



Infrastructure Renewal Planning Incorporating Indirect Cost Analysis of Consequence of Failures





Who We Are

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Objectives of this presentation:

- The Utility
- Why it matters to incorporate indirect costs in renewal planning
- Examples
- How it comes together: the BCE







We own and operate a fortune in buried treasure:

- 1600 miles of underground pipeline 4” to 78” diameter.
- Three wastewater facilities
- Two surface water treatment plants
- 14 active wells, 22 water reservoirs
- 34 Booster stations, 7200 fire hydrants
- 38 WW pump/lift stations
- 2 septage receiving stations
- 17,000 pieces of rotating equipment

Total book value: > \$800 million (US)



Anchorage Water and Wastewater Utility FACILITIES MAP



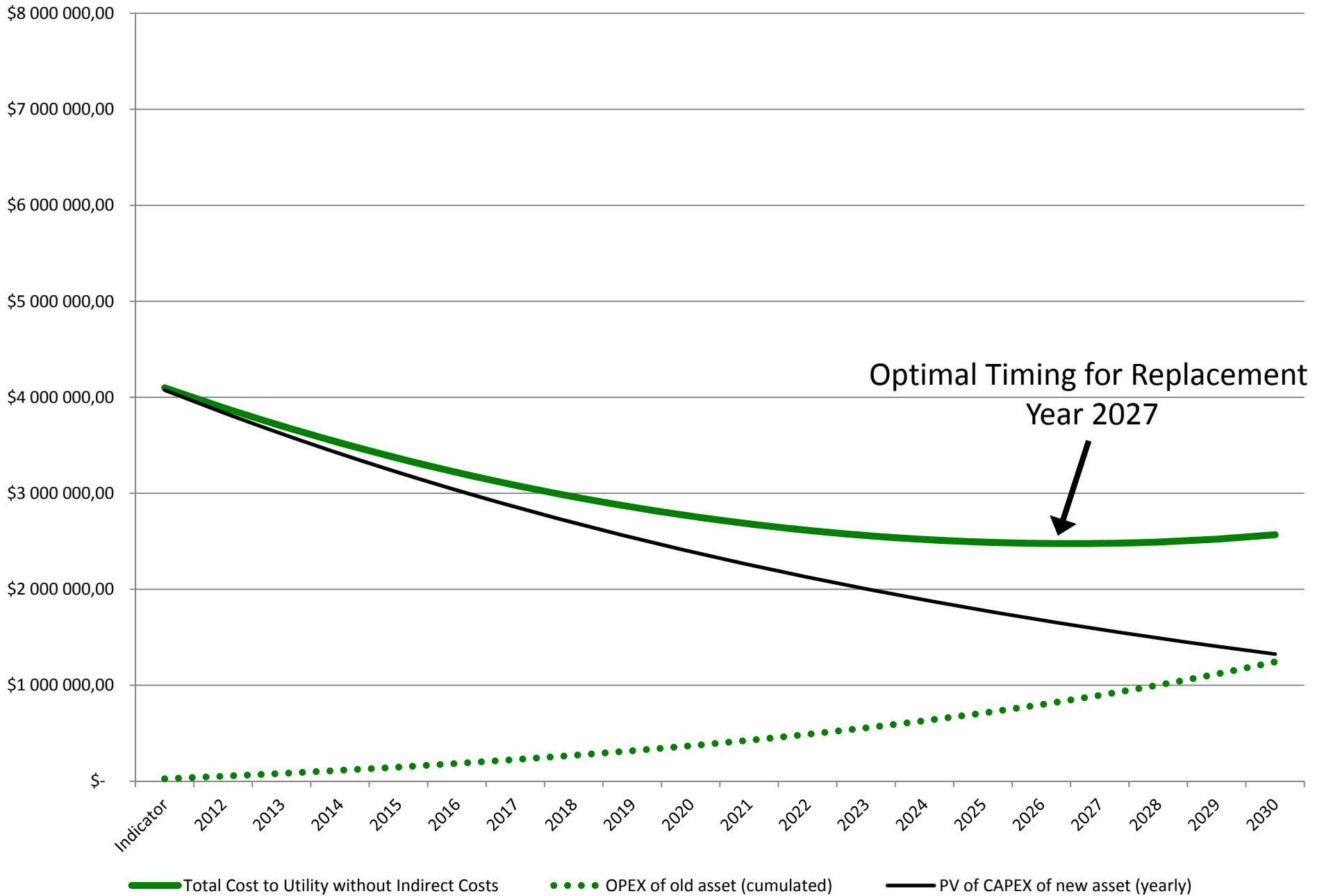


And have experienced increased Financial and Economic Scrutiny

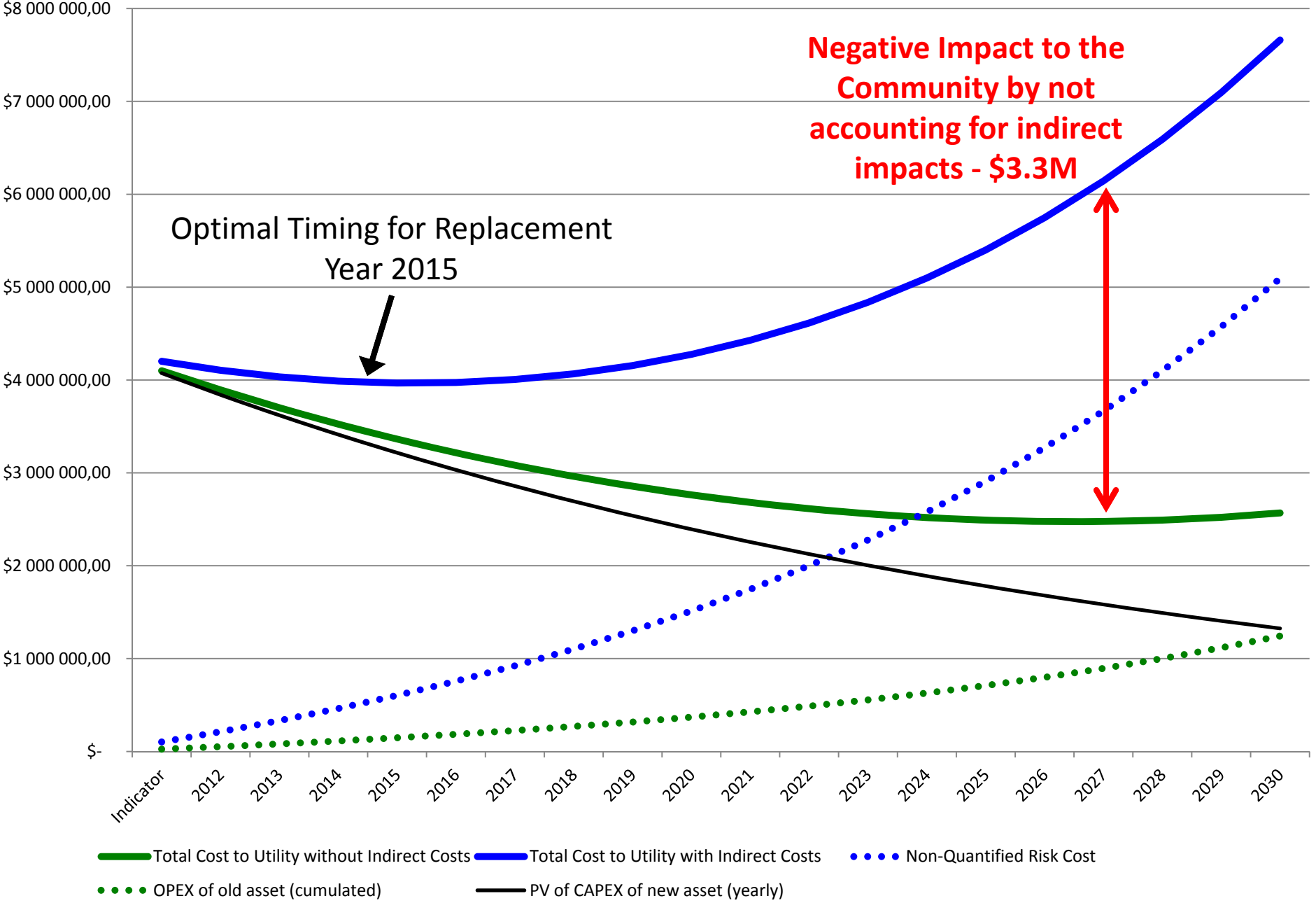
- Affordability
 - Regulators
 - City Councils
 - Customers
- Fiscal Responsibility
 - Long term planning
 - City Wide Impacts
- Direct costs show a limited picture



