



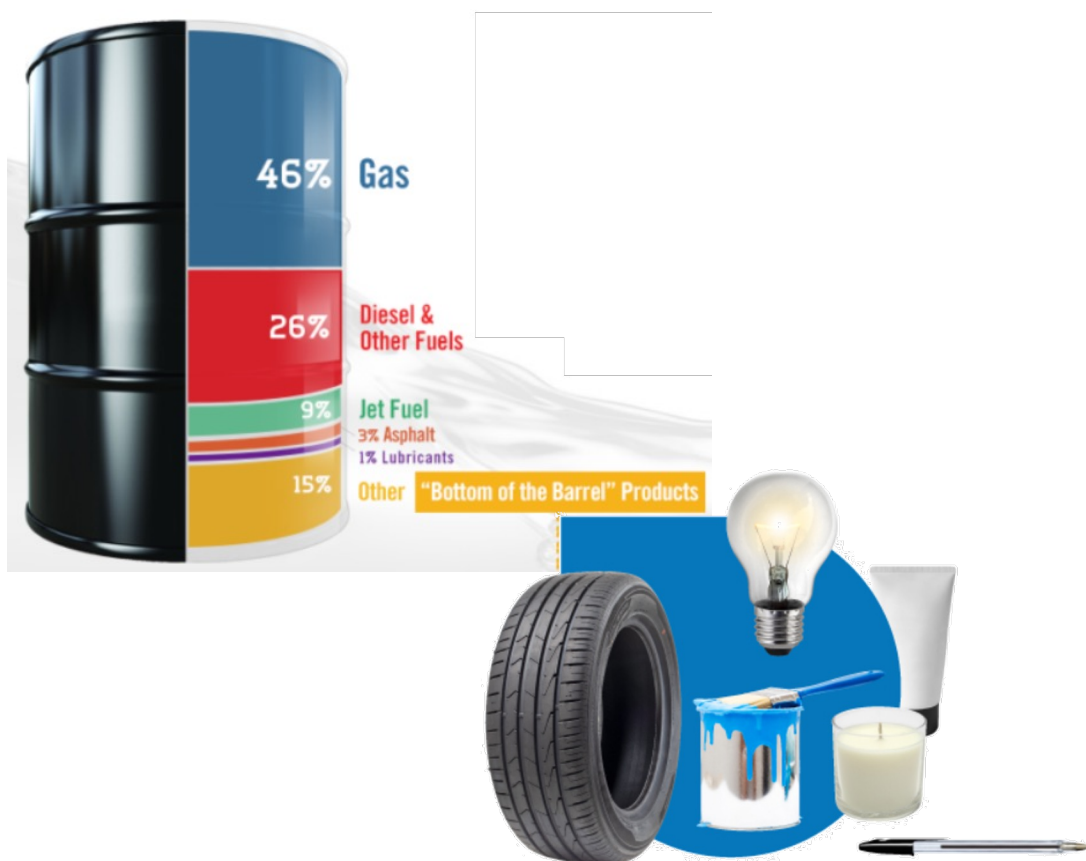
**DECISION
FRAMEWORKS**

**From chaos to
clarity.**

**Factoring
probabilistic
evaluations in
traditionally
qualitative multi-
attribute decisions,
such as plant
turnarounds.**

**SDP Annual Conference
Arlington, VA
April 17, 2024**

Where the rubber meets the road...



A turnaround (**TAR**) is a scheduled event wherein an entire process unit of an industrial plant, such as a refinery, is taken offstream for an extended period for work to be carried out.

While the plant is offstream, the impact on revenue is called lost profit opportunity (**LPO**).

<https://petroleumservicecompany.com/>

Opportunity Statement

What is the most appropriate turnaround (TAR) schedule for the refinery that maximizes value to RefCo and its shareholders?

Driver(s) for a decision at this time

- ▶ This preliminary analysis suggested potential costs savings of up to \$0.5bn over a 1 to 20-year evaluation period.
- ▶ The partners are interested to further evaluate these potential savings against any increased risks and uncertainties related to extending the TAR schedule.
- ▶ The decision needs to be made soon to commit to the upcoming TAR. Lead times are essentially TAR-to-TAR.

Decisions made which set the problem scope

- ▶ RefCo product will continue to be traded entirely on the spot market.
- ▶ There will be an additional tie-in of NewStream feedstock sometime between 2025-2026 (schedule uncertainty).
- ▶ TAR major scopes have been defined to reasonable for the various proposed cycles.

Value measures for strategy selection

- ▶ Financial metrics (NPV, Capex, Opex, TAR cost + LPO)
 - ▶ TAR durations (individual & cumulative)
 - ▶ Plant uptime / downtime
 - ▶ LNG production volumes
- ▶ Stakeholder alignment (partners) – qualitative
- ▶ Value of first NewStream coming online

Key questions management needs answered

- ▶ What are the major risks / uncertainties associated with a longer TAR schedule?
- ▶ What mitigation or assurance plans should be put in place to manage any increase in risk due to a TAR cycle increase?
- ▶ How would the maintenance activities differ, for each different TAR cycle?



Brutal Truths

- ▶ Does the probability of a catastrophic event increase with a longer TAR cycle?
- ▶ Increases chances of an unplanned reliability event.
- ▶ We expect lower reliability in the plant as the lead time between TARs increases.
- ▶ Discovery work (during TAR itself) can push out shut-down windows. The longer you push out the TAR, the greater the chance of discovery work.
- ▶ Benchmark data availability and representativeness is high, reliable.
- ▶ Discovery work has greater risk of cost increases vs. schedule increases.
- ▶ Preliminary scope freeze will be approximately 12 months ahead of TAR.
 - ▶ We will not add items other than recognized equipment degradation issues.
- ▶ We should consider the likelihood of NewStream coming online after 2026.
- ▶ Current streams decline further as the resource is further produced.



