MARKET REFORM

Transaction Costs of OFA for Generators in the NEM
Report to the AEMC

14 January 2015

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Executive Summary

The Australian Energy Market Commission (AEMC) has proposed Optional Firm Access (OFA) related changes to the design of the National Electricity Market (NEM). One of the AEMC's considerations in deciding whether these changes should be adopted is the cost to the market.

OFA would impact all scheduled and semi-scheduled generators actively participating in the NEM. The objective of this study is to develop a cost-range estimate of the implementation and on-going operating costs of OFA on these generators were OFA to be adopted. The cost/benefit impact on participants of changed economic outcomes due to OFA is not within the scope of this study.

Two approaches were taken to estimating the cost of OFA to generators.

- A survey of NEM generators was conducted to obtain their estimates of the within scope costs. The survey identified low, best and high cost estimates for both the implementation cost and on-going annual operational cost of OFA. Affiliated entities (e.g. if a parent trades on behalf of multiple NEM participants) were asked to provide a consolidated response. Fourteen companies completed and returned the survey.
- A cost model was developed based on Market Reform's experience in planning and managing Energy Trade and Risk Management (ETRM) projects. Costs that could not be estimated using this approach– such as legal costs – were taken from survey results.

Each participant was assigned a nominal complexity, based on the perceived scale and sophistication of its operations. Within each complexity grouping, estimates were derived from those who did not respond based on the statistics for those who did. In this way, a survey-based estimate of the total cost of OFA was formed. Similarly, the number of organisations within each complexity level was multiplied by the cost model results for that complexity, in order to provide a cost-model-based estimate of the total cost of OFA.

To examine the sensitivity of the model to the assignment of nominal complexity levels, two different sets of system complexity groupings were modelled:

- The *base grouping* was estimated prior to conducting the survey, based on participant size, technology mix, and whether it traded in one or multiple NEM regions.
- The *alternate grouping* re-assigned the complexity of respondents based on general magnitude of their best estimate costs from the survey. The participant was assigned the complexity that best aligned with this cost, based on cost model results.

Some respondents submitted costs outside the defined scope of this study – including asset replacement costs (additive to implementation costs), financing costs, charges imposed by transmission network service providers, and credit support costs. These costs were excluded from the study dataset.

Table 1 presents the within-scope costs of OFA for NEM generators. These represent total implementation costs plus five years of operating costs. A discount factor of one (1) was assumed and currency values are in 2014 dollars.

	Base Grouping		***Alternate Grouping***	
Method	**Survey**	**Cost Model**	**Survey**	**Cost Model**
Low Cost Estimate	$81.3	$52.0	$67.2	$49.7
Best Cost Estimate	$120.8	$79.8	$99.8	$78.0
High Cost Estimate	$198.7	$128.5	$162.3	$119.9

Table 1 – Summary of Results ($ million)

Drawing results from both complexity groupings, and favouring the most extreme values, the cost model implies a cost range of approximately $50 million to $129 million with a best estimate of approximately $79 million. The survey results are more variable though the most extreme values in the table imply a cost range of $67 million to $199 million. The survey best estimate might be taken

to be $121 million, being a conservatively high value in the context of a cost benefit assessment. It should be noted, though, that it was observed – using the base grouping – that capping a survey respondents cost over five years to not exceed the cost model high cost estimate of that value gave total costs ranging from a low estimate of $61 million to a high estimate of $89 million with a best estimate of $76 million.

Surveys of participant costs can be informative but should not be viewed as definitive. This is because different respondents will have different levels of understanding of the proposed market design changes, and their potential impact on the respondent organisation. There is also potential for responses to be influenced by whether or not the respondent is in favour of the market design proposition. Finally, not all participants responded to the survey meaning that a component of the overall cost estimate had to be interpolated based on others' responses.

The cost model approach is also limited as there is no 'one size fits all' or even 'one size fits most' implementation project or operating model, and the changes required for OFA do not necessarily match those required for any other market change . Instead, results must be based on the observed range of costs seen in other efforts with similar characteristics, segmented based on the complexity of the operations which would need to be changed.

Market Reform views the OFA implementation as being similar to a single market "product" implementation in the realm of an existing wholesale market – requiring an incremental change to existing capabilities (e.g. requiring changes to the existing ERTM system, not implementation of an entirely new one). Depending on the complexity grouping used and its impact of costs taken from the survey, the cost model's high estimate of implementation costs is in the $4 to $5 million range for a single participant. In contrast, a small number of respondents gave best estimates of the one-off costs of implementing OFA in the region of $10 million and high estimates exceeding $18 million.

It is insightful to consider the survey responses in the context of some recent projects in which Market Reform has been involved in the United States.

- The implementation of an ETRM platform to support front, middle and back office functions for gas supply, gas distribution, financial and physical power of a major public utility was done in the course of two years at a total cost of approximately US$ 24 million, inclusive of hardware and licensing, consulting and internal resources.
- A proposed implementation of an ETRM platform to support the management, compliance and settlement of hundreds of structured power contracts, with complex payment calculation and performance scenarios for various types of generation facilities and contract terms, is estimated at US$ 12 million, inclusive of hardware and licensing, consulting and internal resources.

In both cases these implementations included integration to legacy upstream and downstream internal systems, as well as interfaces to external market data. The scope and complexity of these projects would, in our view, conclusively rate higher than the incremental change required for the implementation of OFA.

It is not possible for us to make definitive statements about what costs a participant would actually be exposed to, though it does seem that some of the higher survey cost estimates may reflect much more than an incremental system change. It is also conceivable that some of the costs that respondents associated with OFA may to some degree be incurred anyway, e.g., through periodic reviews of risk management strategies.

1. Introduction

1.1. Background

The Australian Energy Market Commission (AEMC) has proposed Optional Firm Access (OFA) related changes to the design of the National Electricity Market (NEM). As part of the assessment of the OFA proposal, the AEMC has retained Market Reform to provide an estimate of the transaction costs for generators associated with the implementation of OFA.

1.2. Objective and Scope

OFA would impact all scheduled and semi-scheduled generators actively participating in the NEM. The objective of this study is to develop a cost-range estimate of the implementation and on-going operating costs of OFA on theses generators were OFA to be adopted.

Costs incurred up until the point where a final determination on OFA has been made are out of the scope of this study as is the cost impact on participants of changed economic outcomes caused by OFA.

The AEMC is conducting separate studies to assess the impact of OFA on:

- market economic outcomes;
- the implementation and operational cost impacts on Transmission Network Service Providers (TNSPs); and
- the implementation and operational cost impacts on the Australian Energy Market Operator (AEMO).

Broader questions concerning the desirability, or not, of the proposed OFA changes will be addressed through other parts of the process being conducted by the AEMC.

1.3. Report Outline

The remainder of the report is structured as follows:

- Section 2 describes the methodology used.
- Section 3 presents the results.
- Section 4 presents our conclusions.

2. Methodology

2.1. Introduction

Two approaches were taken to estimating the cost of OFA to generators. The first approach involved surveying generators to get their estimates of the within scope costs. Separately, Market Reform developed its own cost based on our experience in planning and managing Energy Trade and Risk Management (ETRM) projects.

Prior to describing these two methods we describe how we classified different complexities of changes as these would vary between participants.

2.2. Complexity of System Changes

Different participants will have different levels of sophistication in their IT solutions. The cost impact of OFA on participants will vary accordingly. This needs to be taken into account in estimating survey results for participants that do not respond and in estimating costs using Market Reform's cost model.

Three types of complexity of change were defined to reflect different levels of complexity of the change to participant systems:

- High complexity assumes system changes are required to a sophisticated and integrated software implementation;
- Medium complexity assumes system changes are required to be made to a smaller or bespoke system/not highly integrated; and
- Low complexity assumes a manual or spreadsheet based process or configuration into an existing, potentially advance, system without requiring software changes.

Prior to receiving any survey results Market Reform formed a view of the complexity levels of changes to participant systems based on the scale of the participant (in terms of registered MW capacity), the number of NEM regions in which the participant generated, and the mix of technologies that the participant used. We refer to this as the ***base grouping***.

Potential limitations of the base grouping include it being an estimate and one which focuses on the complexity of the existing systems, which may differ from the complexity required in changing those systems. For example a sufficiently sophisticated system may allow OFA to be implemented as a configuration change rather than a software change.

As sensitivity test on the results gained with the base grouping a second ***alternate grouping*** was formed and a second set of results developed from this. Participant system complexity was re-assigned based on general magnitude of their best estimate costs from the survey. The participant was assigned the complexity that best aligned with this cost, based on cost model results.

2.3. The Survey

A survey was conducted of the scheduled and semi-scheduled generator operators in the NEM. Affiliated entities (e.g. if a parent trades on behalf of multiple NEM participants) were asked to provide a consolidated response. Thus one survey may have been completed by an entity that trades for multiple NEM registered generators. Respondents were provided with a short summary of OFA (see Appendix A) and were asked to estimate the within scope costs of complying with those changes.

The survey asked respondents to separately provide their estimates of the implementation costs of OFA and the on-going annual operating costs. The survey fields were broken down into a small number of cost categories according to Market Reform's own preliminary assessment of business capabilities which may be impacted, and other areas of potential cost (see Appendix B). These categories were intended to serve as an aid to respondents in assessing the impact of OFA on their organisation, as well as to provide a basis for a 'like for like' comparison and analysis of survey results.

