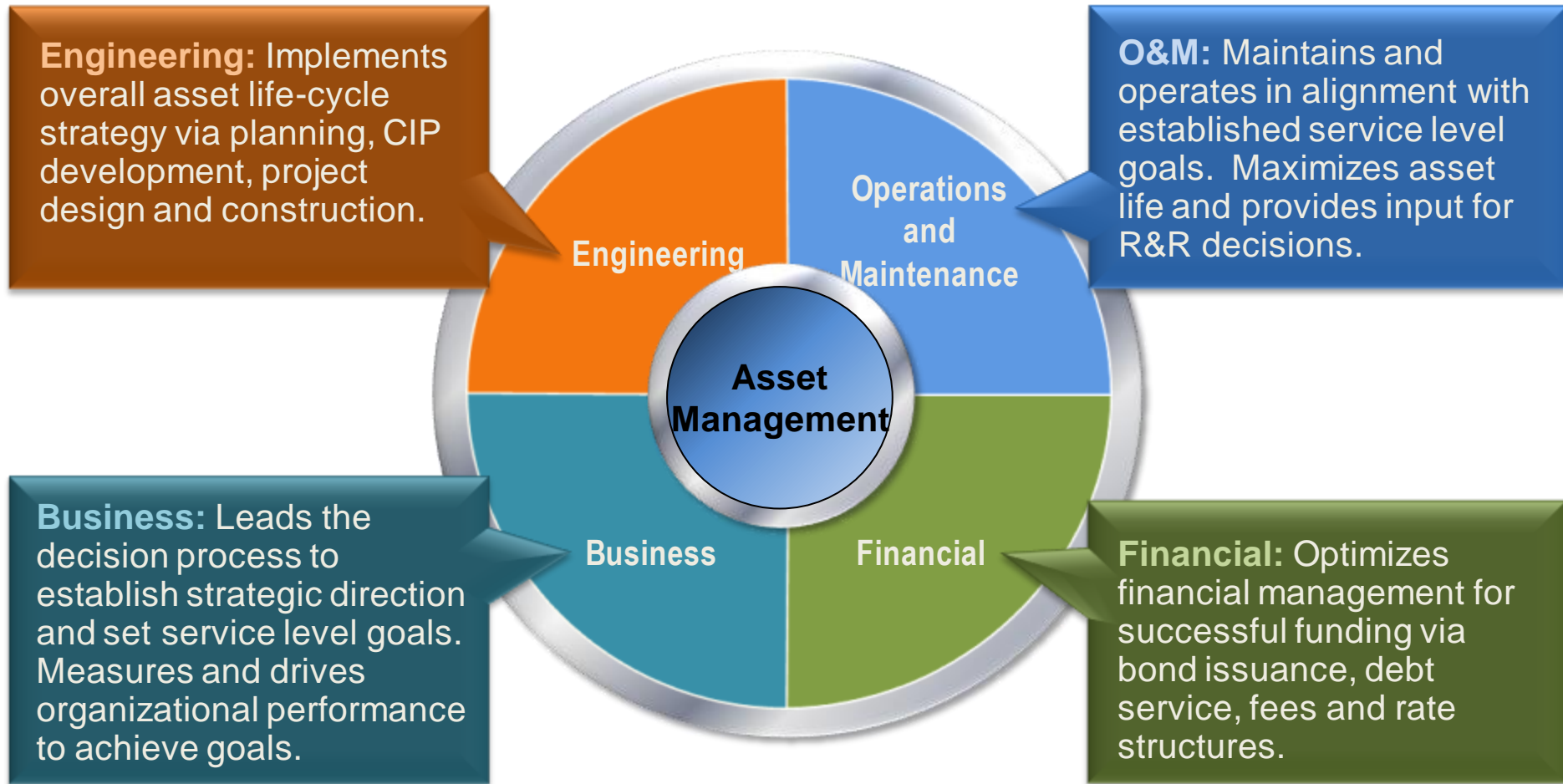


# Benefits of BCE

- Long-term service level and cost implications
- Triple-Bottom-Line evaluation
- Provides greater understanding of true life-cycle costs
- Strengthens long-term financial decision making
- Considers all divisions within the utility
- Documents other project benefits