RefCo TAR Strategy

QUALITATIVE ASSESSMENT AND STRUCTURING THE EVALUATION

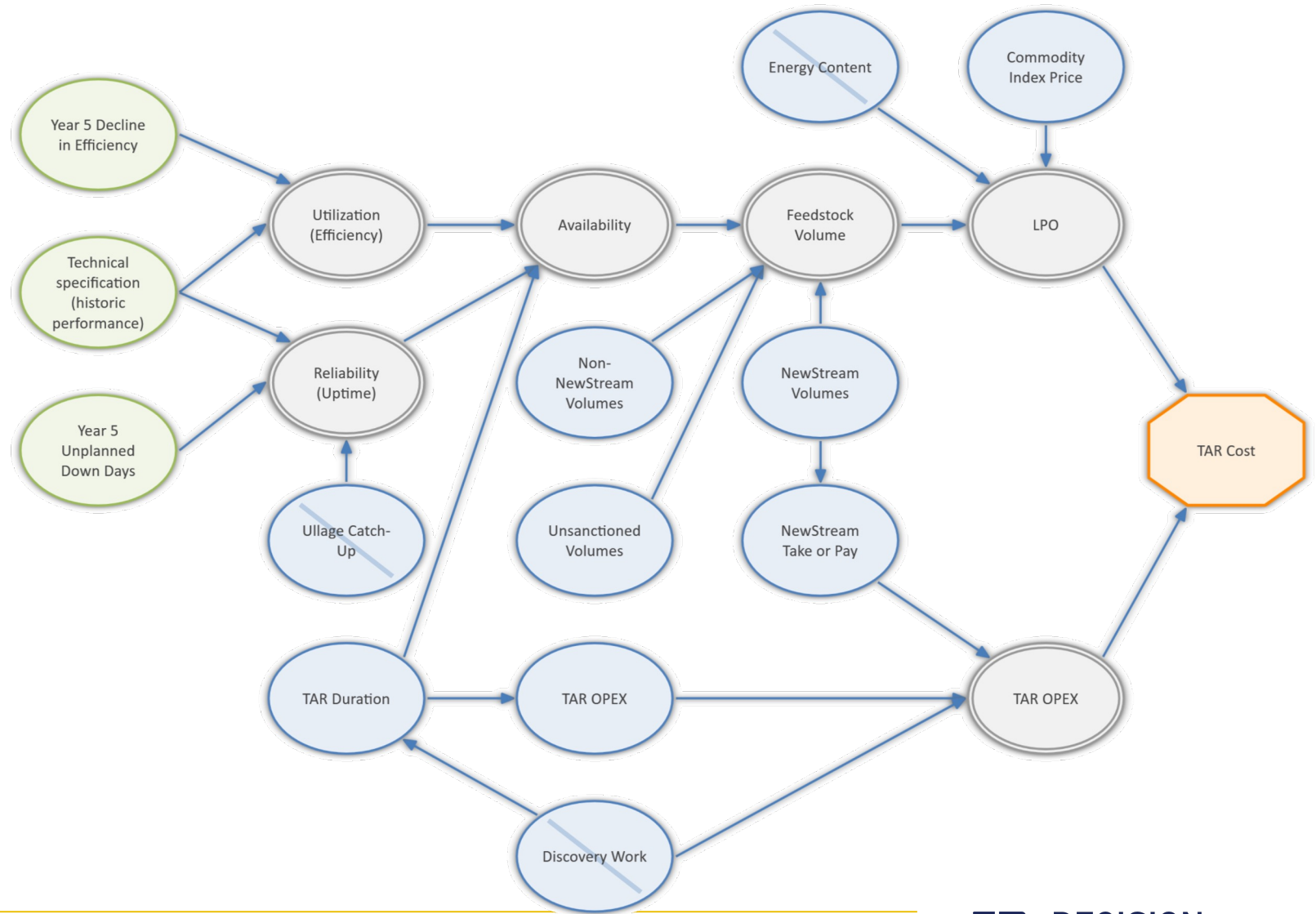
The qualitative assessment high-graded the option: TAR 2025, 5yr Cycles

TAR Strategy	Plant Efficiency	Plant Utilization	Stakeholder Alignment	Feasibility of Execution	Readiness for NewStream
2025, 4yr Cycles	High (Dark Green)	Low (Yellow)	Medium (Light Green)	Medium (Light Green)	High (Dark Green)
2025, 5yr Cycles	Medium (Light Green)	Medium (Light Green)	High (Dark Green)	Medium (Light Green)	High (Dark Green)
2026, 5yr Cycles	Medium (Light Green)	High (Dark Green)	Low (Yellow)	Medium (Light Green)	Low (Yellow)

Assuming each qualitative metric carries roughly equal weight, the leading strategy at this point is TAR 2026+5.

Structuring the Evaluation

This influence diagram serves to structure of the evaluation by showing the relationship between the key uncertainties and the primary metric of TAR Cost.