The survey was tested and refined via a pilot exercise in which two participants with quite different characteristics were provided a draft of the survey and asked to provide comment on it.

It is recognised that the OFA design is not yet at the point where a detailed analysis of functional and business impacts can be carried out. Respondents were requested to provide a cost-range estimate for each cost category, to the level of accuracy reasonably achievable in the available response timeframe. This range comprised a 'best' estimate, along with a high and low estimate around this. While we would expect such estimates to be reasonable and informed, respondents were not expected to develop detailed costing or provide additional evidence.

Respondents were able to propose additional cost fields if they considered them relevant. These were only considered if they were within scope of the survey. Excluded responses are discussed in section 0. Some additional fields proposed by respondents were simply defining a finer resolution of detail than required by standard fields and these were merged into standard fields in our results.

The protocol under which the survey was performed was that individual responses would not be published; rather only aggregated statistics would be reported. Any specific data quoted would be without identification of the source. The organisations that did and did not respond would be identified (see section 3.2).

Not all of those invited to respond submitted a response. In this case the total cost for that complexity group was calculated by taking the simple average cost for those group members who did respond and multiplying that by the number of participants within that group.

2.4. The Cost Model

Surveys of participant costs can be informative but should not be viewed as definitive. This is because different respondents will have different levels of understanding of OFA and its impact on their organisation. There is also potential for responses to be influenced by whether or not the respondent is in favour of the implementation of OFA. Finally, not all participants responded to the survey meaning that a component of the overall cost estimate had to be estimated based on the responses received. The cost model attempts to mitigate these limitations by providing an independent estimate of costs as a cross check.

Market Reform formed its own IT and process costs estimates utilising the capability map provided with the survey (Appendix B). The estimates were based on Market Reform's experience in project planning and management and experience with change projects of a similar magnitude. It was assumed in all cases that incremental changes were being made to existing systems rather than a replacement of systems.

For each level of system change complexity the cost model determined a high, best and low estimate of an individual representative participant's costs. These predictions were the sum of Market Reform derived results and selected survey data (where data could not meaningfully be derived). In the case of the derived results a high and low cost estimate was calculated with the best cost estimate being the simple average of these. Survey data was used for policy/corporate and legal costs (both implementation and operational costs) as well as operational costs associated with any impact on transmission connection work load. As the survey provided specific results for high, best and low cost estimates the final cost model 'best cost estimate' is not the average of its low and high estimates.

Combining this information with our base grouping and alternate grouping data on actual participant system change complexity allowed total market costs to be estimated.

The cost model is limited in nature as there is no 'one size fits all' or even 'one size fits most' model. The level and cost of change in many areas can be highly dependent on the scope and complexity of operations.

The key assumptions used in the cost model are summarised in Table 2.

Cost	Explanation	Complexity	Low Cost Estimate	High Cost Estimate
Staff	Based on the number of full-time equivalent (FTE) personnel required, and the expected duration of work. The daily rate is an average blended daily rate based on different skill mixes. A total of 20 work days was assumed per month.	High	Duration: 9 months Implementation:[1] 9.3 FTE Operation: 1 FTE/year FTE Cost: $1,014/day	Duration: 12 months Implementation: 11.6 FTE Operation: 2 FTE/year FTE Cost: $1,228/day
		Medium	Duration: 6 months Implementation: 11.0 FTE Operation: 0.8 FTE/year FTE Cost: $885/day	Duration: 8 months Implementation: 13.7 FTE Operation: 1.3 FTE/year FTE Cost: $1,020/day
		Low	Duration: 4 months Implementation: 2.0 FTE Operation: 0 FTE/year FTE Cost: $738/day	Duration: 6 months Implementation: 9.3 FTE Operation: 0 FTE/year FTE Cost: $884/day
Systems	Based on a cost per user of the trading system. This comprises software licensing costs per user plus hardware costs. In all cases an operational software maintenance cost of 20% of license cost was assumed.	High	Users: 10 License cost:[2] $10,000/user Hardware costs: $100,000	Users: 9 License cost: $6,000/user Hardware costs: $60,000
		Medium	Users: 7 License cost: $8,000/user Hardware costs: $75,000	Users: 6 License cost: $4,000/user Hardware costs: $30,000
		Low	Users: 0 License cost: 0 Hardware costs: 0	Users: 0 License cost: 0 Hardware costs: 0

Table 2 – Key Cost Model Assumptions

Staffing costs were based on a blended daily rate that differed for different system change complexities and for each of the high and low cost estimate. It was assumed that projects would be staffed by a mix of resource skill levels ranging from junior to subject matter expert/manager. Different reference rates were applied for internal and external resources. These rates were then weighted based on the degree to which a project is resourced from internal or external resources. The level of use of higher cost resources and the level of use of external resources increased with project complexity and were greater for the high cost estimate than for the low cost estimate. The final blended rates are shown in Table 2.

For each level different level of system complexity a level of resourcing was estimated for each of the following capability areas:

- Trading - Front Office
  - ⇒ Market Data Management
  - ⇒ Pricing and Valuation Modelling
  - ⇒ Bidding Strategies
  - ⇒ Bid/Offer Submission
  - ⇒ Deal Capture

[1] Implementation related staffing is for the duration of the establishment project. Operation related staffing is per year and on-going.
[2] This is also a surrogate measure for a participants cost of maintaining the capability to build systems in house.

- Mid Office
  - ⇒ Portfolio Management and Valuation
  - ⇒ Risk Reporting
- Back Office
  - ⇒ Settlement
  - ⇒ Shadow Settlements
  - ⇒ Reporting
- New Asset Development
- Training/Readiness
- Project Management

In each case, and as applicable, the number of person days required for the following task was estimated:

- Defining the requirements of the changed system
- Designing the changes
- Building and/or configuring the changed system
- Testing the system
- Deploying the system for operational use.

These estimates and the assumed project duration allowed the number of full-time equivalent staff required for the implementation to be determined. The totals are shown in Table 2. Application of the blended daily rate gave a cost estimate for developing systems in each capability area.

Software costs were estimated based on estimates of the number of users of systems multiplied by software licensing costs. Licensing costs were treated as a surrogate for labour costs if software developed in-house. Hardware costs were estimated directly and were inclusive of database and applications servers and infrastructure to support interfaces, but not maintenance. The details of users, licensing costs and hardware costs are shown in Table 2.

On-going operational costs were derived from a combination of a maintenance fee equal to 20% of the annual license fee and the number of full time equivalent staff listed in Table 2

3. Results

3.1. Introduction

This section presents the results derived both from the survey and the cost model. They are presented together to allow comparison and contrast between the two sets of results.

All dollar amounts are as at 1 January, 2015. A discount factor of 1 has been assumed. This simplistic approximation recognises that the survey only provides an annual operating cost for a single year, the survey responses are naturally very approximate, no start date for OFA has been established, and the use of a discount factor of 1 is conservative in the context of the AEMC's cost-benefit analysis.

3.2. Survey Responses

A high proportion of the generators in the NEM responded to the survey. The total registered capacity of those who responded amounted to 85% of the generation capacity in the NEM. Table 3 lists the parties responded and which did not respond.

Responded	Did Not Respond
AGL Energy	ACCIONA
Alinta Energy	Alcoa
Energy Australia	CS Energy
Ergon Energy Queensland	Infigen Energy
ERM Power Ltd	Meridian
GDF Suez Australian Energy	Trust Power
Goldwind Australia	Wind Prospect
Hydro Tasmania	
InterGen	
Origin Energy	
Pacific Hydro	
QGC	
Snowy Hydro	
Stanwell Corporation	

Table 3 – Information on Responses

3.3. Costs in Survey Responses Excluded from the Results

The survey responses included some costs which did not conform to the scope or intent of the survey and which were therefore excluded from our results. Nevertheless, details of these excluded costs are summarised here as the information may still be relevant to other aspects of the assessment of OFA.

- A respondent estimated $1.1 to $2.2 million per year for project life cycle costs, i.e. recovering costs to replace systems at end of life. These costs were excluded as the aim of this exercise is to estimate the cost of implementing the systems and to include project life cycle costs would effectively double count the implementation costs. The survey did ask respondents to "… not include any amounts for amortisation or depreciation of implementation costs, nor for the financing and taxation effects of such costs."
- A respondent estimated that OFA's effects on their ability to obtain finance could result in one-off costs of $50 million (low cost scenario) to $250 million (high cost scenario) and could create on-going costs of $2 - $8 million per year. Another respondent commented that it could face tens of millions of dollars of increased finance costs. These costs were excluded as the scope of the study is the implementation and operating costs of OFA whereas financing costs would reflect an economic impact of OFA.

- A respondent perceived OFA as conflicting with a feature of a transmission contract, potentially resulting in a degree of double charging. This cost has been excluded as the scope of the survey is on implementation and operating costs of OFA, whereas this cost reflects a charge for transmission access and as such is out of scope.
- Two respondents included estimates of the changed costs of credit support resulting from a change in the price at which they are ultimately settled. One respondent considered these costs only to be relevant in the high cost scenario and estimated them at $3.75 million per year while the other estimated $2 million (low cost scenario) to $4 million (high cost scenario) per year. These costs were excluded as stemming from economic outcomes which are outside the scope of this study.

3.4. Summary of Survey Responses

This section provides information on the thirteen raw survey responses without attempting to group results or to estimate results for those that did not respond. Results are presented in a manner so as to preclude identification of the data provided by a specific respondent.