# Collaborative Effort



# BCE Template

1. Project Summary Information
2. Project Justification
3. Project Driver(s)
4. Projected Project Schedule and Cost
5. Project Constraints

1. PROJECT SUMMARY			
Project Number			Date
Project Prepared By	Name	Title	Department

2. PROJECT JUSTIFICATION
<b>PROJECT DESCRIPTION / SUMMARY:</b> Provide additional supporting text detailing project scope and purpose and defining the problem you are trying to solve including: project drivers, past problems/issues, expected impacts, analysis performed, data reviewed, alignment with organization and asset management goals, and major assumptions and risks.
<b>DESCRIPTION AND SCOPE</b>

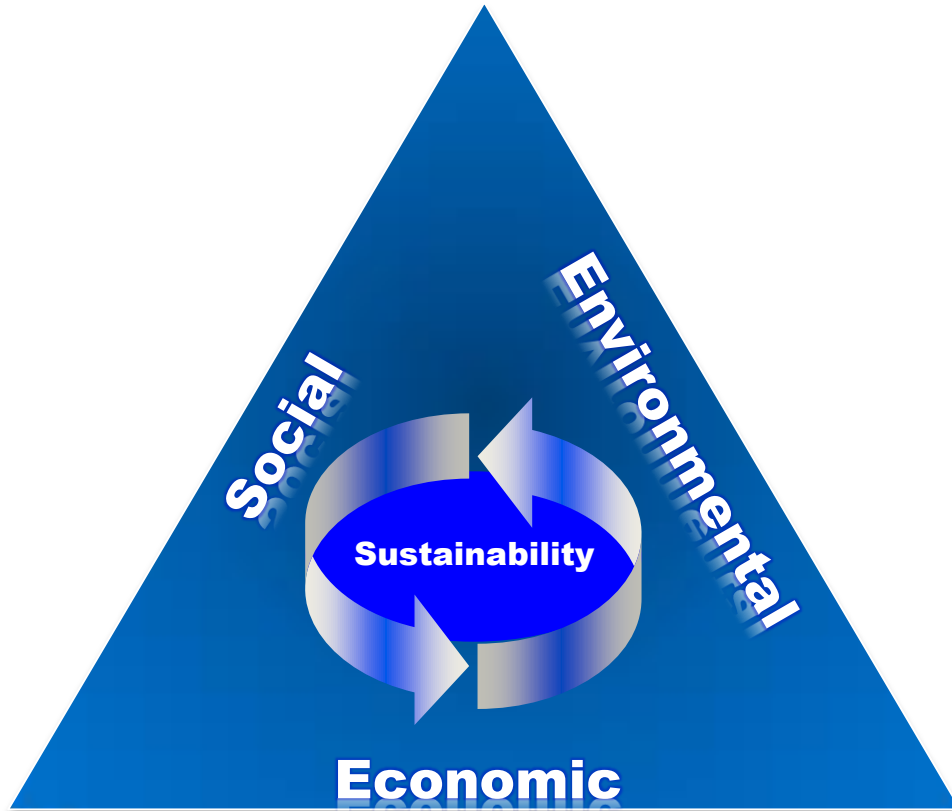
3. PROJECT DRIVER (CHECK ONE WHICH BEST APPLIES)	
<input type="checkbox"/> Renewal / Rehabilitation / Replacement	<input type="checkbox"/> Safety (Public and Employee)
<input type="checkbox"/> Growth / Expansion / Capacity	<input type="checkbox"/> Security / Vulnerability
<input type="checkbox"/> Regulatory Compliance	<input type="checkbox"/> VDOT
<input type="checkbox"/> Risk Management / Risk Reduction	<input type="checkbox"/> Strategic Growth Area
<input type="checkbox"/> Enhancement / Service Level / Reliability / WQ	<input type="checkbox"/> Other _____
<input type="checkbox"/> O&M / Cost Efficiency / Business Performance	<input type="checkbox"/> Other _____