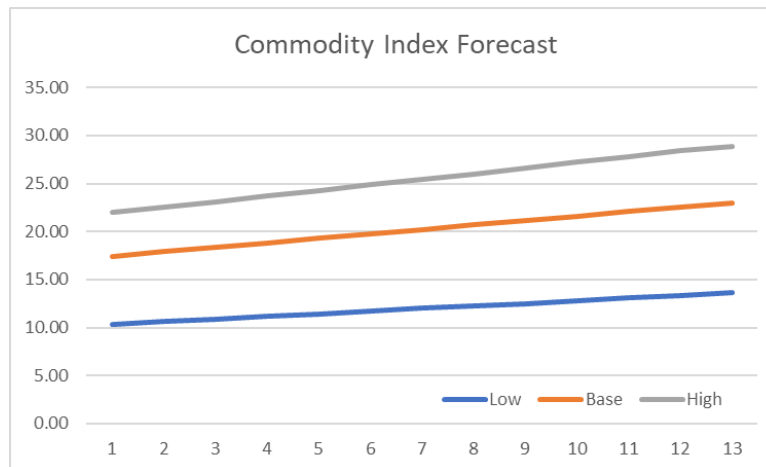
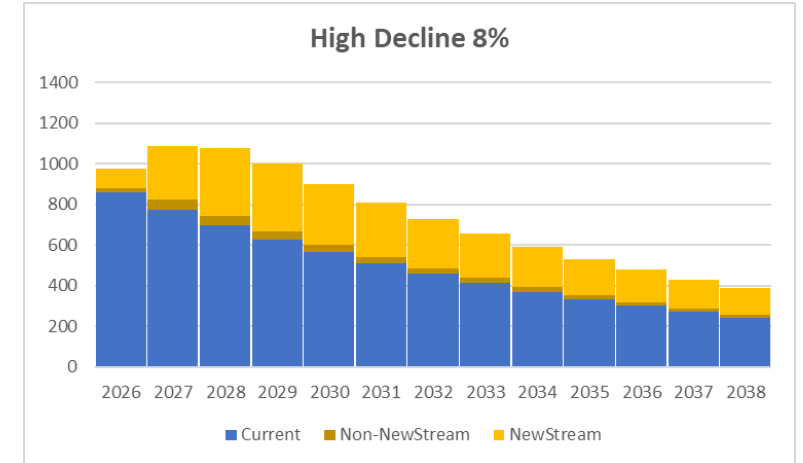
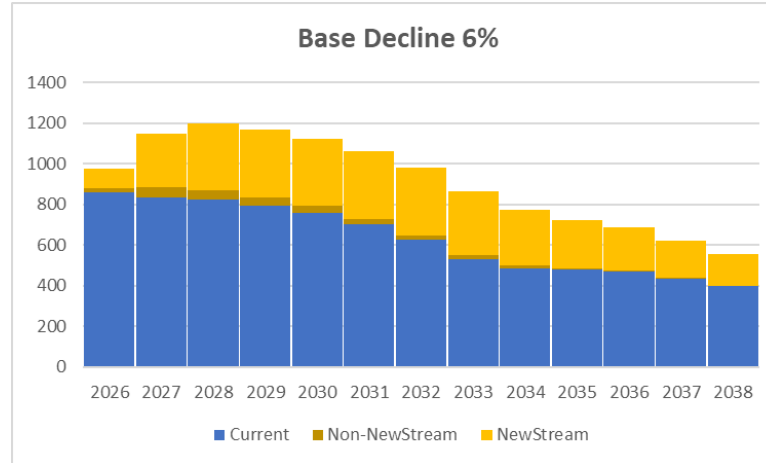
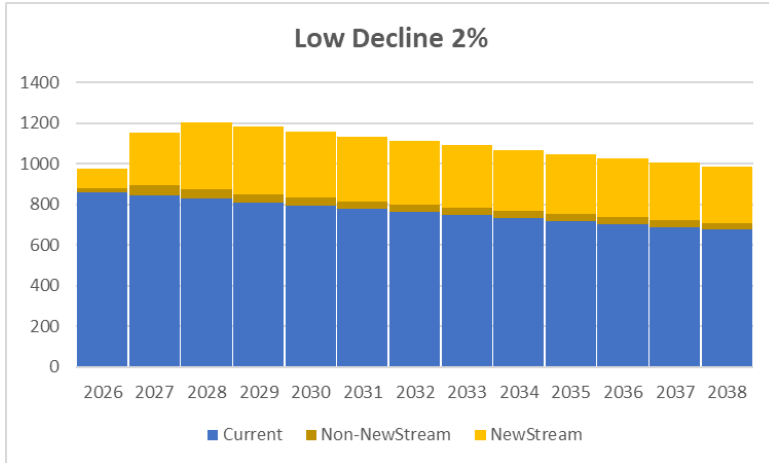
RefCo TAR Strategy

EVALUATION OF THE ALTERNATIVES

Inputs to the Evaluation

Fiscal Inputs		P10 High	P50 Mid	P90 Low
Commodity Index	Low	Low	Base	High
NewStream Take or Pay Price (\$/unit)	\$ 0.50	\$ 0.40	\$ 0.50	\$ 1.00
Discount Rate	10%			
TAR Input Ranges				
TAR Duration Multiplier	1.0	0.9	1.0	1.1
Partial TAR Duration Multiplier	1.0	0.9	1.0	1.1
OPEX Multiplier	1.0	0.9	1.0	1.1
Production Inputs				
Name Place Capacity (units/day)	1075			
Energy heating value	890			
Current Prod Decline Rate (%)	1.4%	1.4%	5.9%	8.0%
NewStream Start Year	2026	2026	2027	2028
NewStream Prod Decline Rate (%)	5.9%	1.4%	5.9%	8.0%
Include Unsanctioned Volumes?	Yes			
Unsanctioned Prod Decline Rate (%)	5.9%	1.4%	5.9%	8.0%
Single Unit Capacity (units/day)	450	380	450	550
Year 5 Degradation				
Year 5 Efficiency	97.5%	97.3%	97.5%	98.0%
Year 5 Additional Down Days	10	7	10	13