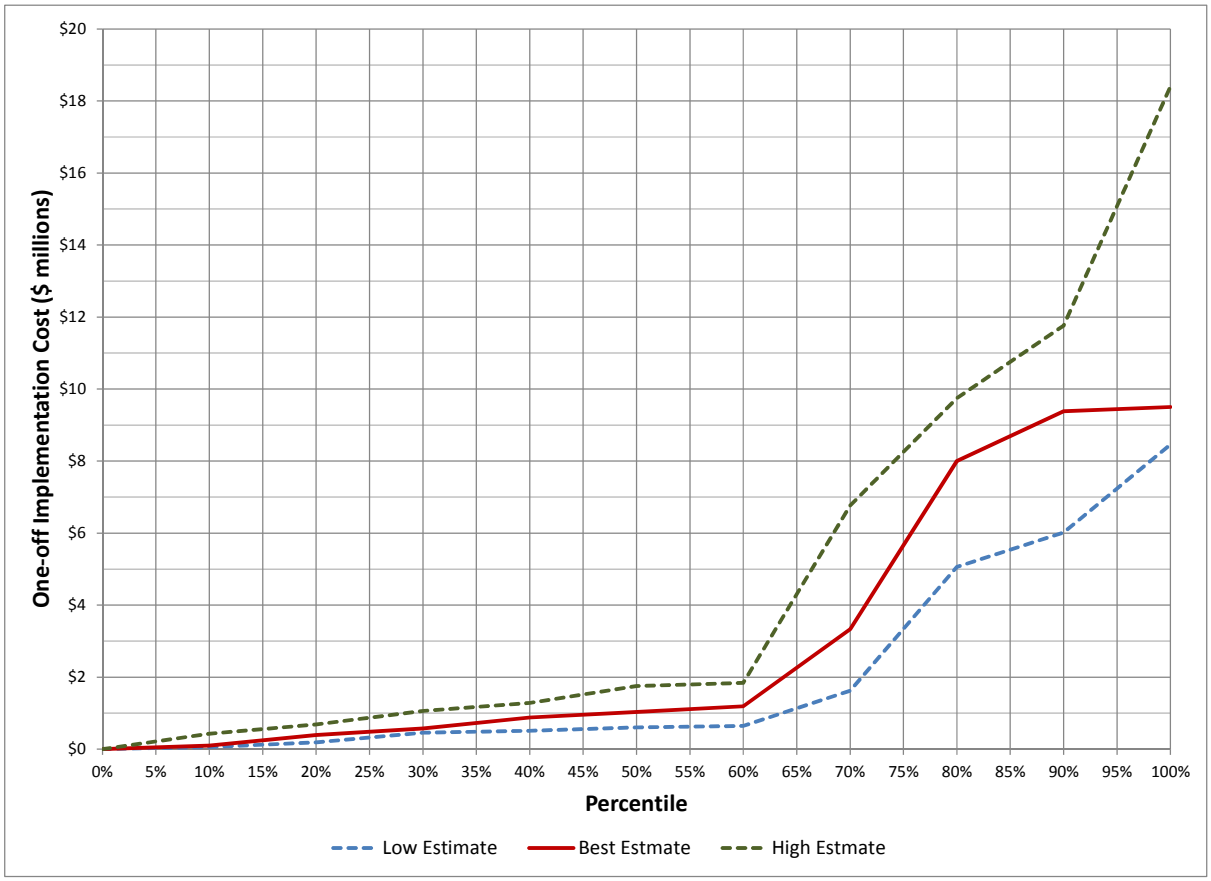

Figure 1 – Distribution of OFA Implementation Costs in Survey Reponses

Figure 1 presents the distribution of the one-off implementation cost estimates from the respondents for each of their low cost estimates, best estimate, and high cost estimates. The graph indicates that 50% of respondents gave best estimate that did not exceed about $1 million with highest estimates less than $2 million. The data on the right of the graph indicates that 30% of respondents gave a best estimate exceeding $3 million. The maximum cost estimate, under a high cost scenario was over $18 million.

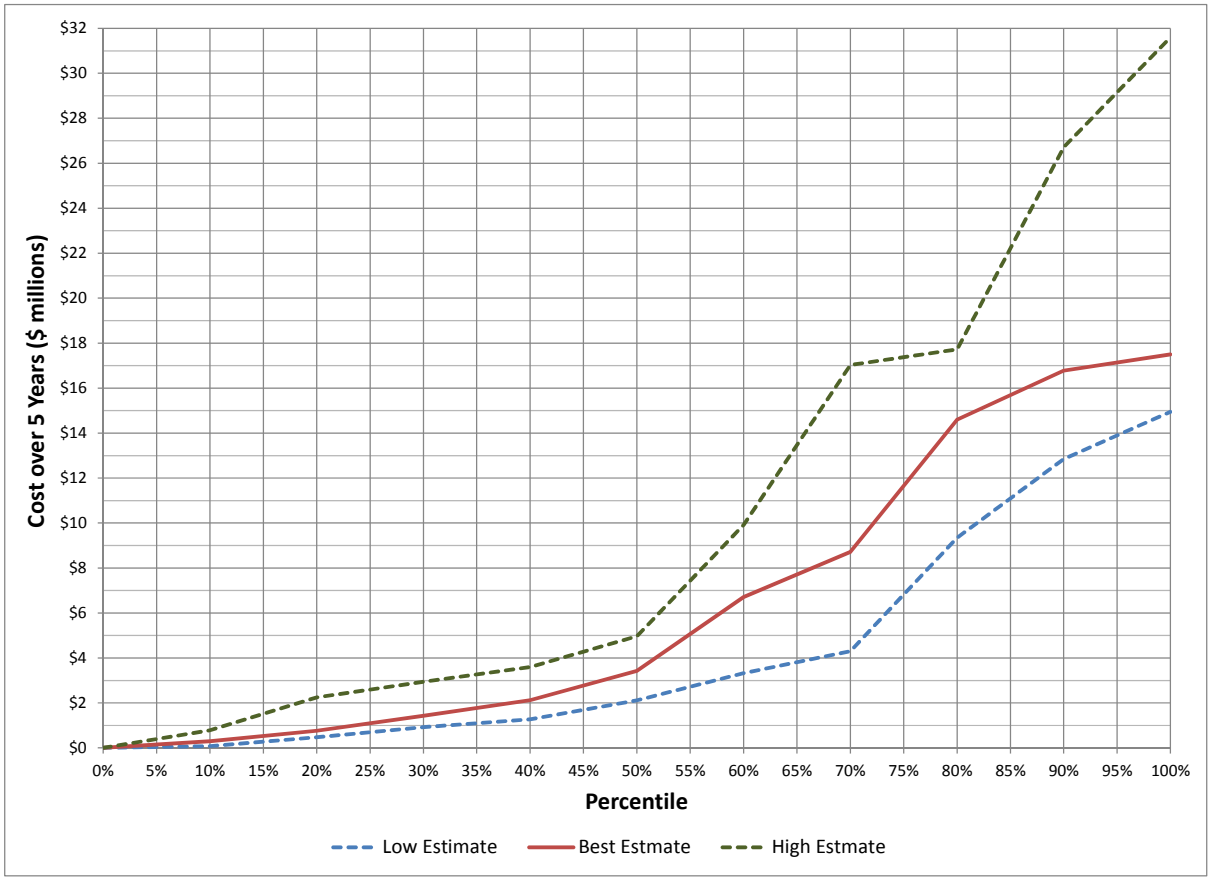

Figure 2 – Distribution of OFA Costs over 5 Years in Survey Reponses

Figure 2 presents an estimate of costs over 5 years. This data combines the implementation costs and respondent estimates of the on-going annual operating costs associated with OFA. The annual cost estimates are multiplied by a factor of 5.

Over five years 50% of respondents gave best estimate that were less than $2 million with the highest estimate not more than $5 million. The data on the right of the graph indicates that 30% of respondents gave best cost estimates exceeding $8 million. The maximum cost estimate, under a high cost scenario was over $31 million.

3.5. Base Grouping Results

This section presents results for both the survey and the cost model using the base grouping of participants to complexity levels. The base grouping concept is described in Section 2.2. Table 4 presents the statistics of the base grouping. For confidentiality reasons we do not reveal which participants were assigned which complexity.

