Transmission Cost – Risk Approach: Stakeholder workshop 15 April 2021

Facilitator: Oliver Derum, ISP Stakeholder Engagement Lead (AEMO)
Presenters:
Natasha Sinclair, Principal - ISP Energy Systems Lead (AEMO)
Ian Nichols, Executive Advisor (GHD)

We acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture.
We pay our respects to their Elders past, present and emerging.

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Introductions, Housekeeping

- Introductions – speakers and panel
- Today's session will be recorded and published on our website
- We will be using Slido to facilitate questions, in addition to verbal Q&A, split into two sessions
    - www.sli.do
    - #AEMO

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Objectives of the day

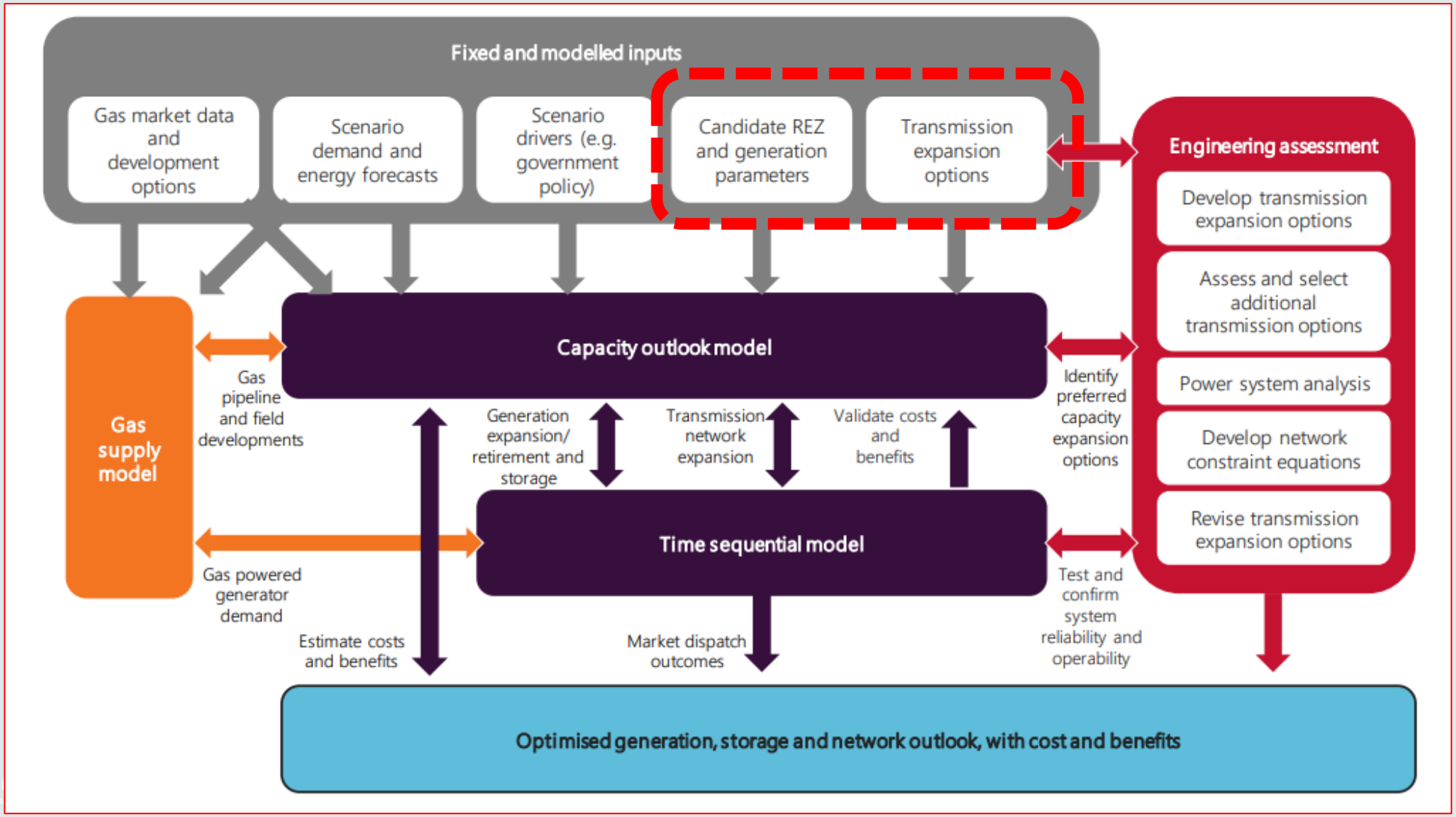
- Outline a proposed approach that incorporates risk when calculating an expected project cost for transmission projects
- Outline a draft process for assessing cost estimates that are provided by Transmission Network Service Providers (TNSPs), including any alignment to ensure risk is applied consistently
- Seek feedback on this approach
- Provide an opportunity for stakeholders to ask questions