Time series inputs



Inputs to the Evaluation – TAR Scopes

TAR 2025, 4 yr Cycles

Item	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
TAR Duration	30				60				25				30
OPEX	65				100				65				90
Compressor Inspection	10				20				10				10
Partial TAR Duration	0				0				0				0
Capacity During Partial TAR	0				0				0				0
Unplanned Down Days 5thYr	0				0				0				0
Efficiency	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TAR 2026, 5 yr Cycles

Item	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
TAR Duration		30					35					35	
OPEX		65					90					120	
Compressor Inspection		10					15					15	
Partial TAR Duration		0					0					35	
Capacity During Partial TAR		0					0					450	
Unplanned Down Days 5thYr	10					10					10		
Efficiency	97.5%	95%	100%	100%	100%	97.5%	100%	100%	100%	100%	97.5%	100%	100%

TAR 2025, 5 yr Cycles

Item	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
TAR Duration	30					35					35		
OPEX	65					90					120		
Compressor Inspection	10					15					15		
Partial TAR Duration	0					0					35		
Capacity During Partial TAR	0					0					450		
Unplanned Down Days 5thYr	0				10					10			
Efficiency	100%	100%	100%	100%	97.5%	100%	100%	100%	100%	97.5%	100%	100%	100%

Tornado of the TAR25-5 strategy

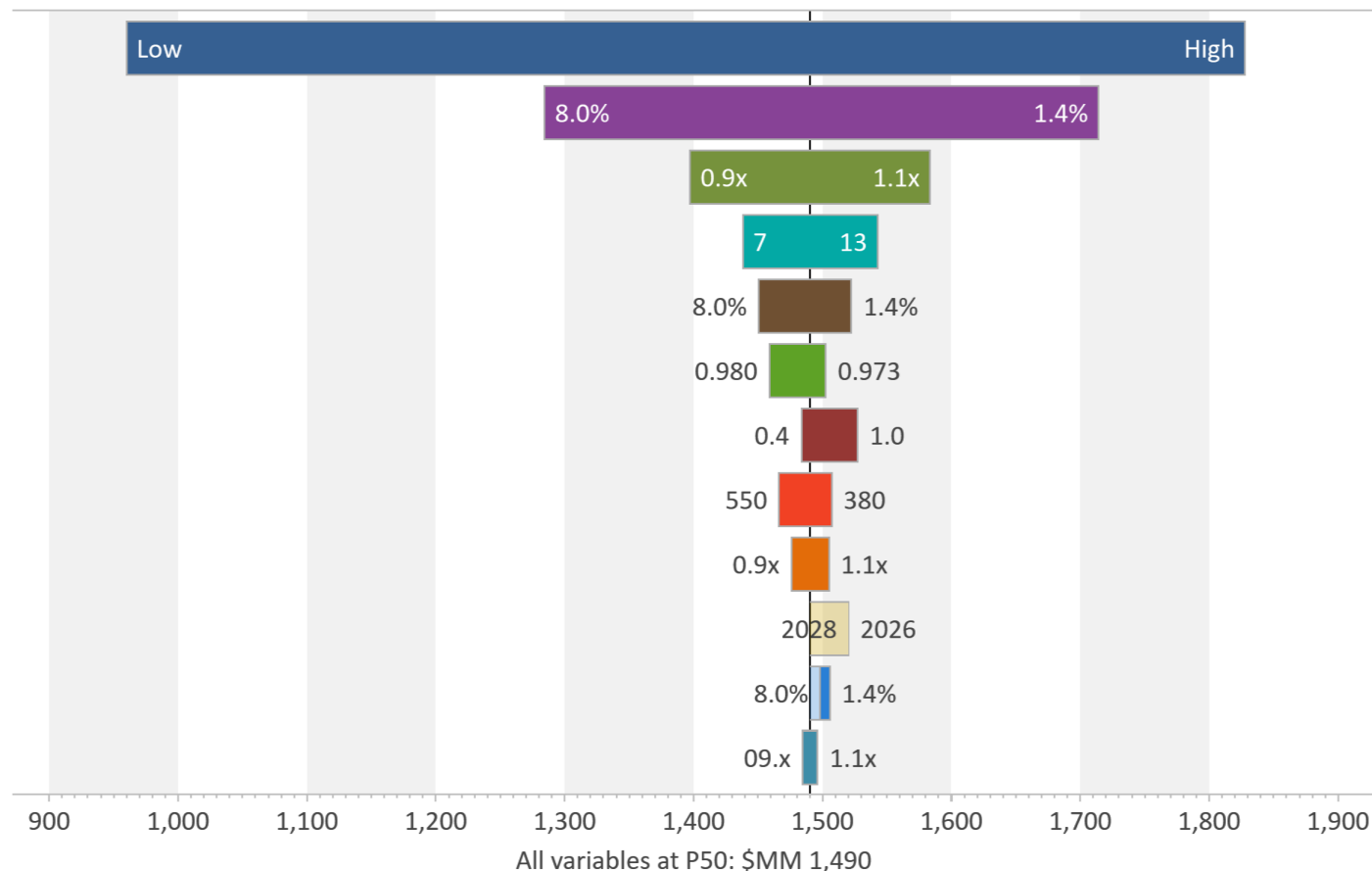
The most impactful uncertainties on TAR Cost.

The impact from a fifth year of continuous operation is not impactful because it would be in 2030.