Complexity	High	Medium	Low
Proportion of Participants	24%	38%	38%
Proportion in Group who Responded	100%	63%	50%

Table 4 – Statistics of Base Grouping

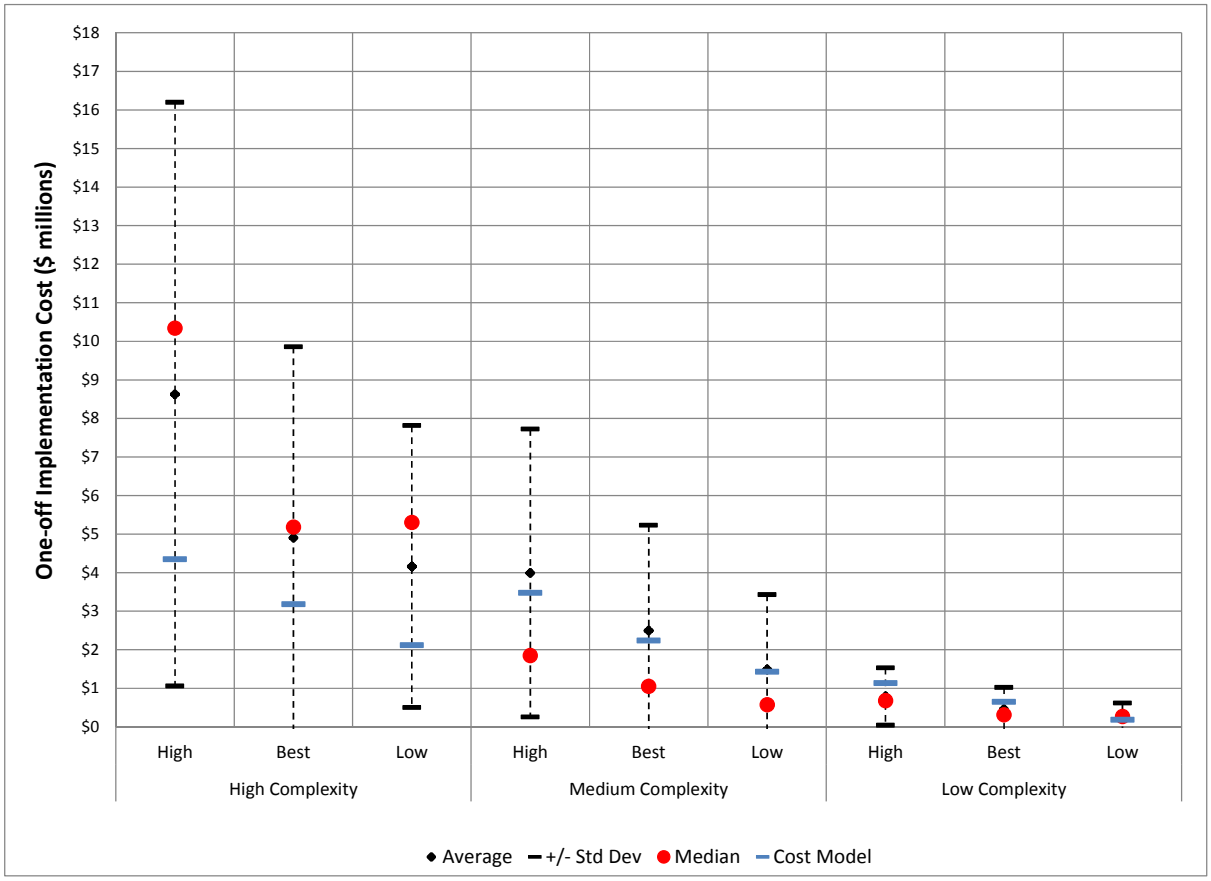

Figure 3 – Base Grouping Variability of Implementation Costs

Figure 3 contrasts the survey results for the implementation costs with those of the cost model. For each of three levels of change complexity statistics for the high cost estimate, best cost estimate and low cost estimate are shown. In each case:

- A range of one standard deviation around the average survey response value is shown. As the standard deviations of responses are quite large this range can go negative, though this part of the range is truncated in the chart.
- A red dot indicates the statistic median value of the responses within the range. The median reflects the middle value within the set of responses and may be more meaningful in this context than an average.
- The blue bar indicates the corresponding cost model estimate.

Figure 3 indicates that the variability of survey responses is quite large with the standard deviation typically being of a similar value to the average response. This may in part reflect imperfections in the classification of participant system complexity, though this aspect is explored further below in the context of the alternate grouping.

The cost model and survey results are comparable in the context of low complexity and medium complexity cases. For medium complexity system changes it predicts a cost slightly lower than the average of survey responses but greater than the median cost survey response. The cost model predicts lower costs in the high complexity case than are typically predicted by respondents.

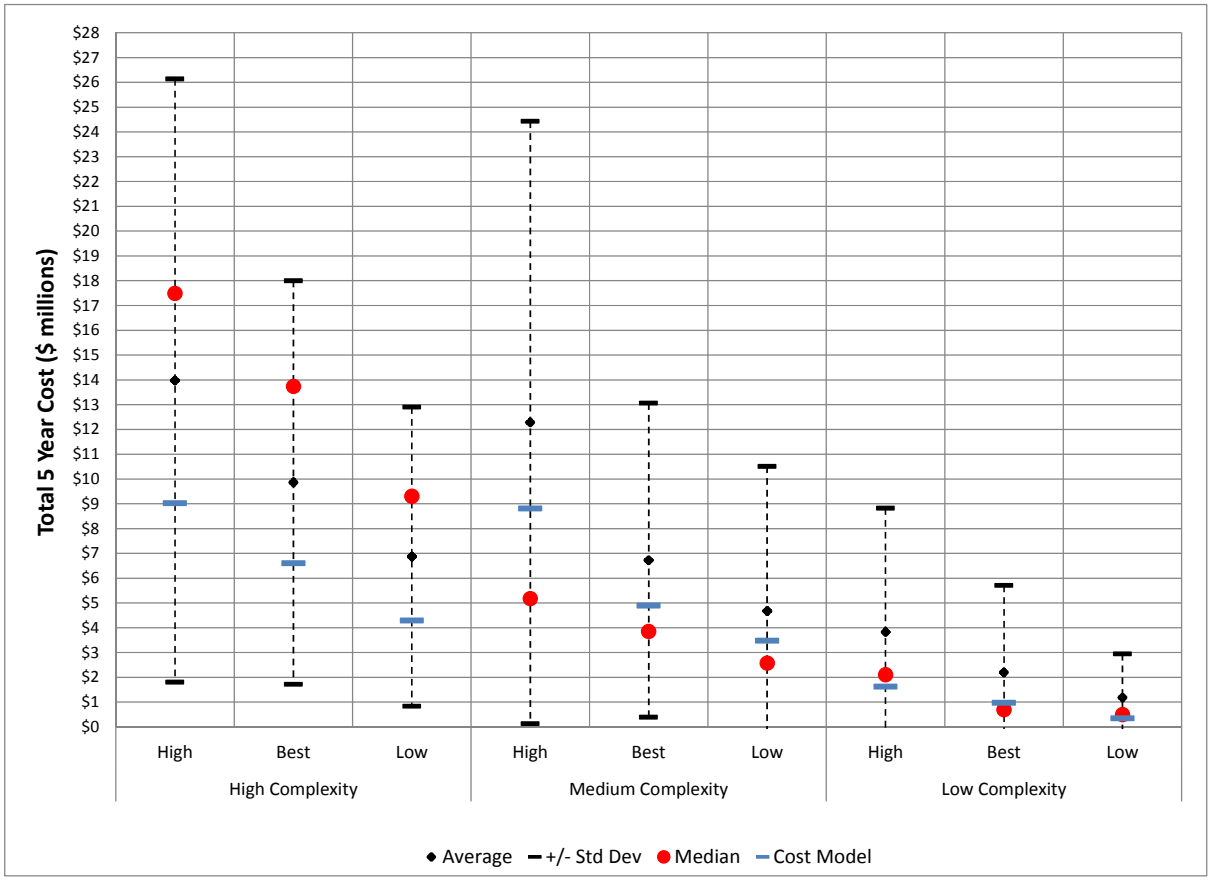

Figure 4 – Base Grouping Variability of Total Costs over Five Years

Figure 4 presents the corresponding results for the total costs over five years, these being the implementation costs plus five times the annual operating costs.

The high variability of the high cost estimate of the medium complexity results reflects the impact of a single response. This is discussed further below.

The cost model conforms relatively well to the survey results in the medium complexity case and to a lesser degree to the high complexity case. It tends to predict costs that are low relative to the median and average value for the low complexity case as the cost model assumes no additional personnel are required to support OFA operationally for this group whereas such costs are assumed in some responses.