Agenda

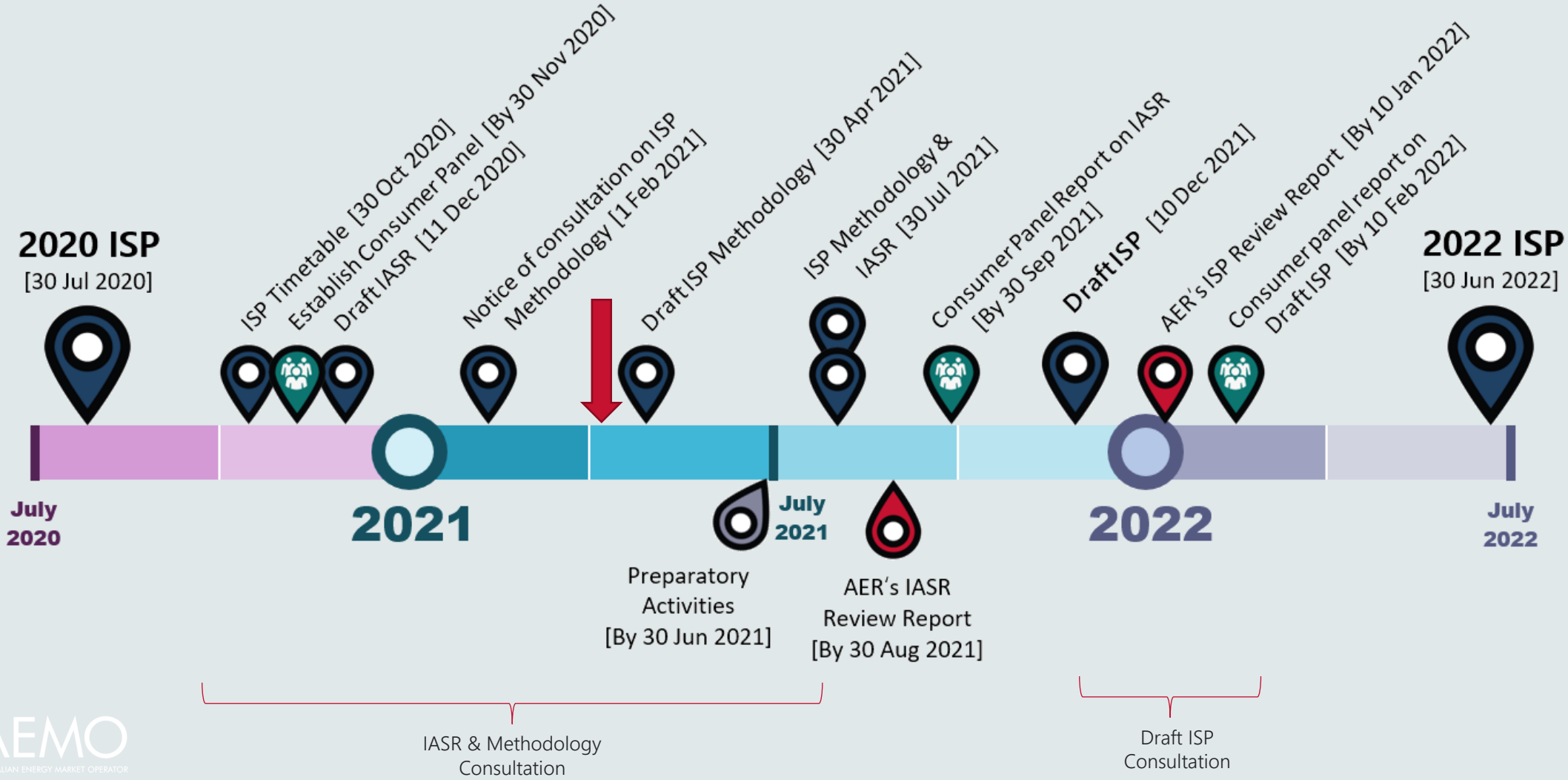
Item	Time (min)
Introductions, housekeeping	5
Context – Transmission costs in the ISP	10
Risk Approach in Transmission Cost Estimation	20
Feedback, Q&A session 1	**30**
Cost classification and review of TNSP estimates for ISP	15
Feedback, Q&A session 2	**30**
Next Steps	10
Total:	2 hours