Replacement Timing Without Indirect Costs



Replacement Timing with Indirect Costs



Negative Impact to the Community by not accounting for indirect impacts - \$3.3M

Optimal Timing for Replacement Year 2015



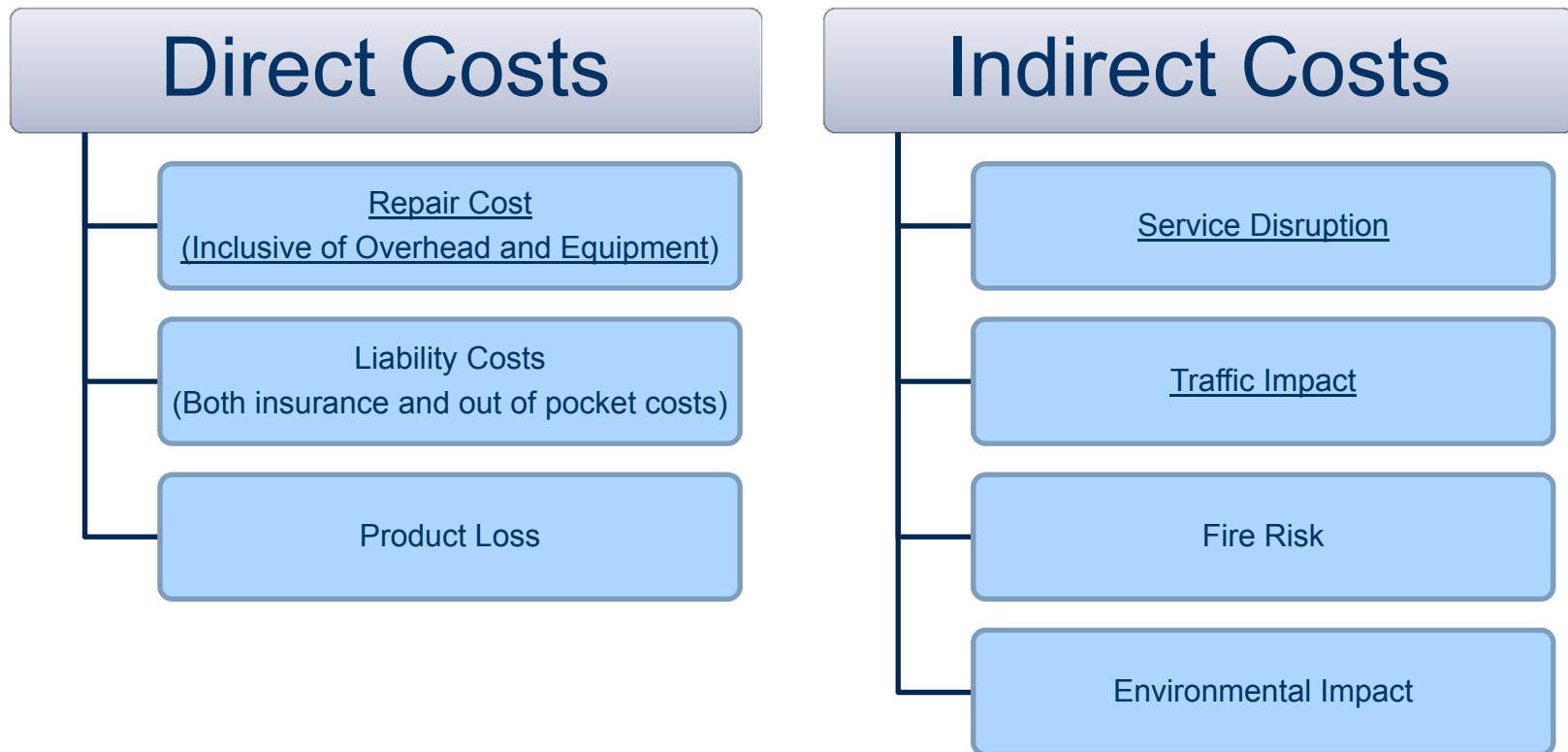
Consequence of Failure – Where to Start

- Identify all Consequences of Failure
- Analyze Past Failures for Information
- Include all costs Including Indirect Costs
 - Quantified
 - Non-Quantified





What COF are typically considered?





COF - Finding the Data

- Utility Data
 - Financials
 - Break History
 - Equipment Registers
 - Flow Rates and Average Pressures
 - Liability Costs
- Developed Data
 - Road Closure Impacts
 - Outage Area
 - Fire Risk
- Local Data
 - Road Category
 - Land Use
- Regional Data
 - Average Wages
 - Industry Economic Reports
 - Vehicle Use Costs





COF – Prepping the Data

- Standardizing
- Averaging
- Normalizing
- Etc.

*“The machine actually learns more about your next likely action by studying **others** than by studying **you**.”*

Eric Siegel – Predictive Analytics

Then apply it consistently in your analyses.....





Calculating COF

Total Failure Cost = C_D (Direct Costs) + C_I (Calculated Indirect Costs)

$$C_D = C_R + C_L + C_P$$

C_R = Average Repair Cost

C_L = Standard Liability Cost

C_P = Product Loss Cost

$$C_I = C_S + C_T + C_F + C_E$$

C_S = Service Disruption Cost

C_T = Traffic Impact Cost

C_F = Fire Risk Cost

C_E = Environmental Impact Cost





Calculating COF – One Example:

Traffic Impact Cost

$$C_T = T_v * AvgDt * W * P_c + DI * V_c$$

T_v = Traffic Volume based on Road Type (Local Data)

$AvgDt$ = Average Detour Time (Spatially Developed Data)

W = Average Wage (Local Data)

P_c = Passenger Count (Local Data)

DI = Detour Length in Miles (Spatially Developed Data)

V_c = Vehicle Cost per Mile (Regional Data)

Result is a more accurate indicator
of consequences of failure.