# BCE Template

6. Service Levels, Prioritization Narrative, Regulatory Compliance
7. Condition and Criticality Narrative
8. Optional Information
9. Project Approval
10. Prioritization Analysis

<b>6. ADDITIONAL SUPPORTING NARRATIVE - PRIORITIZATION, SERVICE LEVELS, AND REGULATORY COMPLIANCE</b>			
Provide additional supporting text in the space below to describe expected impacts on service levels: Include			
<b>8. OPTIONAL INFORMATION: List Of Assets Involved (Or New Assets Proposed), Map Of Location, And/Or Asset Photos:</b>			
PROJECT LOCATION /MAP/REFERENCE DOCUMENTS		ASSET LISTING AND/OR PHOTOS	
<b>9. FINAL BUSINESS CASE REVIEW AND APPROVAL</b>			
Project Manager Name / Title		Date	Signature
<b>10. PRIORITIZATION ANALYSIS</b>			
<b>PRIORITIZATION FACTORS:</b> For all project criteria, indicate total average scores (1-5) from evaluation, and include specific justification or explanation for the scoring. Business case owner or Project Manager will complete an initial scoring recommendation which will be reviewed by the CIP committee.			
Criteria	Recommended Eval. Score (1-5)	CIP Committee Evaluation Score (1-5)	Justification / Explanation
Physical Condition			
Performance / Process Condition			

# Triple Bottom Line Considerations



- **Economic**
  - Financial Returns / Impact
  - Operations and Maintenance
- **Environmental**
  - Environmental / Regulatory Compliance
  - Efficiency / Energy
- **Social**
  - Service Level / Reliability
  - Public / Employee Safety
  - Public Benefit
  - Alignment with Strategic Goals
  - Community / Growth
  - Process Effec. / Inst. knowledge

# Prioritization Criteria / Weightings

	<i>Weighting</i>
<b>1 Physical Condition</b>	<b>13%</b>
<b>2 Performance / Process Condition</b>	<b>14%</b>
<b>3 Strategic Plan Alignment</b>	<b>8%</b>
<b>4 Regulatory / Environmental</b>	<b>15%</b>
<b>5 Service Level / Reliability</b>	<b>11%</b>
<b>6 O&amp;M and Safety</b>	<b>10%</b>
<b>7 Public Benefit</b>	<b>7%</b>
<b>8 Financial</b>	<b>7%</b>
<b>9 Efficiency / Energy</b>	<b>4%</b>
<b>10 Redevelopment / Public / Community</b>	<b>8%</b>
<b>11 Process Effect. / Inst. Knowledge</b>	<b>5%</b>
<b>TOTAL - Must Equal 100%</b>	<b>100%</b>