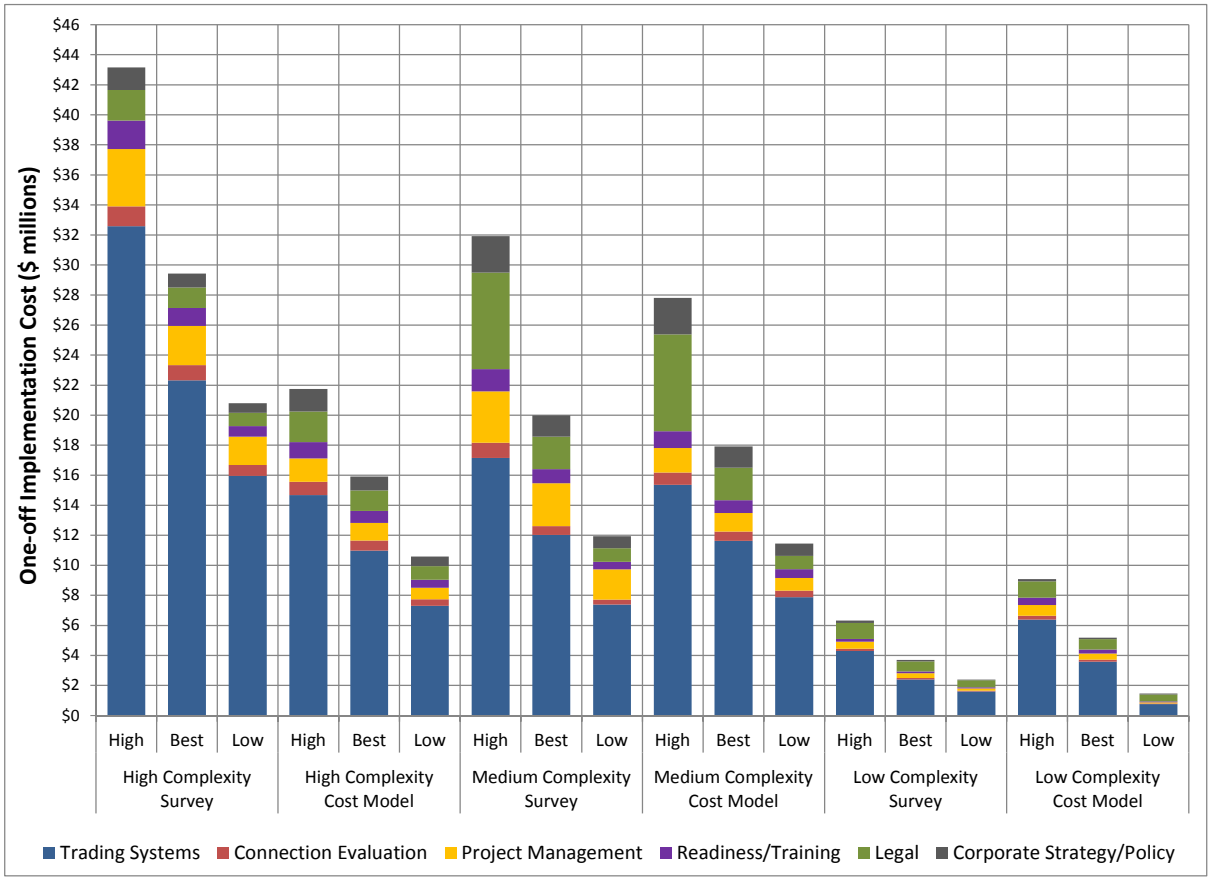

Figure 5 – Base Grouping Survey and Cost Model Implementation Cost Results – All Participants

Figure 5 requires some explanation:

- Survey respondents have been grouped based on their base grouping system change complexities. If a group comprises n participants but only m participants have responded then the aggregate results of the m respondents is scaled up by n/m to give an estimated cost for all the participants in that group (e.g. if 5 out of 10 responses are received the results are scaled up by a factor of two).
- The cost model results, which are for one participant, are multiplied by the number of participants in that group to give an overall market cost estimate.
- For each combination of survey/cost model and complexity we present a low cost estimate, a best cost estimate and a high cost estimate. For the cost model results the best estimate is just the average of the low and high cost estimate.
- The reported costs are grouped as follows:
    - *Trading Systems* reflect all hardware, software and staffing incremental costs of transitioning trading systems to a point where the participant can operate under OFA.
    - *Connection Evaluation* reflects the incremental costs of updating processes for transmission connection evaluation to reflect OFA (e.g. to recognise that different levels of firm capacity could be available at different connection points when assessing where to locate a new generating unit).
    - *Project Management* relates to managing the implementation project.
    - *Readiness/Training* relates to getting the participant's organisation ready OFA commencement including any training costs (if separately identified).
    - *Legal* reflects costs for contract reviews, etc.
    - *Corporate Strategy/Policy* reflects the cost of reviewing the implications of OFA for the organisation, assessing and potentially modifying trading strategies etc.

The survey results for legal and corporate strategy/policy were also used in the cost model results.

It is apparent that the major source of difference between cost model and survey results is with respect to trading system costs. While reasonably similar for medium sophistication systems, the survey results are less than the cost model predictions for low complexity systems while the survey results for trading system costs can be in the region of double those of the cost model for high complexity systems. However, as noted in earlier graphs, the cost model results are still relatively central within the wide variation of survey response estimates.

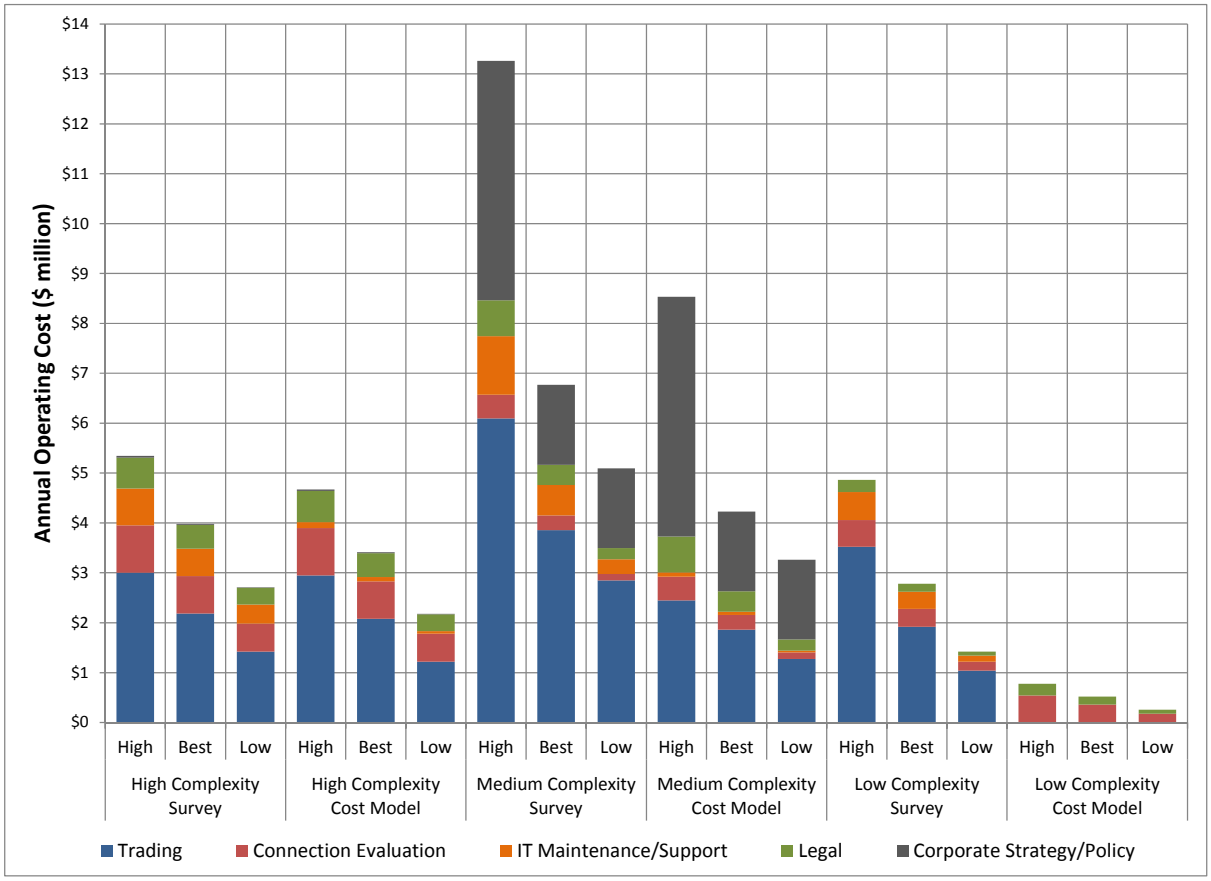

Figure 6 – Base Grouping Survey and Cost Model Annual Operating Cost Results – All Participants

Figure 6 shows results for the annual operating costs. The reported costs are grouped as follows:

- *Trading* reflects the increased operating costs of trading under OFA.
- *Connection Evaluation* reflects the increased operational cost of assessing new network connections under OFA.
- *IT Maintenance/Support* relates to the increased costs of maintaining IT systems under OFA.
- *Legal* reflects costs for contract reviews, etc.
- *Corporate Strategy/Policy* reflects the cost of on-going reviews of the implications of OFA for the organisation, assessing and potentially modifying trading strategies etc.

The survey results for connection evaluation, legal and corporate strategy/policy were also used in the cost model results.

The extreme corporate strategy/policy costs in the medium complexity case are dominated by a single response. The responded was of the view that significant (and costly) reviews of risk management would need to be conducted on an on-going basis. Note that even if this survey cost were excluded from the cost model results, there are still some significant differences between the cost model predictions and the survey results.

Figure 7 shows the total five year costs broken down by implementation costs and operational costs.