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

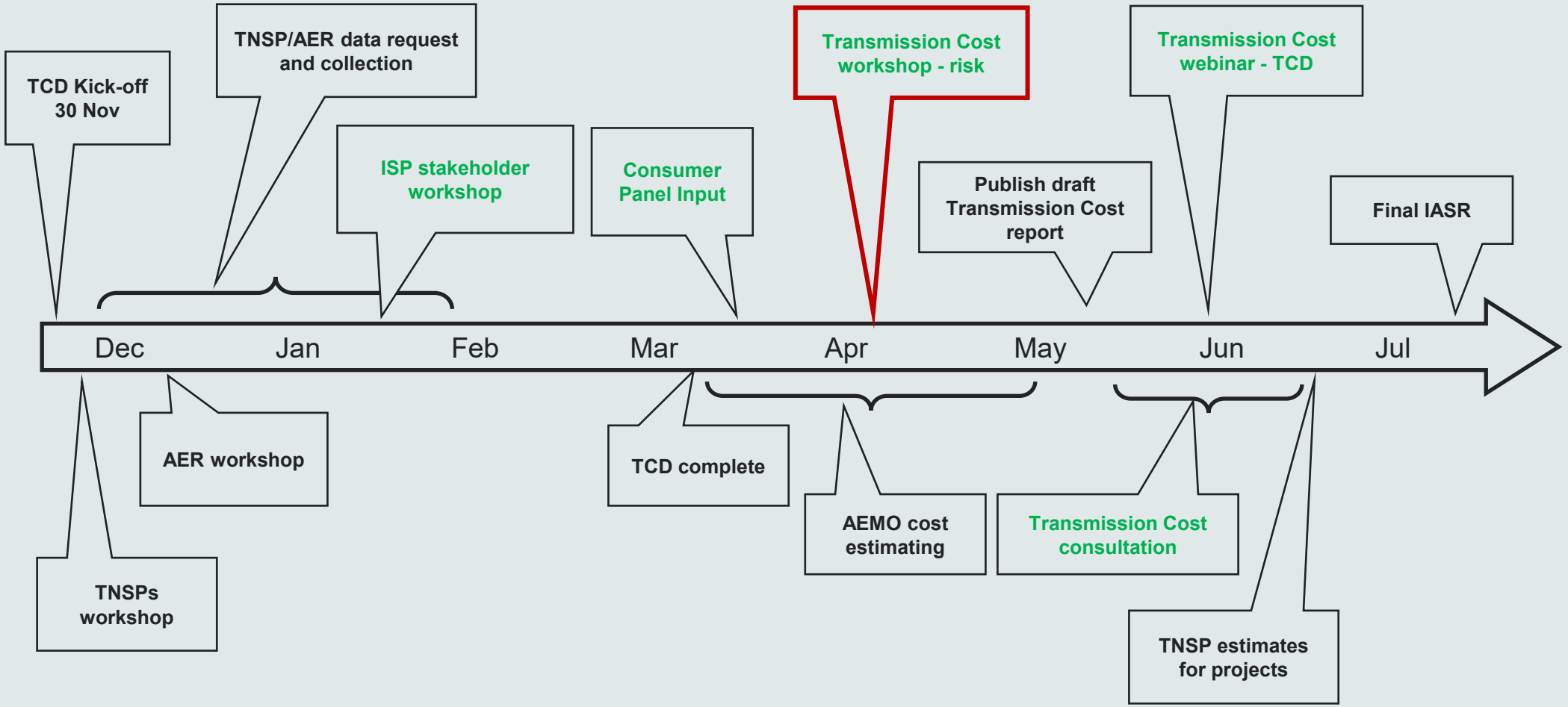
2022 ISP Big Picture



2022 ISP Timeline



Transmission Cost Timeline



Legend: **Opportunities for stakeholder engagement**

Transmission Cost Database – Risk Approach

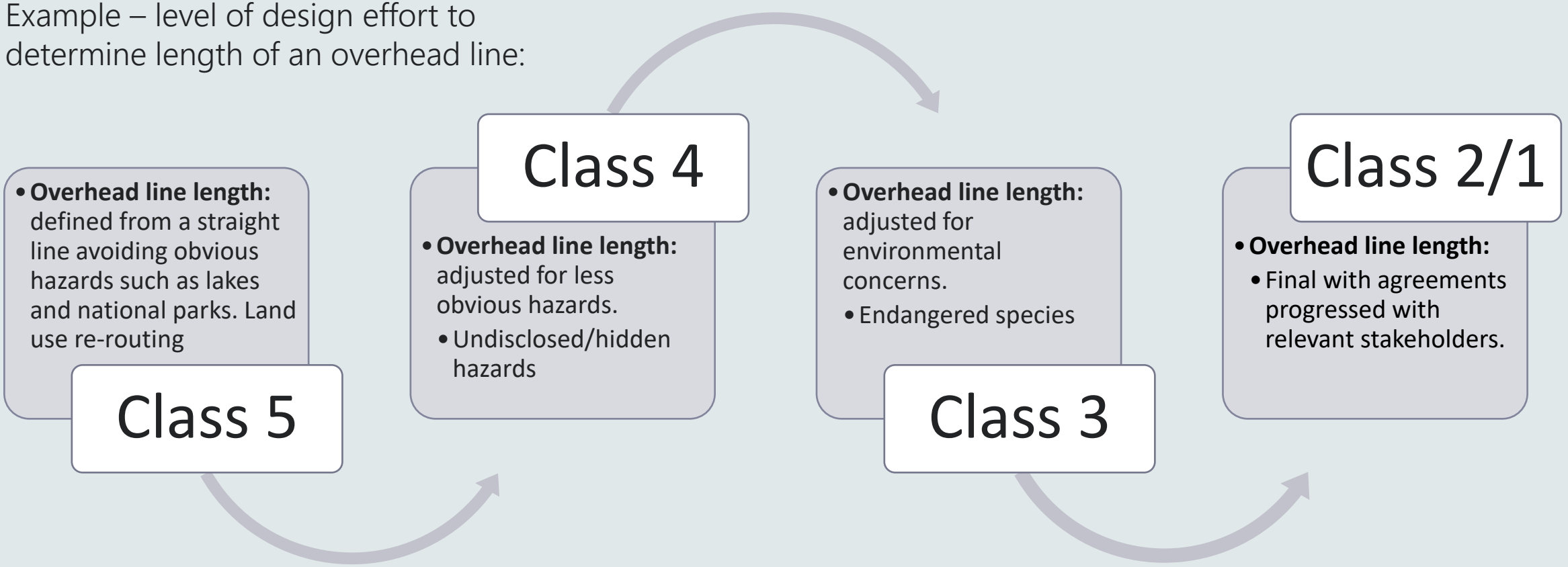
Overview

	Future ISP Projects Identification	Preparatory Activities for Future Projects	Project Assessment Draft Report (PADR)	Project Assessment Conclusions Report (PACR)	Contingent Project Application (CPA)
Description	• Identification of future projects to include in the ISP • High level assessment of potential costs / benefits to determine whether project has net benefits	• More detailed analysis of project options to determine provisional preferred option	• Comparison of credible options to determine the preferred option, taking into account submissions received on PSCR	• Final report on the comparison of credible options to determine the preferred option, taking into account submissions received on PADR	• Final application to AER for revenue adjustment to reflect costs of the project
Planning Works Undertaken	• Specify approximate route • High level line / substation specifications (eg voltage / capacity)	• Market engagement completed with cost indications received • Desktop geotechnical / ecology / heritage study undertaken, and some fieldwork undertaken in identified high risk areas • Major landowners identified, including any high risk areas • Alignment developed based on Geotech / ecology / heritage / property ownership studies available • Biodiversity offset liability estimated based on ecology reports available • Corporate cost budget estimated at a high level	• Market engagement completed with cost indications received • Desktop geotechnical / ecology / heritage study undertaken, and some fieldwork undertaken in identified high risk areas • Major landowners identified, including any high risk areas • Alignment developed based on Geotech / ecology / heritage / property ownership studies available • Biodiversity offset liability estimated based on ecology reports available • Corporate cost budget estimated at a high level	• Market engagement completed with cost indications received • Desktop geotechnical / ecology / heritage study undertaken, and some fieldwork undertaken in identified high risk areas • Major landowners identified, including any high risk areas • Alignment developed based on Geotech / ecology / heritage / property ownership studies available • Biodiversity offset liability estimated based on ecology reports available • Corporate cost budget estimated at a high level	• Procurement of construction contractor substantially progressed • Detailed geotechnical investigations substantially progressed • Procurement of options over easement commenced, initial consultation with landowners substantially complete • Alignment finalised apart from micrositing issues • Biodiversity offset liability determined and strategy finalised • Ecology / heritage studies substantially progressed • Planning approval commenced • Corporate cost budget finalised
Price Certainty	• +/-[ ]%	• +/-[ ]%	• +/- [ ]%	• +/- [ ]%	• +/- [ ]%