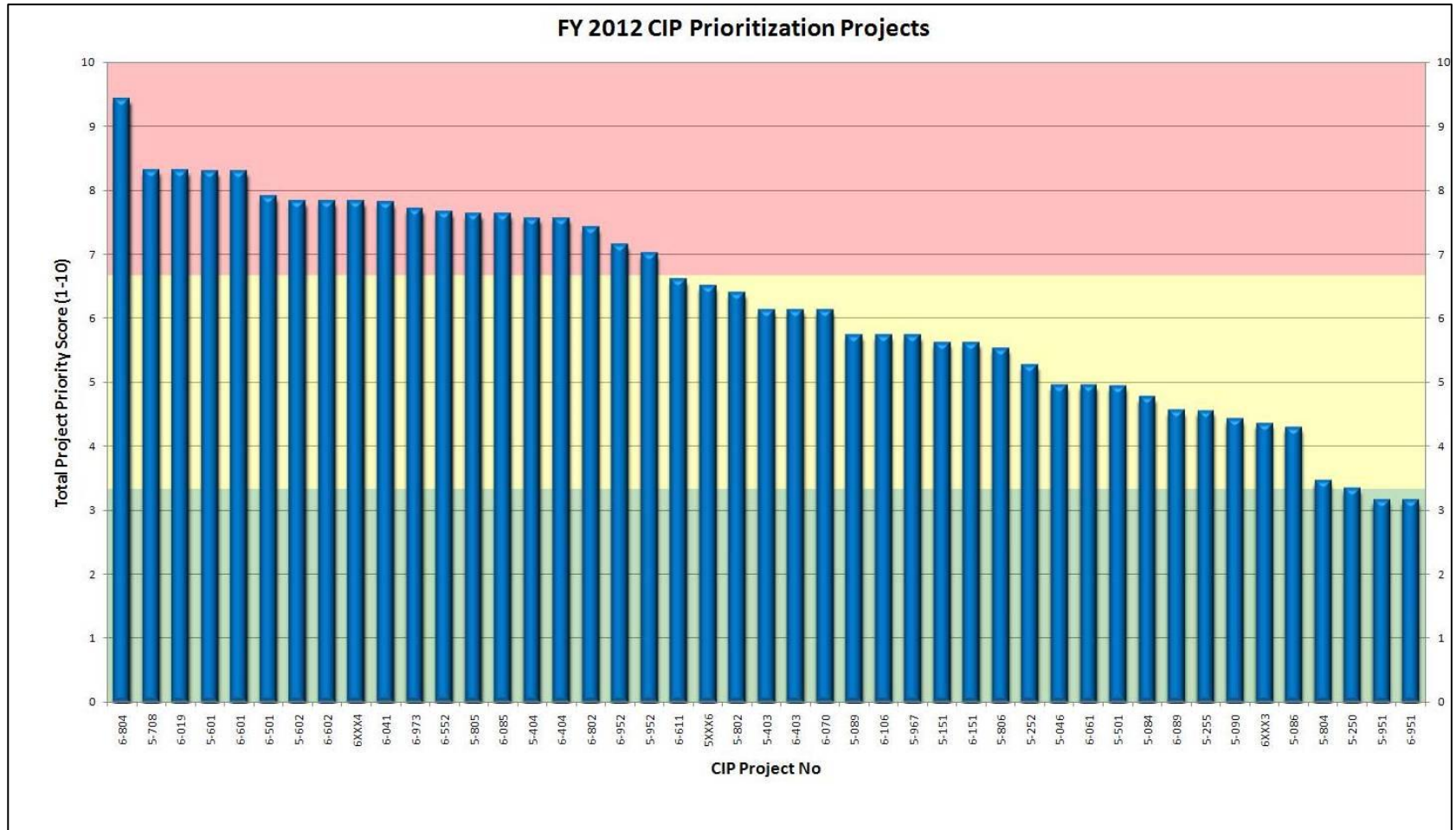
# Sample Prioritization Analysis

<b>Criteria</b>	<b>Recommended Evaluation Score</b>	<b>CIP Committee Evaluation Score</b>	<b>Justification/Explanation</b>
Physical Condition	4	4	Significant pipe deficiencies and I/I sources based on field investigations
Performance/Process Condition	3	3	Operational performance issues and occasional overflow occurrences during significant wet weather events
Strategic Plan Alignment	4	5	Strongly aligned with Asset Management Initiatives and Dept. goals
Regulatory / Environmental	3	3	Potential non-compliance issues (SSOs)