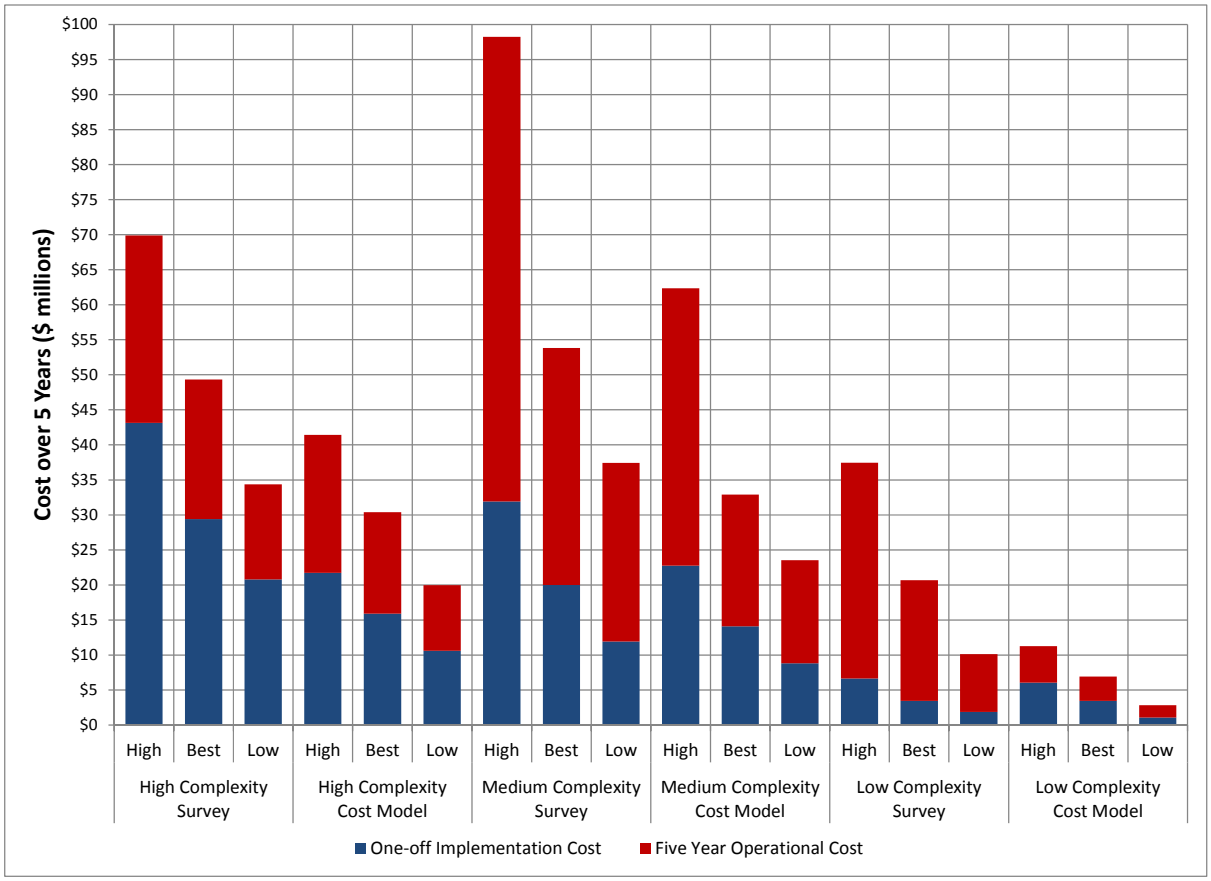

Figure 7 – Base Grouping Survey and Cost Model Five Year Results – All Participants

Table 5 combines the total implementation costs with the five-years of operating costs and aggregates these across the three complexity groups to give a number of alternative total market cost estimates.

Method	Survey	Cost Model
Low Cost Estimate	$81.3	$52.0
Best Cost Estimate	$120.8	$79.8
High Cost Estimate	$198.7	$128.5

Table 5 – Base Grouping Total Cost Estimates ($ million)

The base grouping cost model results imply costs in a range of approximately $50 to $130 million over five years, with a mid-range estimate of cost around $80 million. The survey based estimates are all slightly more than 50% greater than the corresponding cost model estimate. The primary driver for this difference is a number of responses which included cost estimates far beyond the cost model estimates. It is possibility that some of the survey respondents simply over-estimated costs.

Method	Survey	Capped Survey
Low Cost Estimate	$81.3	$61.2
Best Cost Estimate	$120.8	$75.7
High Cost Estimate	$198.7	$88.7

Table 6 – Impact of Capping Survey Cost Estimates ($ million)

Table 6 explores the impact of survey response cost over-estimation by capping survey responses – whether a low, best or high cost estimate - at the cost model high cost estimate applicable to that respondent. The capped results are more similar to the cost model results. Note that for a given participant the cost model high cost estimate is just the cap applied to survey participants so the cost model high cost estimate cannot be less than the capped survey result.

3.6. Alternate Grouping Results

The results presented thus far provide a range of cost estimates from low to high reflecting a number of different assumptions as to what it would take generators to implement and operate OFA functionality. However, all these results have been based on our estimation of the likely complexity level of the changes to a given participant's systems. These complexity estimates impact the results. If a participant is considered to require minor or low cost changes it could have been assigned to the low complexity group, but that participant might actually have responded to the survey in a manner which implies that it should be in a different group. Moving that participant between groups will impact the results. Cost model participant estimates for a given complexity group are multiplied by the number of participants in that group. Changing the group size will change the overall cost estimates. Similarly, the survey estimate s for a given complexity group apply the average estimate for that group to participants in that group who did not respond. Changing the number of respondents in the group will change the average.

This section provides some sensitivity testing of results by exploring an alternate assignment of participants to system change complexity groups. The assignment was changed by treating the respondent survey cost levels as the driver of system change complexity. For example, if in the base grouping a participant was classified as having low complexity system changes but its responses implied a cost over five years similar to the cost predicted by the cost model for a medium complexity system change then the participant was re-assigned as having a medium complexity.

Table 7 presents the statistics of the alternate grouping. A total of six respondents were reclassified.

Complexity	High	Medium	Low
Proportion of Participants	33%	29%	38%
Proportion in Group who Responded	100%	50%	50%

Table 7 – Statistics of Alternate Grouping

It is important to note that by definition this approach must reduce the variability of costs within a complexity grouping as we are re-grouping them based solely on cost. This does not mean that the predictions are necessarily better than the base groupings; it is simply an alternative way of grouping participants which gives a different result.

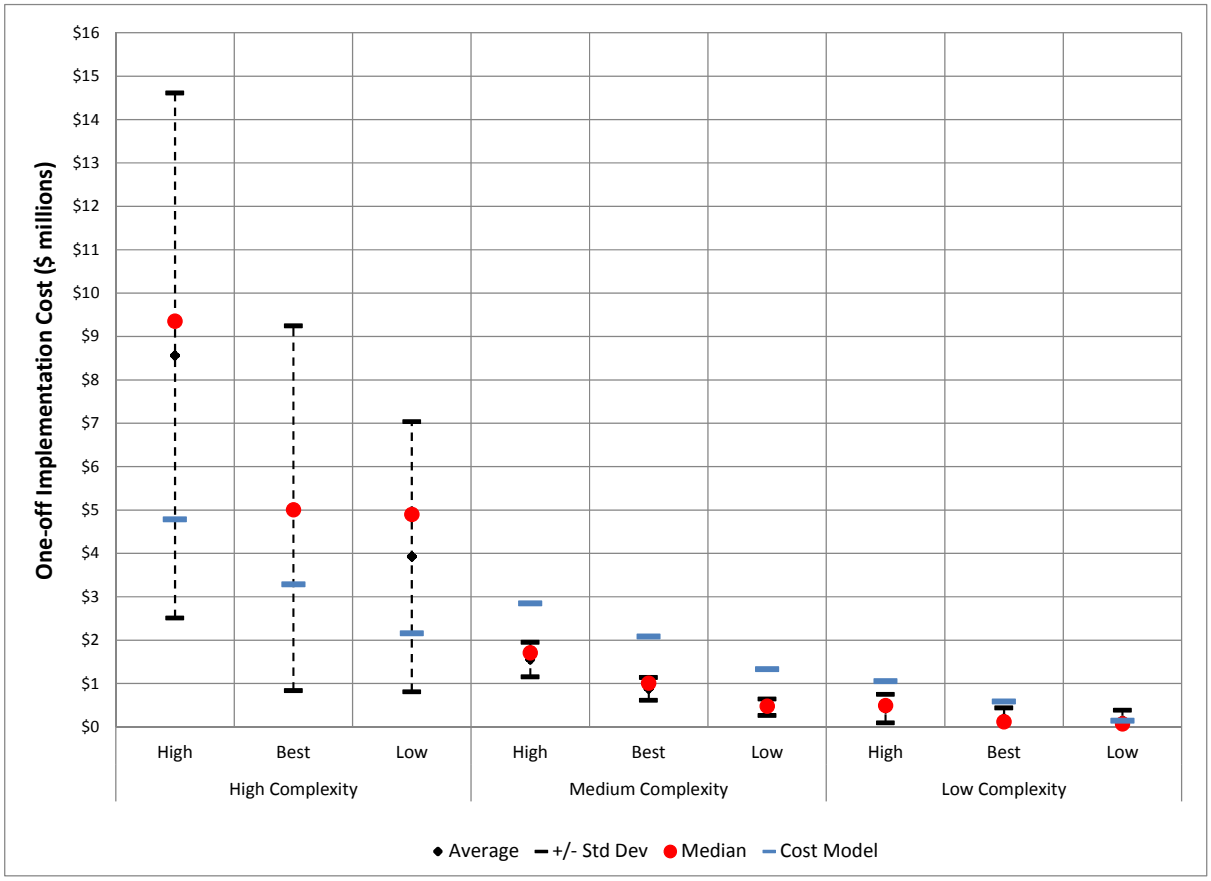

Figure 8 – Alternate Grouping Variability of Implementation Costs

As predicted, Figure 8 shows greatly reduced variability of implementation cost within each complexity grouping. Not only has the range of variation decreased but the median and average values are better aligned. For the medium and low complexity cases the average and standard deviation have both dropped sufficiently that the cost model solution is not within one standard deviation of the average. Generally the cost model estimate of cost is greater than respondent costs for the medium and low complexity case but the high complexity responses are still significantly higher than implied by the cost model. This is not unexpected. An extreme high outlier survey cost response for a participant with a base grouping of medium or low complexity can be moved to the high complexity case, reducing the variability in the medium and low complexity groups. However, an extreme high outlier survey cost response in the high complexity group cannot be removed from that group as it is the highest cost group.