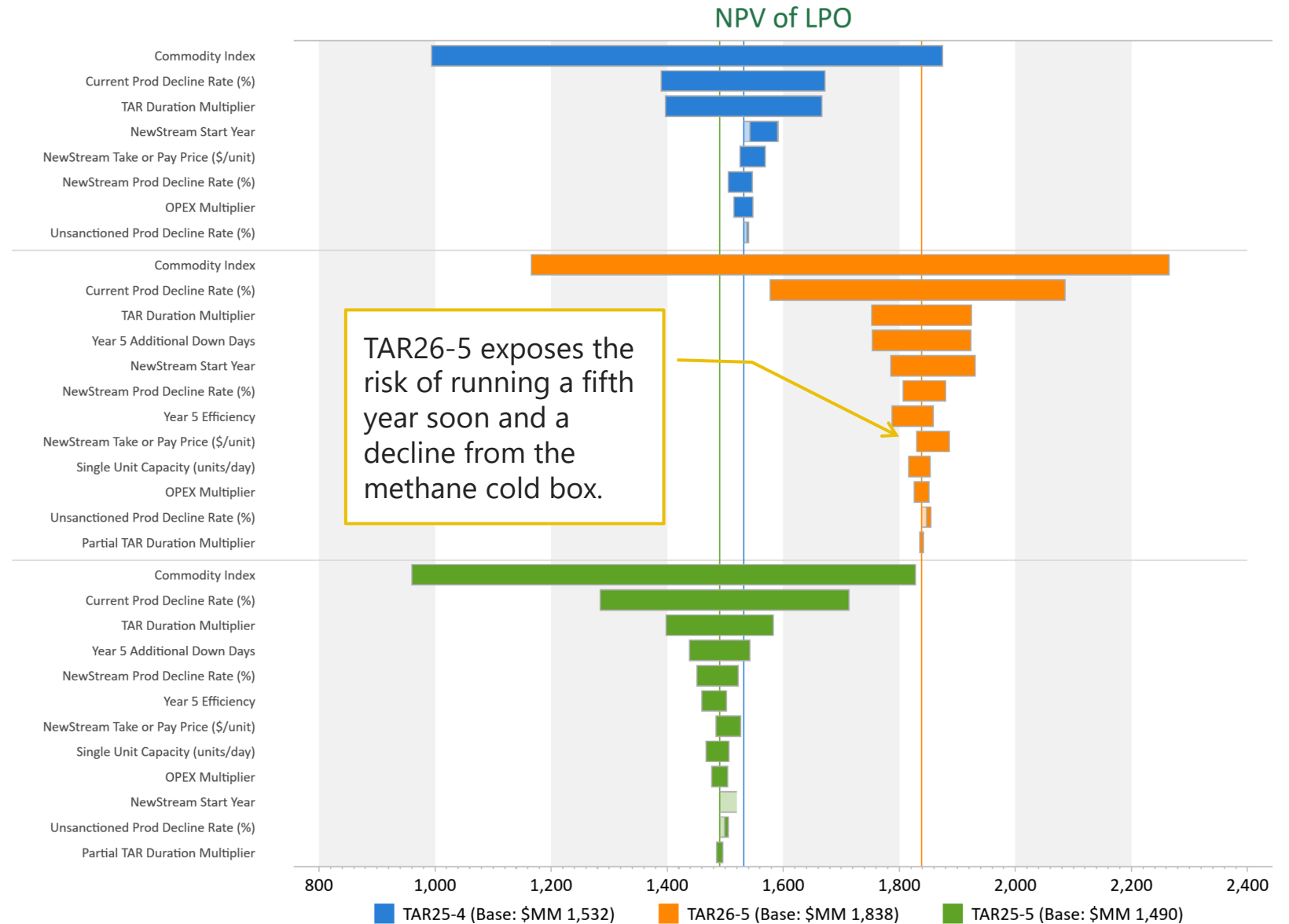
A delay in NewStream commencement is not impactful.

Commodity Index	75.49 %
Current Prod Decline Rate (%)	18.54 %
TAR Duration Multiplier	3.50 %
Year 5 Additional Down Days	1.12 %
NewStream Prod Decline Rat...	0.54 %
Year 5 Efficiency	0.20 %
NewStream Take or Pay Price...	0.20 %
Single Unit Capacity (units/day)	0.18 %
OPEX Multiplier	0.09 %
NewStream Start Year	0.09 %
Unsanctioned Prod Decline R...	0.03 %
Partial TAR Duration Multiplier	0.02 %