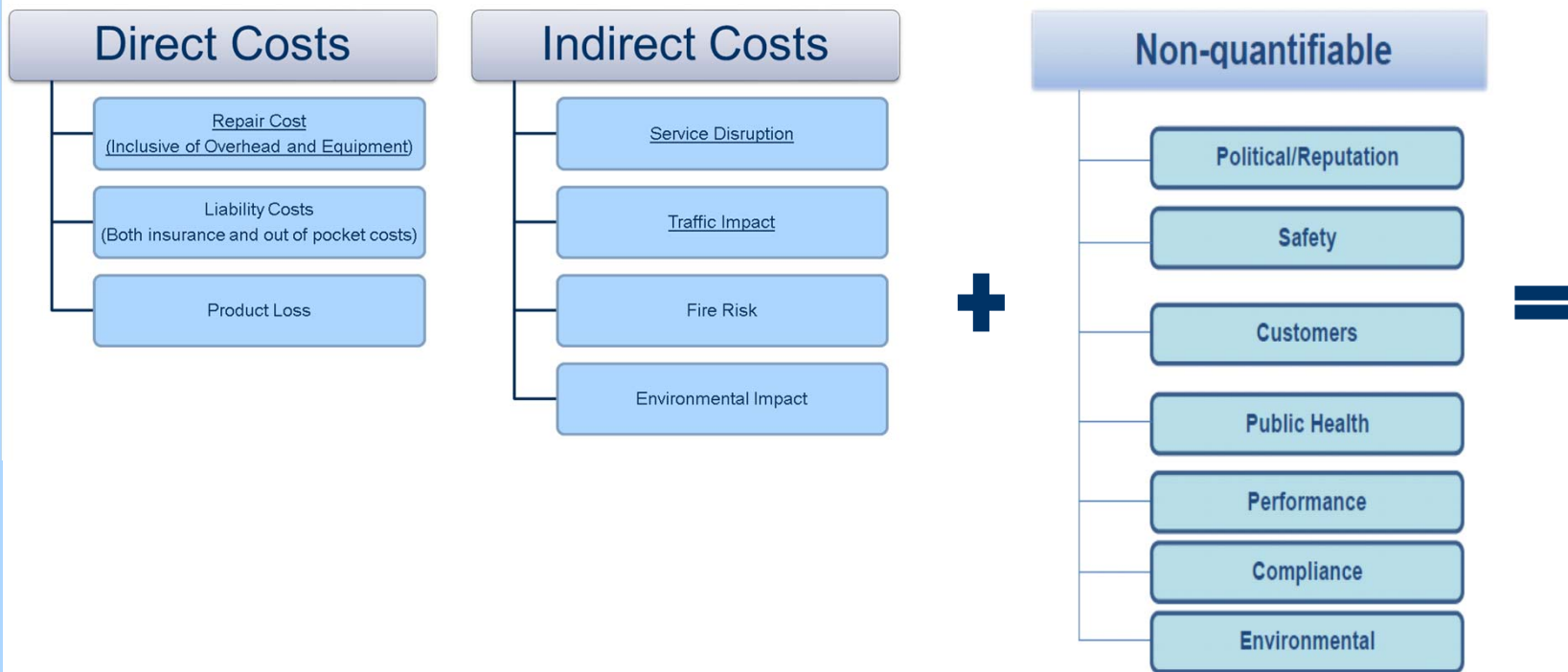
What About Non-Quantified Impacts?

- Quality Complaints
 - Product Quality
 - Odor complaints
- Regulatory Compliance
- Reputational Impact
- Financial Impacts(bond ratings, etc.)





We can use other techniques to assess “non-quantifiable” impacts



Total Cost (Consequence) of Failure





Calculating COF with “Non-Quantified” COF:

Total Failure Cost = C_D (Direct Costs) + C_I (Calculated Indirect Costs) + C_E (Estimated Indirect Costs)