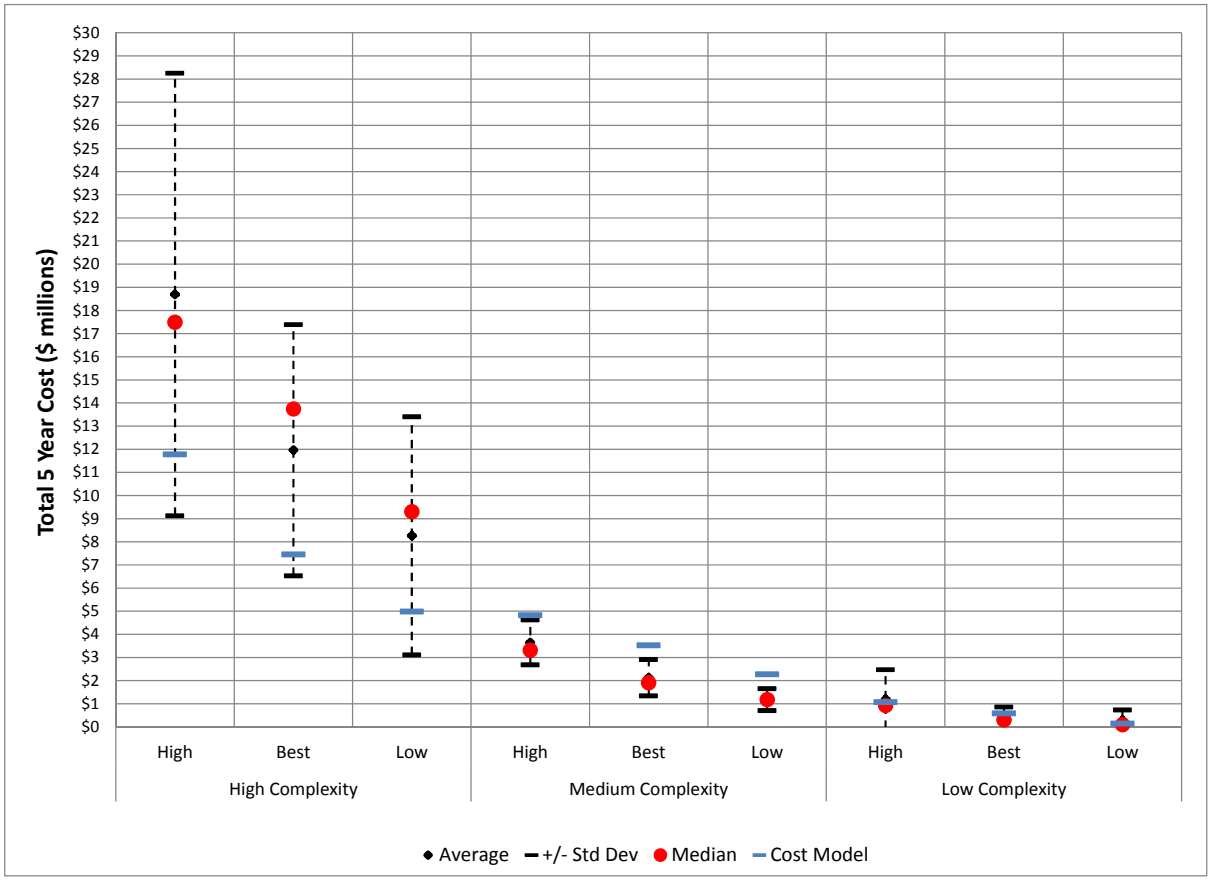

Figure 9 – Alternate Grouping Variability of Total Costs over Five Years

Similar trends to those in Figure 8 are visible in Figure 9 for the case of total costs over five years.

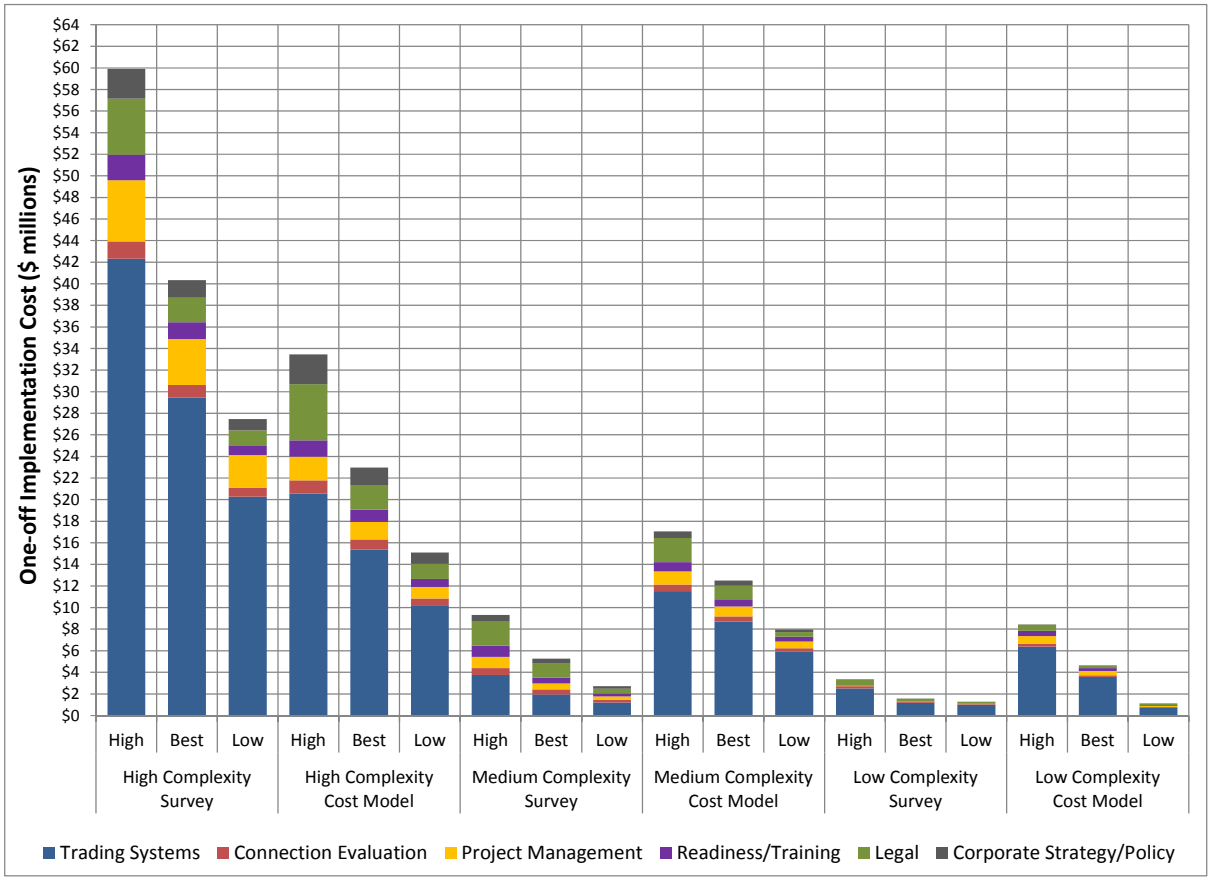

Figure 10 – Alternate Grouping Survey and Cost Model Implementation Cost Results – All Participants

It is apparent from Figure 10 that the cost model now predicts higher implementation costs than the survey results for medium and low complexity cases. It still predicts lower implementation costs for the high complexity case but this is not unexpected as more responses with costs exceeding any cost model prediction have been moved to this group.