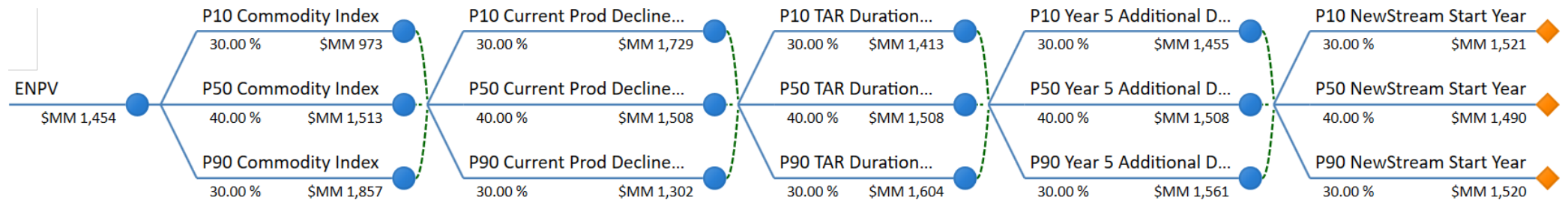
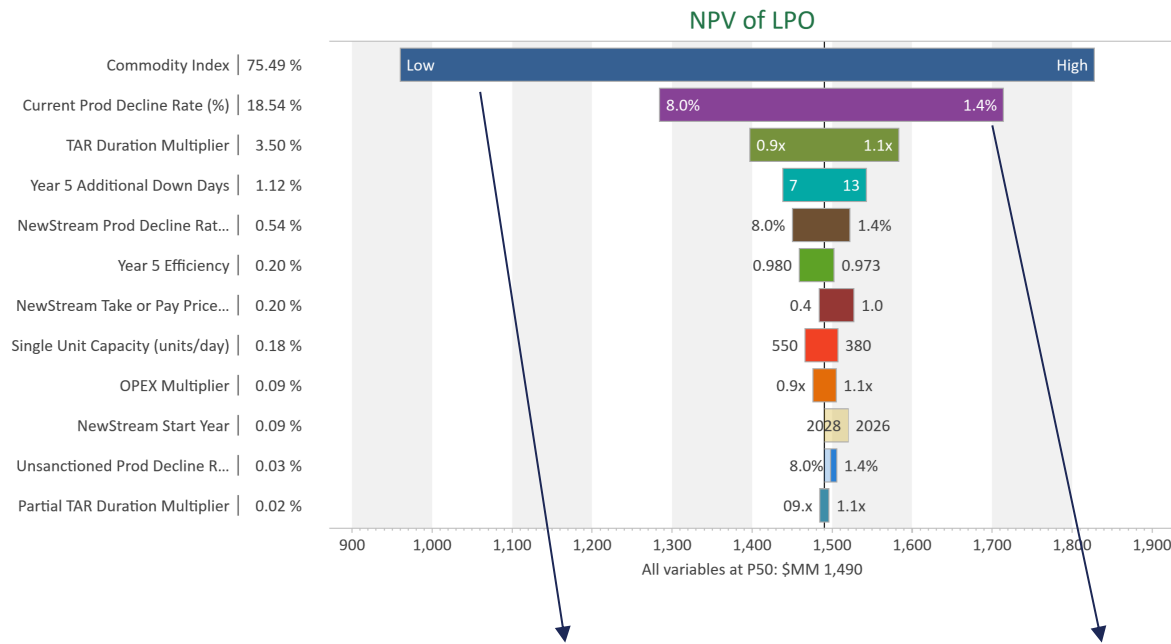
NPV of LPO



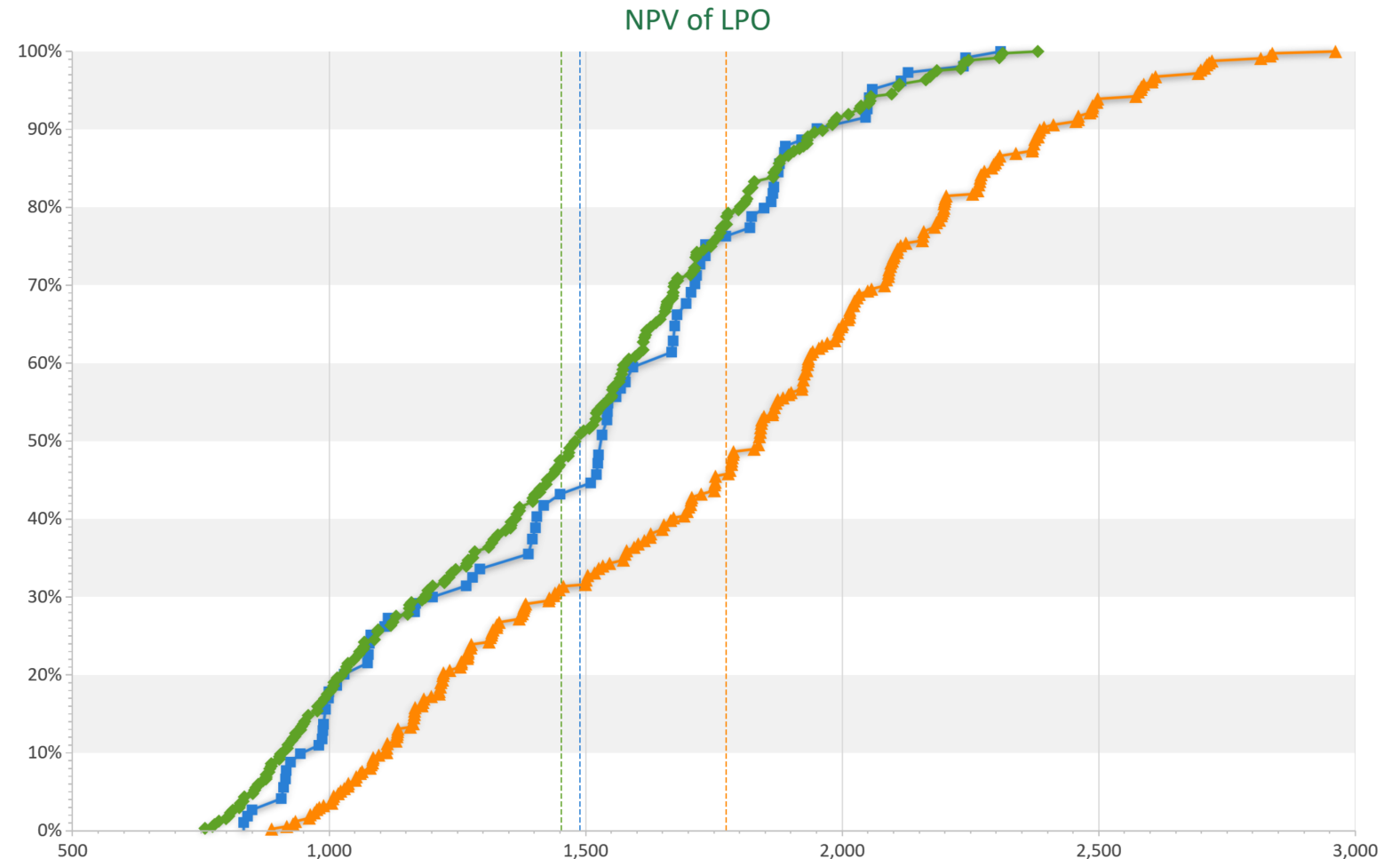
The deterministic evaluation shows TAR25-5 as the least costly.