# Sample Prioritization Table

CIP Project	Water/Sev	Category	Project Type	Cost	Total Sc
6-804	Sewer	Regulatory Compliance	Aging Infrastructure	\$4,300,000	9.43
6-611	Sewer	Renewal / Rehabilitation / Replacement	Aging Infrastructure	\$1,000,000	6.61
5-708	Water	Renewal / Rehabilitation / Replacement	Design and Construction	\$100,000	8.32
6-019	Sewer	Renewal / Rehabilitation / Replacement	Design and Construction	\$750,000	8.32
6-501	Sewer	Regulatory Compliance	Design and Construction	\$600,000	7.90
5-602	Water	VA DOT	Design and Construction	\$200,000	7.83
6-602	Sewer	Strategic Growth Area	Design and Construction	\$150,000	7.83
6-603	Sewer	Renewal / Rehabilitation / Replacement	Design and Construction	\$0	7.83
5-XXZ	Water	Renewal / Rehabilitation / Replacement	Design and Construction	\$0	7.83
6-973	Sewer	Growth / Expansion / Capacity	Aging Infrastructure	\$500,000	7.71
6-552	Sewer	Regulatory Compliance	Aging Infrastructure	\$4,500,000	7.66
5-805	Water	Risk Management / Risk Reduction	Aging Infrastructure	\$2,000,000	7.63
6-085	Sewer	Risk Management / Risk Reduction	Aging Infrastructure	\$1,000,000	7.63
6-XYX	Sewer	Renewal / Rehabilitation / Replacement	Design and Construction	\$70,000	7.63
5-404	Water	O&M / Cost Efficiency / Business Performance	Planning and Analysis	\$377,353	7.57
6-404	Sewer	O&M / Cost Efficiency / Business Performance	Planning and Analysis	\$724,848	7.57
6-952	Sewer	Renewal / Rehabilitation / Replacement	Aging Infrastructure	\$5,200,000	7.15
5-952	Water	Renewal / Rehabilitation / Replacement	Aging Infrastructure	\$182,500	7.01
6-070	Sewer	Renewal / Rehabilitation / Replacement	Aging Infrastructure	\$1,500,000	6.13
5-XXY	Water	VA DOT	Design and Construction	\$400,000	6.50
6-041	Sewer	Renewal / Rehabilitation / Replacement	Aging Infrastructure	\$8,592,689	7.81
5-403	Water	Enhancement / Service Level / Reliability / WQ	Planning and Analysis	\$0	6.13

# CIP Prioritization Chart





# Make Better Decisions

- Quantify benefits that may or may not be obvious
- Prioritize your efforts
- Maximize return on investment
- Get the right answer



# Sell Your Ideas

- Justify and Support your ideas
- Document facts and decisions
- Build support – executive, political, customers



# Hit Your Targets

- Know what you're aiming for
- Track and measure your success



**"If you aim at  
nothing, you will hit  
it every time"**

*Author Unknown*

# Case Studies



# Water Treatment Softening Alternatives

- Utility wants to add softening process to existing water treatment facility
- Alternatives include Membranes, Lime Softening, Ion Exchange, and EDR
- Flow is expected to increase over time
- Costs are anticipated to increase at varying rates



# Water Treatment Softening Alternatives

Membrane Softening at 80% Recovery						
Year	1	2	3	4	19	20
Flow, MGD	2.79	2.87	2.95	3.03	4.58	4.71
Initial Capital	\$5,797,497					
Annual Debt Service	\$426,590	\$426,590	\$426,590	\$426,590	\$426,590	\$426,590
Chemicals	\$89,682	\$ 96,794	\$ 104,469	\$ 112,753	\$ 354,185	\$ 382,270
Membranes	\$99,274	\$ 105,105	\$ 111,278	\$ 117,814	\$ 277,345	\$ 293,635
Power	\$122,947	\$ 132,696	\$ 143,218	\$ 154,575	\$ 485,558	\$ 524,061
Totals	\$738,493	\$761,185	\$785,556	\$811,732	\$1,543,678	\$1,626,556
NPV	\$11,532,620					
20 Year Total	\$21,789,137					
Chemical Inflation Rate	5%					
Electricity Inflation Rate	5%					
Membrane Inflation Rate	3%					
Consumption Growth Rate	2.8%					
Debt Interest Rate	4%					
NPV Discount Rate	6%					

## Options Summary

### Ion Exchange

Initial Capital	\$ 4,407,303
Initial O&M	\$ 673,252
20 Year NPV	\$ 18,878,792
Initial Annual Cost (\$/kgal)	\$ 0.98