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Illustration of design progression

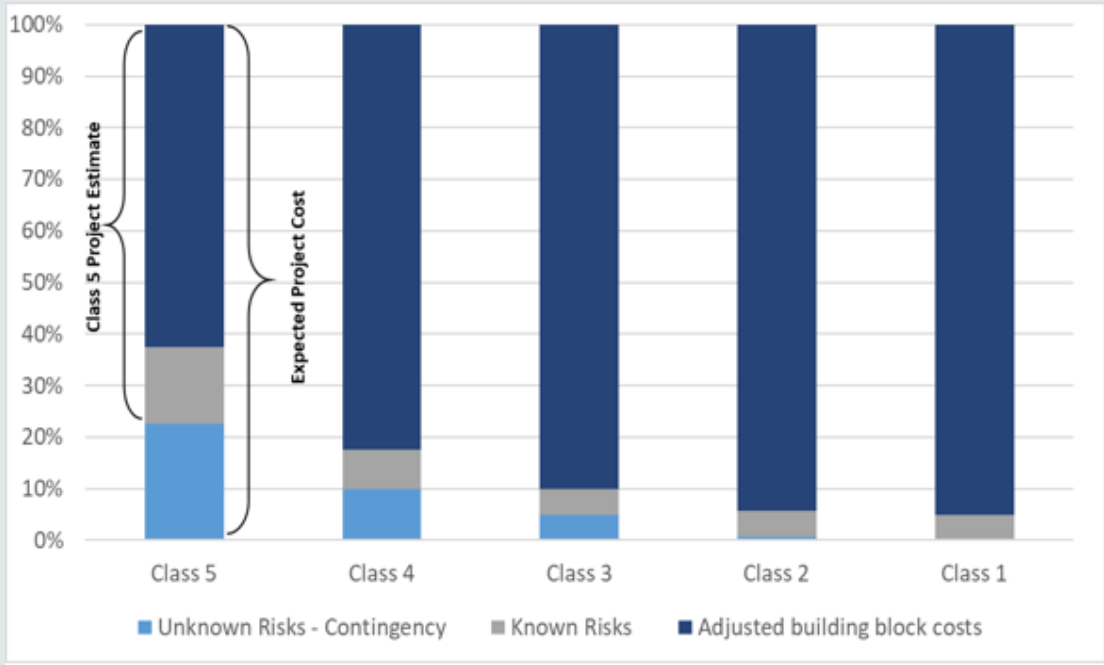
Example – level of design effort to determine length of an overhead line:



Calculating risks in the estimate build up – Transmission Cost Database approach

- Baseline estimate of project building blocks (e.g. $/km of line, $/switchbay, $/transformer etc.) and indirect costs
- Adjustment to the above costs to account for project specific attributes (e.g. brownfield, short length, geography etc.)
- Known Risks – some (for e.g. bad weather) will continue to exist during delivery
  - Set of user input choices will drive the allowance allocation to relevant cost categories
- Unknown Risks – expected to be known or shifted to contractor as estimate advances to CPA stage
  - TCD uses AACE practice guideline accuracy bands
  - Set of user input choices will drive the allowance allocation to relevant cost categories

Adjusted building block costs

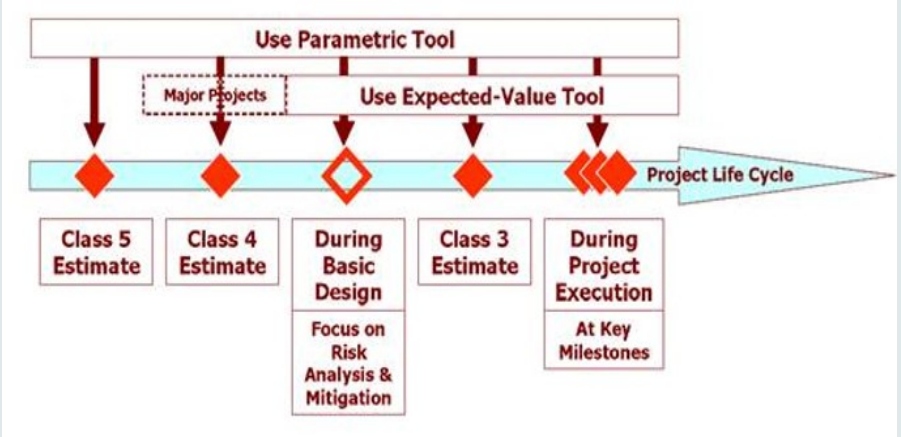


*AEMO expects that CPA estimates will have no unknown risks

Risk determination in cost estimate

AACE defines 4 risk assessment approaches:

- Expert Judgement
- Parametric modelling using predetermined guidelines with a hybrid of judgement and empirical use of historical norms
- Parametric modelling using more sophisticated empirical models usually derived through regression analysis. This requires a strong historical data set being available
- Simulation analysis (Expected Value Tools):
  - Qualitative risk assessment using range estimating and probabilities to derive an expected value
  - More sophisticated Monte-Carlo based analysis using expertise in stochastic risk processes.