$$C_D = C_R + C_L + C_P$$

C_R = Average Repair Cost

C_L = Standard Liability Cost

C_P = Product Loss Cost

$$C_I = C_S + C_T + C_F + C_E$$

C_S = Service Disruption Cost

C_T = Traffic Impact Cost

C_F = Fire Risk Cost

C_E = Environmental Impact Cost

C_E = Consequence Matrix





Rating Indirect Criteria for Consequences of Failure

Assessment	Financial	Political / Reputation	Environment	Safety (Employee & Public)	Customers	Public Health	Performance	Compliance	
5	Catstrophic	> 500K Annual Impact or >5M Incident Impact	Loss of Govt and Widespread Community Confidence Sustained Key Adverse Media	Large Scale, Irreversible, uncontained harm to environment	Fatality, Amputation of Limb, person on life support, other immediately life threatening incidents, Widespread Serious injuries or illnesses	Complete Disruption to services > 1week, affects > 30% of customers	widespread illness/fatalities	Very significant non-Performance	Significant compliance breach - May result in operating license sanction. High impact prosecution.
4	Severe	100K - 500K Annual Impact or 1-5M Incident Impact	Considerable Govt and community concern. Key adverse media	Large Scale, Long-term (>2 years), uncontained harm to the environment	A serious injury or long term illness or lost time injury (minimum 1 day lost per injury)	Partial disruption > 2 days. Affects 10-30% of customers in system. Widespread complaints.	serious illness requiring hospitalization	Significant non-Performance	Compliance breach - may result in severe enforcement action, regulatory sanction or prosecution.
3	Moderate	50 - 100K Annual Impact or 500K-1M Incident Impact	Some Public Concern Raised Adverse Local Media	Small Scale, Medium Term (1-2 years), uncontained harm to the environment. Eg small fire on utility property that damages adjoining protected wilderness	Significant near miss incident, injury or illness requiring medical treatment	Unreliable services. Increases in # of complaints. 5-10% of customers affected.	Deterioration in water quality parameters. Reportable event. Increase in illnesses.	Non-Performance	Compliance breach - may result in ministerial corrective action or business requirement. Possible Fine
2	Minor	10K - 50K Annual Impact or 100K-500K Incident Impact	Minor Public Concern	Short-term (<1 year), reversible, contained harm to the environment. Eg damage to a heritage building	illness or injury requiring first aid. Eg. Minor burns, abrasions, strains	Multiple customer complaints	Deterioration in water quality parameters. Reportable event. No increase in illnesses.	Some non-Performance	Compliance breach - may result in minor corrective action or business requirement
1	Insignificant	< 10K Annual Impact or 100K Incident Impact	Minimal Public Concern	Temporary reversible environmental degradation eg industrial noise emissions at night.	Near misses/accidents	isolated customer complaints	Non-reportable event	Very Minor non-Performance	Technical compliance breach with limited material impact



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Quantifying the Consequence Rating

Consequence Category	Consequence Value
1	\$ 5,000
2	\$ 30,000
3	\$ 75,000
4	\$ 300,000
5	\$ 750,000





Quantifying the Likelihood Matrix Rating

Likelihood Description	Likelihood Value (Used in Calculation)
0-10% / Yr or Less than 1 every 10 years	5%
11-35% / Yr or Once every 3-10 Years	25%
36-66% / Yr or Once every 2-3 Years	50%
66-90% / Yr or Once every 1-2 Years	75%
91-100% / Yr or At least 1 per Year	95%





For each indirect criteria, a risk cost is computed:

Likelihood							
1	0-10%/Yr or Less than 1 every 10 years						
2	11-35%/Yr or Once every 3-10 Years						
3	36-66%/Yr or Once every 2-3 Years						
4	66-90%/Yr or Once every 1-2 Years						
5	91-100%/Yr or At least 1 per Year						
95%	5	4,750	28,500	71,250	285,000	712,500	
75%	4	3,750	22,500	56,250	225,000	562,500	
50%	3	2,500	15,000	37,500	150,000	375,000	
25%	2	1,250	7,500	18,750	75,000	187,500	
5%	1	250	1,500	3,750	15,000	37,500	
		1	2	3	4	5	
		5000	30000	75000	300000	750000	