### Membrane Softening

Initial Capital	\$ 5,797,497
Initial O&M	\$ 311,903
20 Year NPV	\$ 11,532,620
Initial Annual Cost (\$/kgal)	\$ 0.73

### EDR Softening

Initial Capital	\$ 13,327,135
Initial O&M	\$ 441,923
20 Year NPV	\$ 20,684,467
Initial Annual Cost (\$/kgal)	\$ 1.40

### Lime Softening

Initial Capital	\$ 11,819,202
Initial O&M	\$ 709,445
20 Year NPV	\$ 24,085,199
Initial Annual Cost (\$/kgal)	\$ 1.55

Membrane Softening is the lowest cost alternative on a life-cycle NPV basis.



# Automated Metering Infrastructure

- Utility wants to know if installing an AMI system is a good investment
- Only 1 alternative evaluated – project will either be beneficial or not
- Costs are anticipated to increase at varying rates
- Need to consider the time value of money and opportunity costs

# Automated Metering Infrastructure

	EXISTING (FY 2014)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2033	2034
<b>Number of Meters</b>												
Manual Water	4,440	3,552	2,664	1,776	888	-	-	-	-	-	-	-
AMI Water	-	888	1,776	2,664	3,552	4,440	4,440	4,440	4,440	4,440	4,440	4,440
Manual Electric	4,150	-	-	-	-	-	-	-	-	-	-	-
AMI Electric	-	4,150	4,150	4,150	4,150	4,150	4,150	4,150	4,150	4,150	4,150	4,150
Totals	8,590	8,590	8,590	8,590	8,590	8,590	8,590	8,590	8,590	8,590	8,590	8,590
<b>Equipment Purchase and Installation Costs</b>												
New Water Meters		\$ (71,040)	\$ (73,171)	\$ (75,366)	\$ (77,627)	\$ (79,956)						
New Water Meter Endpoints		\$ (88,800)	\$ (91,464)	\$ (94,208)	\$ (97,034)	\$ (99,945)						
New Electric Meters		\$ (249,000)										
New Electric Meter Endpoints		\$ (249,000)										
Meter Installation Services		\$ (151,140)	\$ (27,439)	\$ (28,262)	\$ (29,110)	\$ (29,984)						
Collector base stations		\$ (72,000)										
Software and Project Management		\$ (180,000)										
Annual Maintenance Fees for AMI Software		\$ (7,200)	\$ (7,416)	\$ (7,638)	\$ (7,868)	\$ (8,104)	\$ (8,347)	\$ (8,597)	\$ (8,855)	\$ (9,121)	\$ (12,258)	\$ (12,625)
Server Installation and Setup		\$ (50,000)					\$ (57,964)					
Hand Held Devices		\$ (11,000)					\$ (12,752)					
Engineering Services		\$ (75,000)										
Billing System Interface Professional Services		\$ (20,000)										
Subtotal Annual Costs		\$ (1,224,180)	\$ (199,490)	\$ (205,475)	\$ (211,639)	\$ (217,989)	\$ (79,062)	\$ (8,597)	\$ (8,855)	\$ (9,121)	\$ (12,258)	\$ (12,625)
<b>Tangible O&amp;M Savings</b>												
Audit Cost Savings		\$ 21,600	\$ 25,956	\$ 30,554	\$ 35,404	\$ 40,518	\$ 41,734	\$ 42,986	\$ 44,275	\$ 45,604	\$ 61,288	\$ 63,126
Vehicle Cost Savings		\$ 5,806	\$ 6,977	\$ 8,213	\$ 9,517	\$ 10,891	\$ 11,218	\$ 11,555	\$ 11,901	\$ 12,258	\$ 16,474	\$ 16,968
Handheld Data Transfer Savings		\$ 826	\$ 993	\$ 1,169	\$ 1,354	\$ 1,550	\$ 1,596	\$ 1,644	\$ 1,694	\$ 1,744	\$ 2,344	\$ 2,415
Meter Reader Lost Time Savings		\$ 4,131	\$ 4,964	\$ 5,843	\$ 6,771	\$ 7,749	\$ 7,982	\$ 8,221	\$ 8,468	\$ 8,722	\$ 11,721	\$ 12,073
Additional Water Revenue		\$ 11,061	\$ 22,785	\$ 35,203	\$ 48,345	\$ 62,245	\$ 64,112	\$ 66,036	\$ 68,017	\$ 70,057	\$ 94,151	\$ 96,975
Additional Sewer Revenue		\$ 19,576	\$ 40,327	\$ 62,306	\$ 85,567	\$ 110,167	\$ 113,472	\$ 116,876	\$ 120,383	\$ 123,994	\$ 166,638	\$ 171,637
Additional Electric Revenue		\$ 82,209	\$ 84,675	\$ 87,215	\$ 89,832	\$ 92,527	\$ 95,303	\$ 98,162	\$ 101,107	\$ 104,140	\$ 139,955	\$ 144,154
Net Annual O&M Savings		\$ 145,209	\$ 186,678	\$ 230,503	\$ 276,791	\$ 325,647	\$ 335,417	\$ 345,479	\$ 355,844	\$ 366,519	\$ 492,571	\$ 507,348
Total Annual Savings (Costs)		\$ (1,078,971)	\$ (12,813)	\$ 25,028	\$ 65,151	\$ 107,659	\$ 256,354	\$ 336,882	\$ 346,989	\$ 357,398	\$ 480,314	\$ 494,723
Cumulative Savings (Costs)		\$ (1,078,971)	\$ (1,091,783)	\$ (1,066,755)	\$ (1,001,604)	\$ (893,945)	\$ (637,591)	\$ (300,708)	\$ 46,280	\$ 403,679	\$ 4,349,989	\$ 4,844,712
Simple Payback		7.9 years										
Present Worth Costs		(\$2,089,656)										
Present Worth Benefit		\$3,882,710										
Net Present Value (6% discount rate)		\$1,793,054										
Internal Rate of Return		17.1%										
Cost/Benefit Ratio		1.86										