For Class 5/4 estimates, which is what the TCD is designed for, the use of Parametric Tools is appropriate.

Known Risks

Definition: Where risks are identified but ultimate value is not known.

- A set of 9 known risk factors for each of the 3 categories (substation, overhead lines and underground cables) used for TCD.

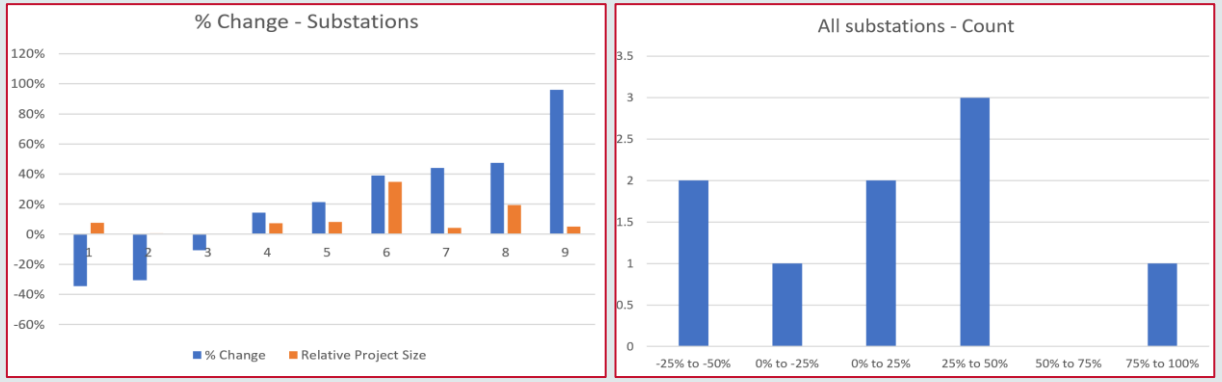
Factors are: compulsory acquisition; cultural heritage; environmental offset risks; geotechnical findings; project complexity; macroeconomic influence; market activity; outage restrictions; weather delays.

- Known risks are estimated using "top-down" percentage cost. This percentage factor is greater for a quantity and cost based Class 5 estimate than for a Class 4 or 3 estimate.
- Linear construction activities (OHL and underground cables) are exposed to more uncertainties (risks) than site specific construction works (substation).
- Percentage values for known risk factors derived from experience with electricity network infrastructure projects.
- Risks included are only the risk categories AER accepts within final revenue determinations.
- Some factors benchmarked against cost estimate information from TNSPs.

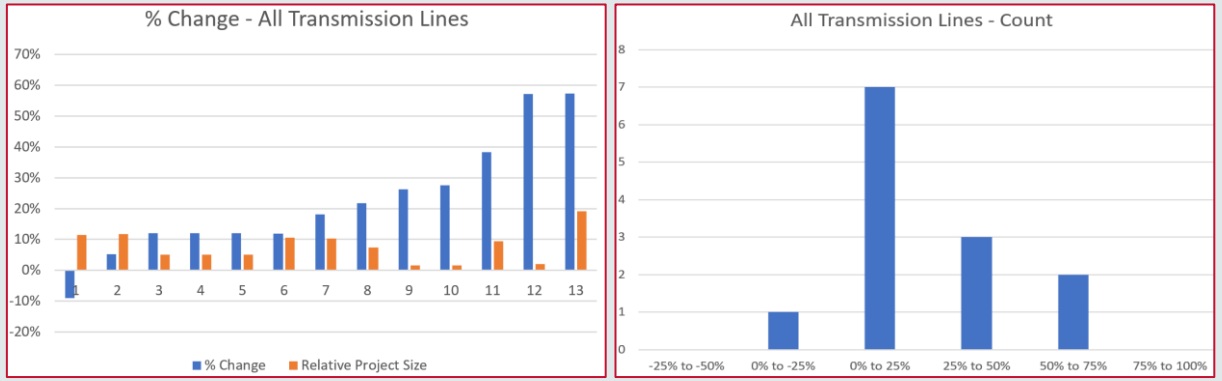
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Developing unknown risk factors for the TCD

- To develop unknown risk factors, a progression of cost estimates of 22 recent major project network elements (9 substations and 13 OHL) was studied, focusing on changing/increasing cost needed to correct accuracy offset of early estimates compared to later versions.
- The charts illustrate the change in cost estimates over the projects from PADR to CPA. Excluding outlier projects with extreme variations, the unknown risk factors were developed.
- On average TNSPs changed their early stage cost estimate by ~15%, driven by changes in four unknown risk categories. Highest variations were for scope and technology risks.
- The accuracy range of the Australian TNSPs' early stage (i.e. Class 5) cost estimates can be reasonably assumed to be ±30% based on the analysis of the network elements of current advanced transmission projects