Only the key uncertainties are included in the tree.

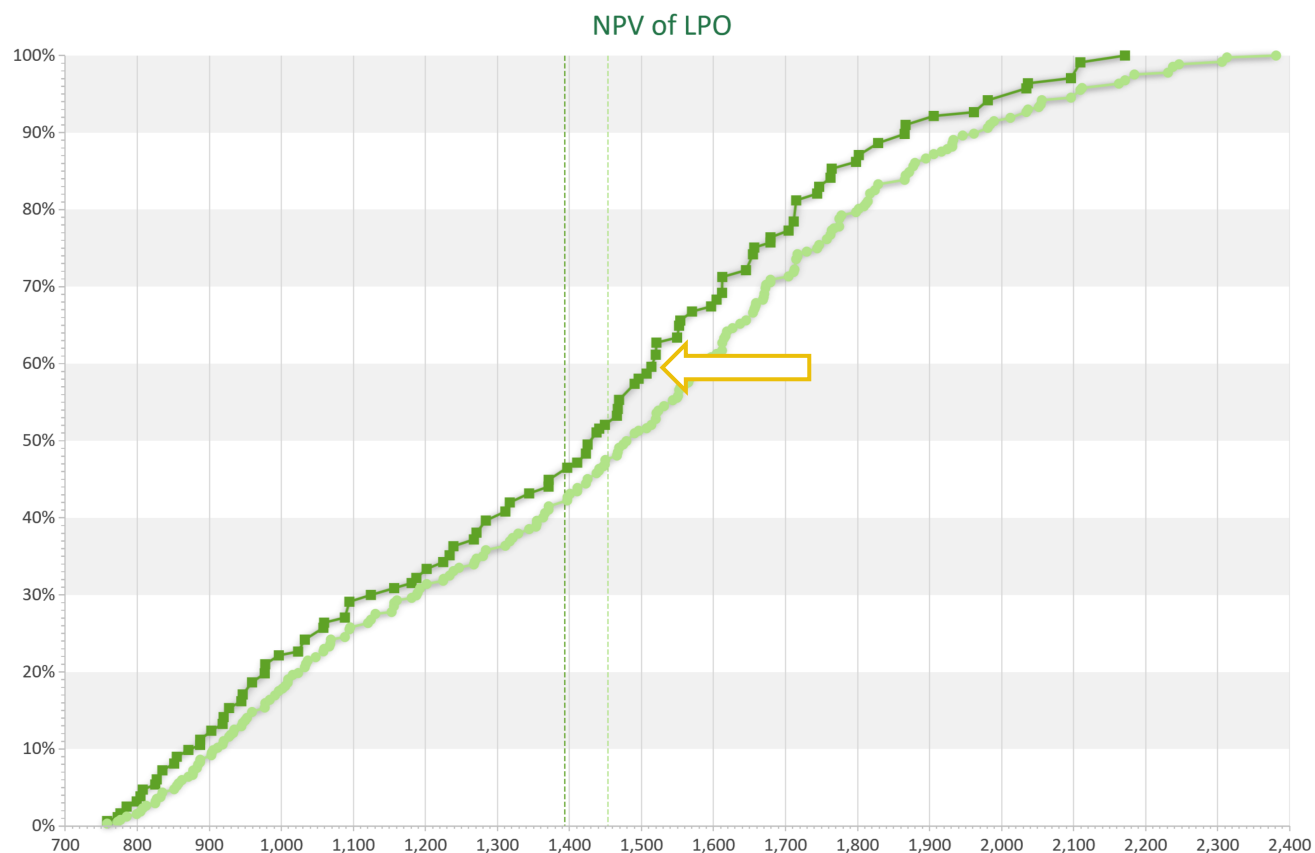


The probabilistic evaluation shows TAR25-5 as the least costly.



Series	EV	P10	P50	P90	Value > EV	Value < 0	Min	Max	Spread
TAR25-4	\$MM 1,488	\$MM 947	\$MM 1,530	\$MM 1,949	55.87 %	0.00 %	\$MM 833	\$MM 2,309	\$MM 1,475
TAR26-5	\$MM 1,775	\$MM 1,110	\$MM 1,838	\$MM 2,386	54.21 %	0.00 %	\$MM 888	\$MM 2,961	\$MM 2,073
TAR25-5	\$MM 1,454	\$MM 908	\$MM 1,479	\$MM 1,965	52.34 %	0.00 %	\$MM 758	\$MM 2,381	\$MM 1,623

Even if we could improve the reliability and TAR duration, the impact is immaterial.