 **Positive NPV means project is beneficial**



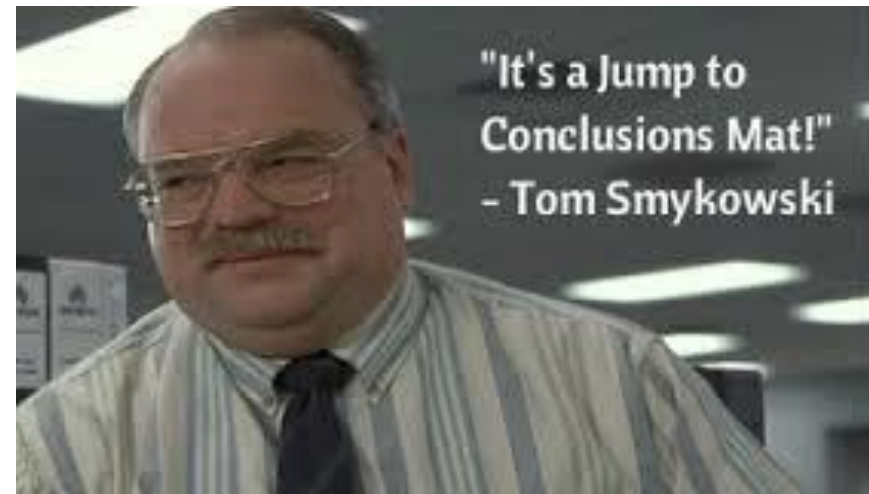
# WWTP Blower Replacement

- Utility wants to compare various options for replacing WWTP blowers before end of life
- Several alternatives evaluated, including “Do Nothing”
- Costs are anticipated to increase at varying rates
- Need to consider the time value of money and opportunity costs



# Conclusion

Lifecycle Cost Analysis should play an important role in helping utilities make sound decisions and be responsible stewards of public resources.





Thank you!

**Matt Carpenter**

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