Recent Australian substation network element cost estimates

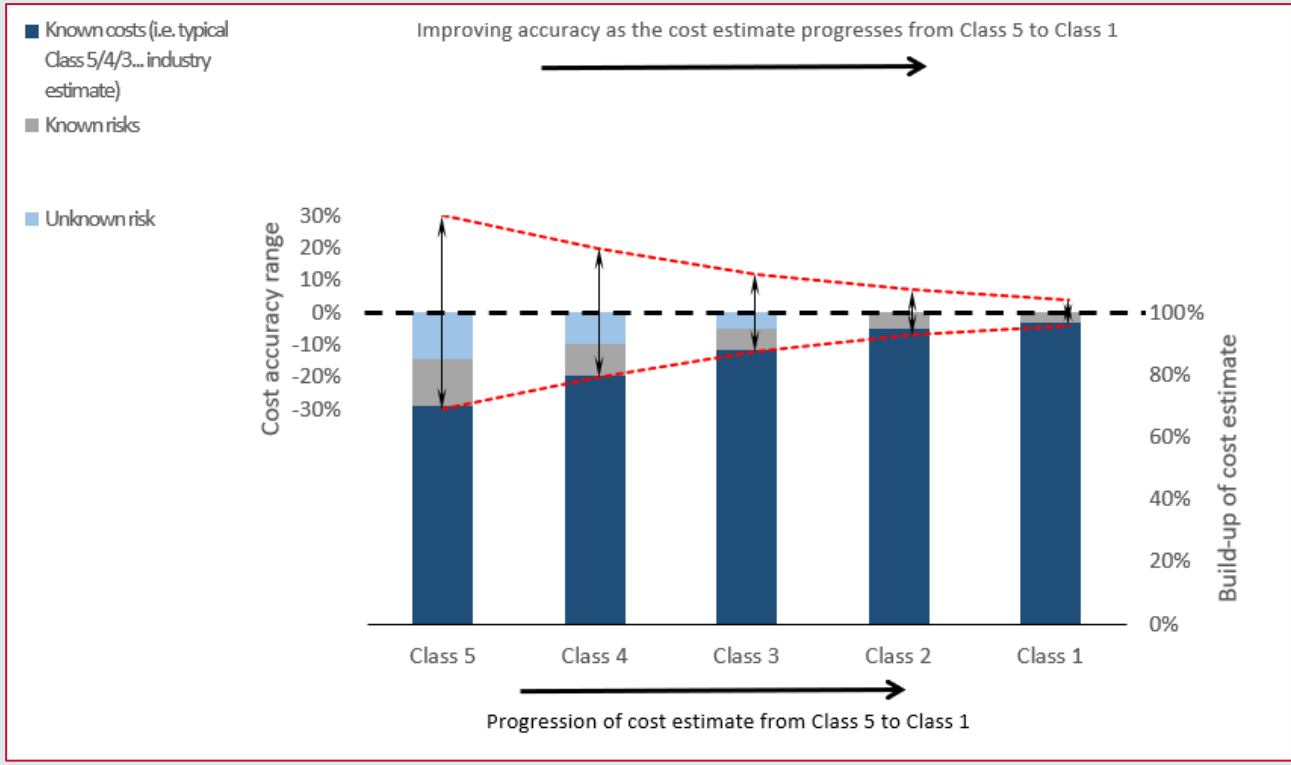


Recent Australian overhead line network element cost estimates

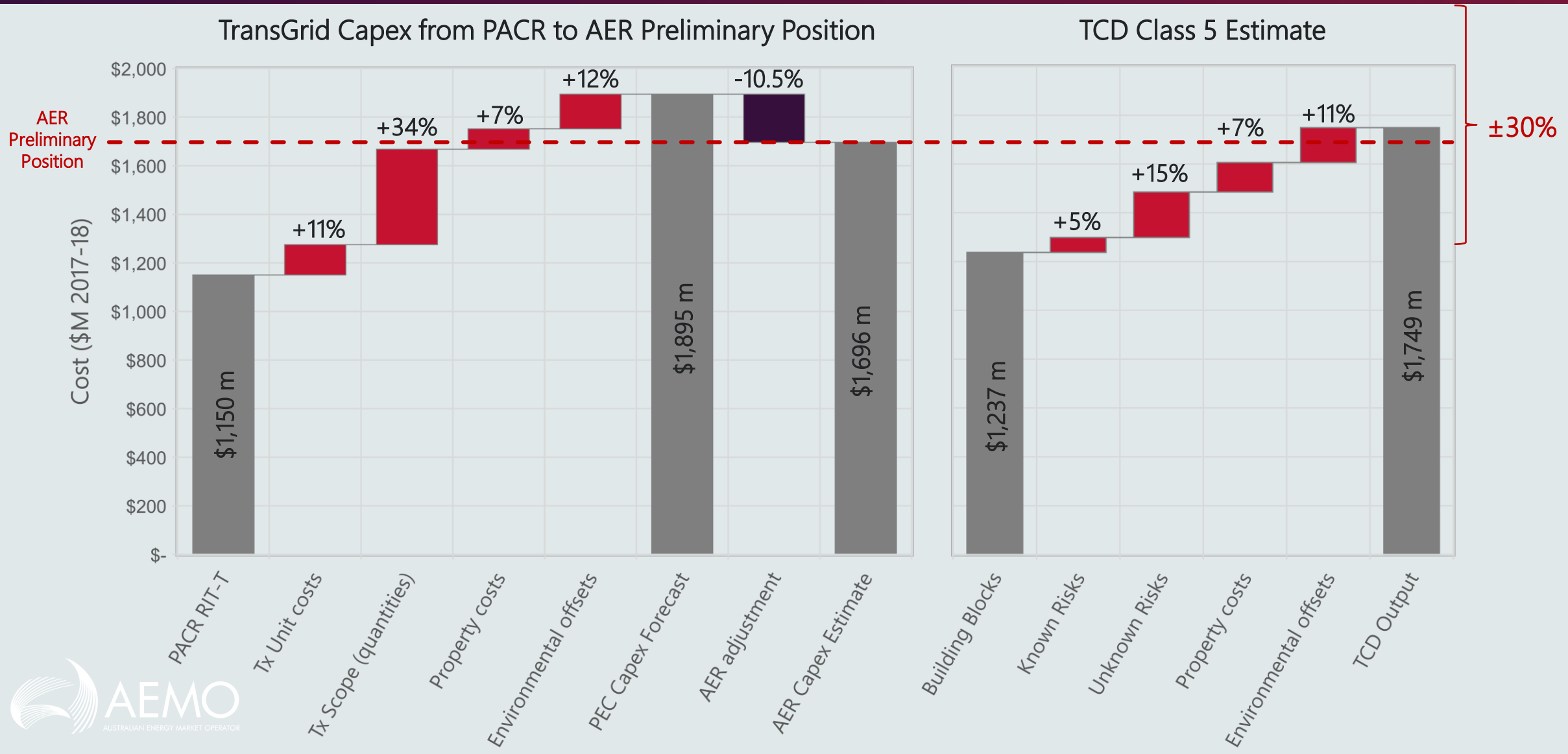
Calculating the mid-point estimate for ISP