Filter and Highlight

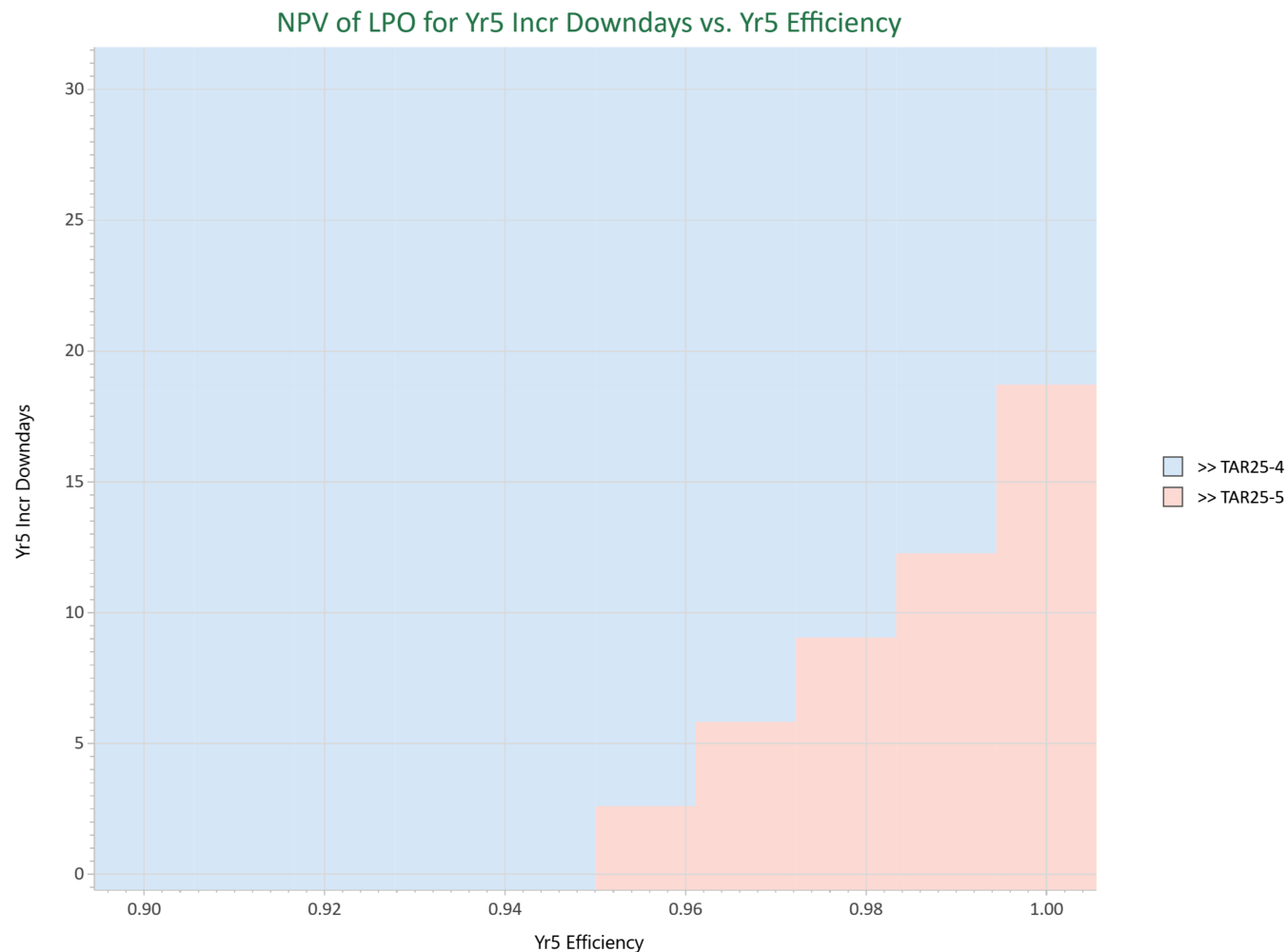
TAR25-5

- P10 NewStream Start Year
- P50 NewStream Start Year
- P90 NewStream Start Year
- P10 Year 5 Additional Down Days
- P50 Year 5 Additional Down Days
- P90 Year 5 Additional Down Days
- P10 TAR Duration Multiplier
- P50 TAR Duration Multiplier
- P90 TAR Duration Multiplier
- P10 Current Prod Decline Rate (%)
- P50 Current Prod Decline Rate (%)
- P90 Current Prod Decline Rate (%)
- P10 Commodity Index
- P50 Commodity Index
- P90 Commodity Index

Series	EV	P10	P50	P90	Value > EV	Value < 0	Min	Max	Spread
TAR25-5	\$MM 1,394	\$MM 874	\$MM 1,429	\$MM 1,866	53.69 %	0.00 %	\$MM 758	\$MM 2,171	\$MM 1,413
TAR25-5 Baseline	\$MM 1,454	\$MM 908	\$MM 1,479	\$MM 1,965	52.34 %	0.00 %	\$MM 758	\$MM 2,381	\$MM 1,623

Under current operating conditions, TAR25-5 is best unless year 5 efficiency declines and down days increase.

- ▶ If the efficiency of year 5 is at or above 94%, then TAR25-5 is best, as long as the additional down days in year 5 remain under six.
- ▶ If the additional down days in year 5 increase, there would be a greater efficiency requirement to justify the five-year cycles.
- ▶ Under no conditions is TAR26-5 the best option in this sensitivity.





RefCo TAR Evaluation

DECISION QUALITY AUDIT

Qualitative assessment continue to be useful



Appropriate Frame

Is there a clear purpose and rationale for making this decision/pursuing this opportunity? (Is there an opportunity statement that can be easily described?)

The issue has been addressed sufficiently

Is the scope well-defined? (Do we know and agree on what are givens, focus decisions, decisions to be deferred? Is the frame sufficiently broad that important factors are not being overlooked, yet not so broad as to make the project unmanageable?)

The issue has been addressed sufficiently

In developing the frame, have we incorporated cross-functional input to have a breadth of perspective, from commercial to technical? (Was there sufficient dialogue, or was conversation short-circuited?)

The issue has been addressed sufficiently

APPROPRIATE FRAME SCORE

100%