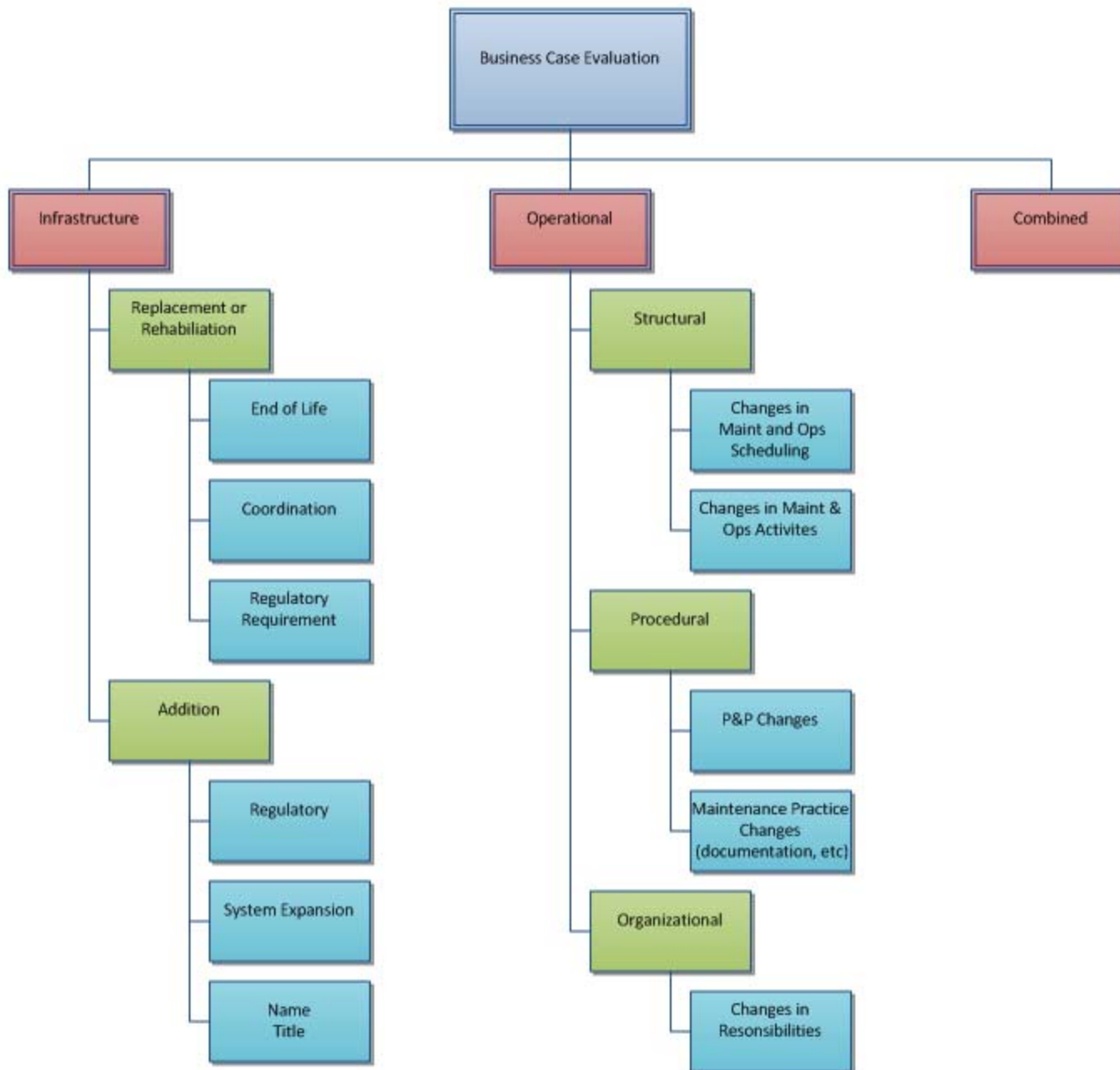




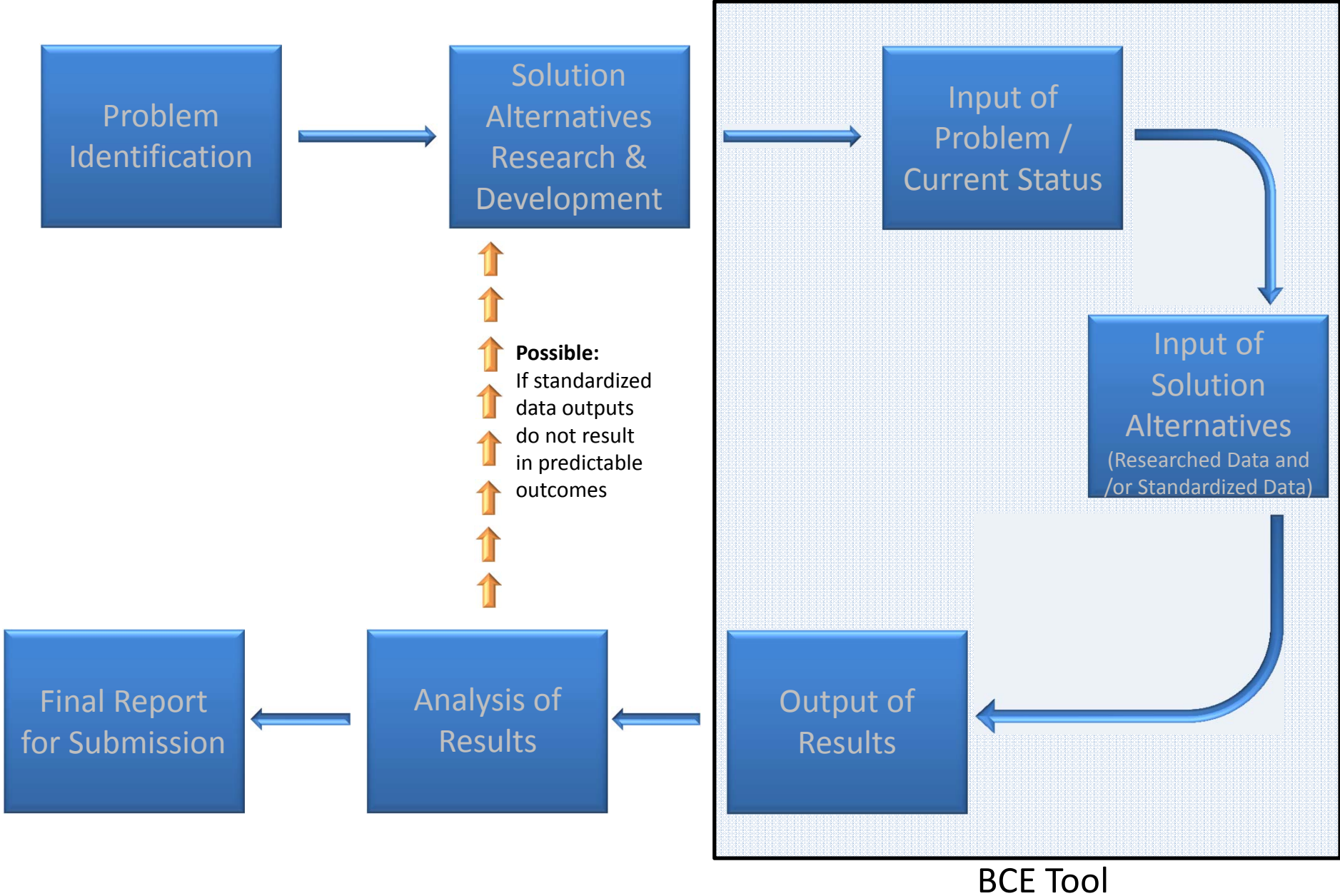
Tying it together – the BCE:

- BCE – what it provides
 - Data driven results for decision making
 - Comparative tool – consistent review of options
 - Provides basis for capital and operational spend
- Incorporates Risk and Uncertainty
- Repeatable and measurable results





Business Case Evaluation (BCE) Process Flowchart





Keys to the analysis:

- Costs (direct operational and capital)
- Inclusion of pertinent criteria that are material to decision-making
- COF values specific to each criteria
- Risk assessment (likelihood and consequence)
- Scalability





Inputting the Impacts in the BCE:

- Each Asset/Issue included in the BCE scored independently
- Each type of factor scored independently for each Asset/Issue
 - Calculated LOF
 - Calculated COF
 - Non-Calculated LOF
 - Non-Calculated COF





Scalability

- Standardized inputs
 - Allow for quick options analysis by all users
- Override Functions
 - Allows for higher level analysis for higher impact projects
 - Allows for analysis of non-standard situations
- Can easily be re-run as projects evolve to ensure continued value





Each potential solution is then evaluated (vs “Do-nothing”):

- Based on capital cost related to structural improvements to correct failure
- Based on operating costs related to on-going operation and maintenance expense
- Based on “risk costs” which incorporate consideration of indirect consequences of failure and the changes to this risk based on the solution





The desired result is:

- **Objective, data-driven, risk-based cost analysis of options**
 - Consistent Analysis
 - Utility Wide Functionality
 - Scalable





Questions?

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And Thank You!