- A positive amount of contingency or unknown risk for all four unknown risk factors totalling ~15%, on average, would need to be added to the Class 5 cost estimate with known risks to reflect a 50% probability of underrun and overrun of the expected final project cost.
- This is an amount or factor needed in the estimate to deal with uncertainties inherent in the estimating process.
- The TCD has been designed to include an average unknown risk of 15% for all Class 5 estimates
- The expectation is that unknown risks will reduce to near zero as the project advances to delivery.
- The accuracy of the Class 5 estimate produced in the TCD is +/-30%.
- The output 'total expected cost' is the 'best estimate' with an aim of being equally under and over the expected costs in an advance cost estimate.
- The 'total expected cost' output should be applied as the point estimate for ISP modelling purposes

Early stage cost estimate build-up used for TCD



TCD Performance – Project EnergyConnect



Questions?

Q&A on Risk Approach for the Transmission Cost Database

- Are you comfortable with the proposed approach to risk?
- Do any aspects need further explanation?

Cost Classification and Review of TNSP estimates

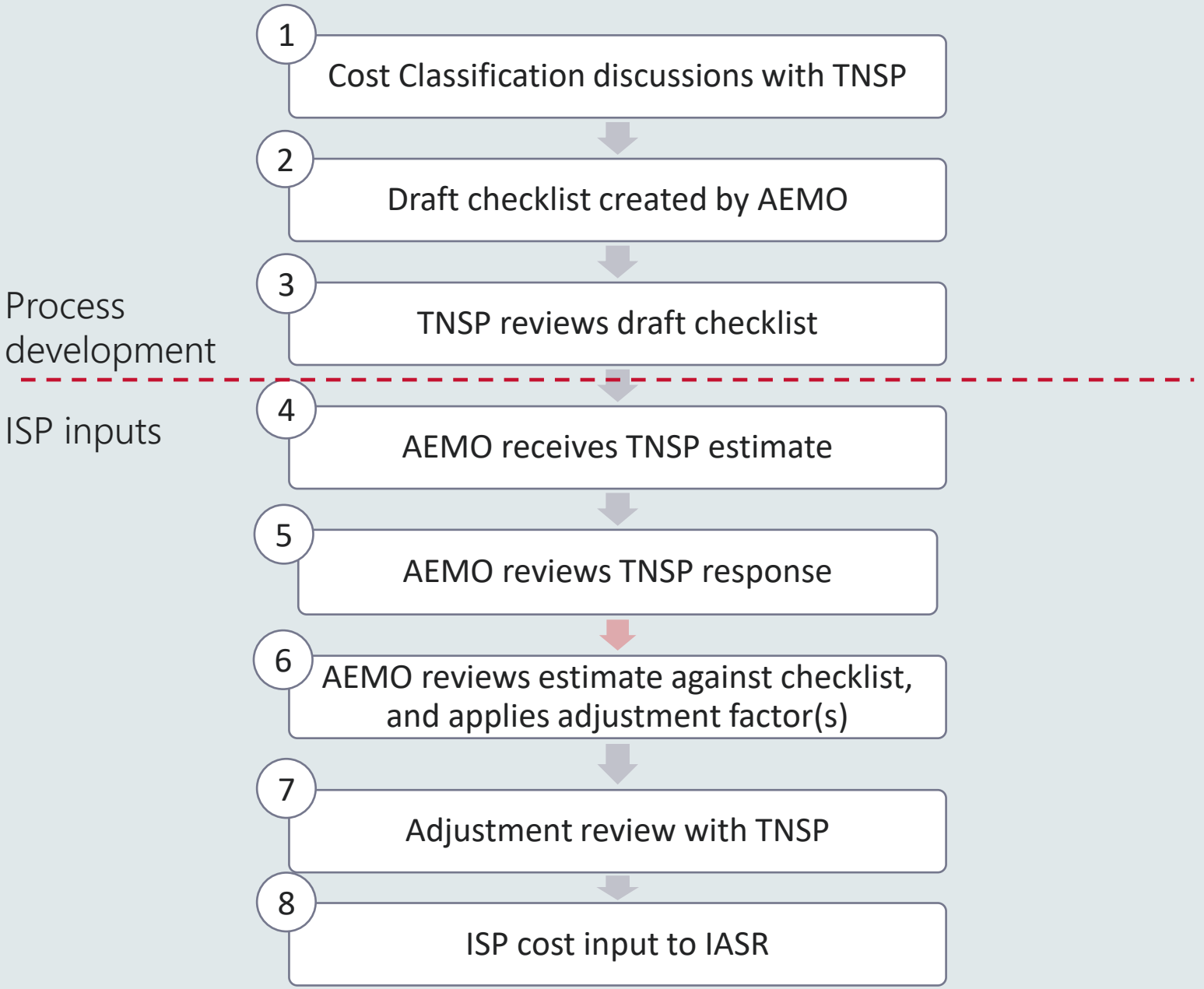
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Cost Classification Project Objectives

- Better understand how the TNSPs develop estimates for projects, including the stages they go through, inclusion of risk allowances and accuracy that is achieved at each stage
- Develop a common definition of work required to meet each estimate class for transmission projects (2/3/4 through 5)
- Develop a process, including checklist, to ascertain what is included in the TNSP estimates and then apply adjustments to TNSP estimates to ensure they meet the stated class of estimate (2/3/4 through 5)

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

TNSP Estimate Review Process



Draft Checklist

Work in progress – feedback requested

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

	First Stage	Second Stage	Third Stage
Scope of Works - line, station, cable			
Voltage defined?	Yes	Yes	Yes
Rating (MVA, MW, MVAr) defined?	Yes	Yes	Yes
Conductors specified?	No	Yes	Yes
Connection locations (substation, terminal station, converter) defined?	Yes	Yes	Yes
Which option best describes the maturity of the routing?	Preliminary Corridor	High Level Route	Detailed Route
Has gas network avoidance measures been included?	No	No	Yes
Which option best describes the consideration of national parks?	None	High Level	Detailed
Which option best describes the consideration of cultural heritage?	None	High Level	Detailed
Which option best describes the consideration of environmentally sensitive areas?	None	High Level	Detailed
Underground lines defined?	-	-	-
Which option best describes the maturity of the design?	Concept/High Level	Preliminary	Detailed/Complete
Which option best describes the documentation prepared?	Conceptual Single Line Diagram	Detailed Single Diagram	For Construction/Civil Diagrams
Level of site investigation for stations/substations/converters/terminal stations?	Desktop	Desktop	Preliminary Site Investigation
Has site remoteness been incorporated into the scope of works?	Yes	Yes	Yes
Which option best describes the georaphical location of any stations/substations included?	Assumed	General Area Defined	Actual Location Defined
Which option best describes the tower design progress?	Assumption Based	Preliminary Design	Final Design
Sites			
Are there any environmental offsets included based on past experience?	No	No	No
Strategy/approach developed to refine environmental offsets complete?	No	No	No
Are outage restrictions (specific to line diversions and cut ins) considered?	No	No	No
Which option best describes the consideration of brownfield works across the project?	Indicative	Indicative	Detailed/Complete
Terrain assessment	Desktop	Desktop	Detailed
Which option best describes the current level of engagement with landowners?	None	None	Community Level
Project Management and Delivery			
Which option best describes the level of geotech assessment?	None	None	Desktop Assessment
Which option best describes the source of cost estimate for equipment and construction?	Previous Projects	Previous Projects	Multiple Quotes
Which option best describes the identification and assessment of risk progress?	Concept/High Level	Preliminary	Detailed/Complete
Has macroeconomic influence been factored into the assessment of risk?	No	No	Yes
Has market activity been factored into the assessment of risk?	No	No	Yes
Has project complexity been factored into the assessment of risk?	No	Yes	Yes
Has compulsory acquisition been factored into the assessment of risk?	No	No	Yes
Has environmental offset been factored into the assessment of risk?	No	Yes	Yes
Has geotechnical findings been factored into the assessment of risk?	No	No	No
Has outage restrictions been factored into the assessment of risk?	No	No	No
Has weather delays been factored into the assessment of risk?	No	No	No
Has cultural heritage been factored into the assessment of risk?	No	Yes	Yes
Has any allowance been made for unknown scope and technology risk?	-	-	-
If yes, please indicate allowance amount as a % of baseline cost			
Has any allowance been made for unknown productivity and labour cost risk?	-	-	-
If yes, please indicate allowance amount as a % of baseline cost			
Has any allowance been made for unknown plant procurement cost risk?	-	-	-
If yes, please indicate allowance amount as a % of baseline cost			
Has any allowance been made for unknown project overhead risk?	-	-	-
If yes, please indicate allowance amount as a % of baseline cost			
Which best describes the level of market engagement?	-	-	-
Has a general contingency allowance been included in the cost estimate (excluding any listed above)?	Yes	Yes	No
If yes, please indicate allowance amount as a % of baseline cost			
Regulatory			
Scope of works prepared as part of which regulatory gateway?	Preparatory Activities	PADR	-
Regulatory model	-	-	-

Summary of alignment process (work in progress – feedback requested)

Hypothetical TNSP estimate received:

	$(million)
TNSP cost estimate (excluding any accuracy contingencies)	$1,000
Apply known risk allowance for environmental offsets	$110
Apply known risk allowance for geotech conditions	$40
Apply class 4 unknown risk allowance	$90
ISP cost input	**$1,240**

Process:

- Cross-check estimate by comparing with TCD, determine gaps
- Add allowance for missing known risks
- Add allowance for missing unknown risks
- Review adjustments with TNSP
- Finalise for IASR

Stakeholder input and discussion

- Are you comfortable with the suggested TNSP estimate alignment process?
- What aspects of the alignment process or checklist should we change?
- Are there specific areas of the estimates that you would like to call out for potential adjustment?
- Other?

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Next Steps

Step Description	Start	End
AEMO to develop estimates for candidate Future projects	1 April 2021	15 May 2021
Draft Transmission Cost Report (4 week consultation) and release of TCD	28 May 2021	25 June 2021
Webinar on overview of network augmentation costs for 2022 ISP	9 June 2021	-
TNSPs provide costs for future projects with preparatory activities and current actionable projects	30 June 2021	-
AEMO review of TNSP estimates	30 June 2021	15 July 2021
Publication of Final Transmission Cost Report and IASR	30 July 2021	-