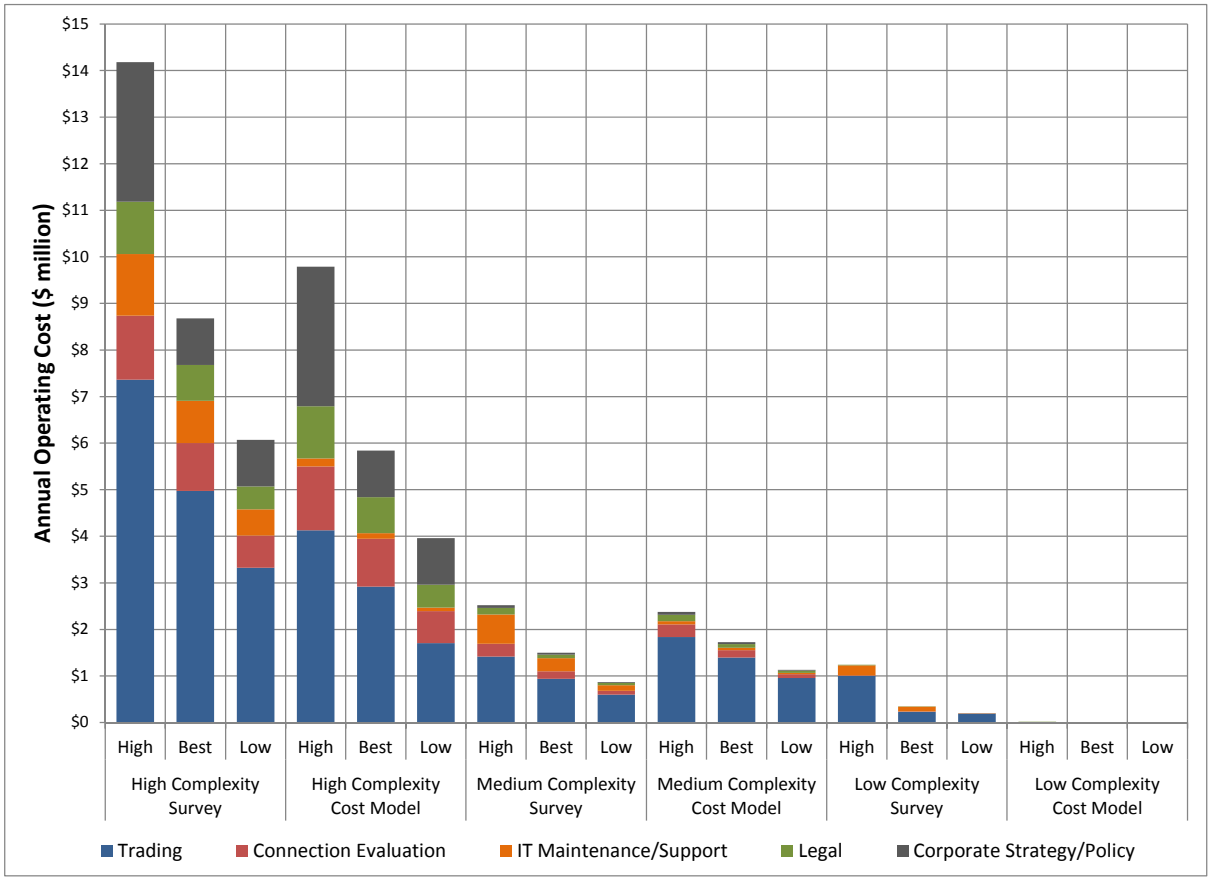

Figure 11 – Alternate Grouping Survey and Cost Model Annual Operating Cost Results – All Participants

Figure 11 shows reasonable alignment between the cost model and survey annual operating cost results for the medium and low complexity cases. The extreme corporate strategy/policy cost result now appears in the high complexity results.

Figure 12 shows the total five year costs derived with the alternate grouping.

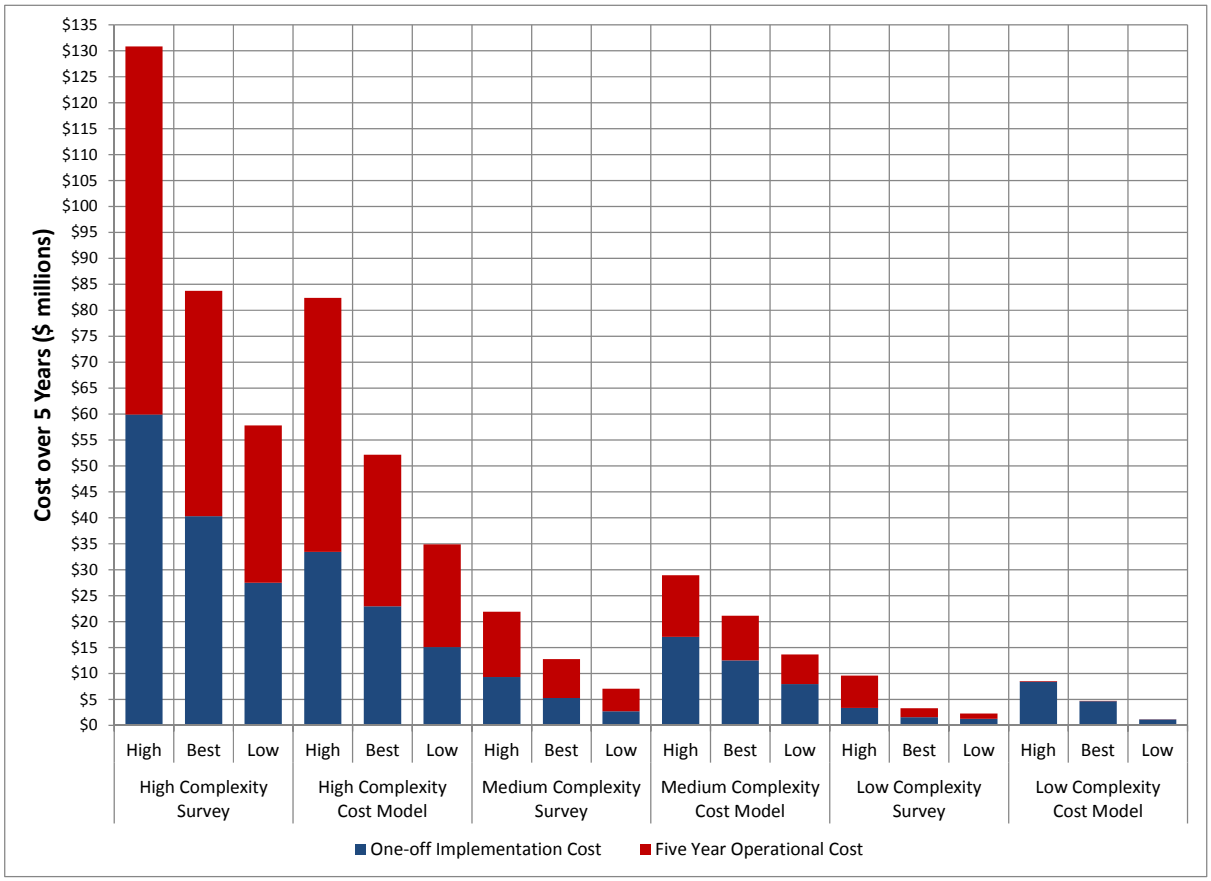

Figure 12 – Alternate Grouping Survey and Cost Model Five Year Results – All Participants

Table 8 combines the total implementation costs with the five-years of operating costs and aggregates these across the three complexity levels based on the alternate grouping to give a total market cost estimate.

Method	Survey	Cost Model
Low Cost Estimate	$67.2	$49.7
Best Cost Estimate	$99.8	$78.0
High Cost Estimate	$162.3	$119.9

Table 8 – Alternate Grouping Total Cost Estimates ($ million).

Relative to the base grouping the cost model results are not significantly changed. This is because the reclassification of participants did not cause the total participant numbers in each complexity group to change significantly. The numbers for the survey results differ from those in the base grouping because of the effects of participants that did not respond. With a shift of high cost responses from the medium complexity case to the high complexity case a major driver for change to the survey results is the lowering of the average cost applied to medium complexity participants who did not respond.

4. Conclusions

The cost estimates are summarised in Table 9. These represent total implementation costs plus five years of operating costs. A discount factor of one (1) was assumed and currency values are in 2014 dollars.

	Base Grouping		*Alternate Grouping*	
Method	**Survey**	**Cost Model**	**Survey**	**Cost Model**
Low Cost Estimate	$81.3	$52.0	$67.2	$49.7
Best Cost Estimate	$120.8	$79.8	$99.8	$78.0
High Cost Estimate	$198.7	$128.5	$162.3	$119.9

Table 9 – Summary of Results ($ million).

Drawing results from both complexity groupings, and favouring the most extreme values, the cost model implies a cost range of approximately $50 million to $129 million with a best estimate of approximately $79 million. The survey results are more variable though the most extreme values in the table imply a cost range of $67 million to $199 million. The survey best estimate might be taken to be $121 million, being a conservatively high value in the context of a cost benefit assessment. It should be noted, though, that it was observed – using the base grouping - that capping a survey respondents cost over five years to not exceed the cost model high cost estimate of that value gave total costs ranging from a low estimate of $61 million to a high estimate of $89 million with a best estimate around $76 million.

Market Reform views the OFA implementation as being similar to a single market "product" implementation in the realm of an existing wholesale market – requiring an incremental change to existing capabilities (e.g. requiring changes to the existing ERTM system, not implementation of an entirely new one). Depending on the complexity grouping used and its impact of costs taken from the survey, the cost model's high estimate of implementation costs is in the $4 to $5 million range for a single participant. In contrast, a small number of respondents gave best estimates of the one-off costs of implementing OFA in the region of $10 million and high estimates exceeding $18 million.

It is interesting to observe that of the 14 responses, three stated best estimates of cost which implied that each year they would need to recover more than $1,000 per MW of NEM registered capacity to recover their cost of implementing OFA. The median level of required revenue was closer to $550 per MW per year and a number of respondents would have required less than $100 per MW per year.

It is insightful to consider the survey responses in the context of some recent projects in which Market Reform has been involved in the United States.

- The implementation of an (ETRM platform to support front, middle and back office functions for gas supply, gas distribution, financial and physical power of a major public utility was done in the course of two years at a total cost of approximately US$ 24 million, inclusive of hardware and licensing, consulting and internal resources.
- A proposed implementation of an ETRM platform to support the management, compliance and settlement of hundreds of structured power contracts, with complex payment calculation and performance scenarios for various types of generation facilities and contract terms, is estimated at US$ 12 million, inclusive of hardware and licensing, consulting and internal resources.

In both cases these implementations included integration to legacy upstream and downstream internal systems, as well as interfaces to external market data. The scope and complexity of these projects would in our view conclusively rate higher than the incremental change required for the implementation of OFA.

It is not possible for us to make definitive statements about what costs a participant would actually be exposed to, though it does seem that some of the higher survey cost estimates may reflect much more than an incremental system change. It is also conceivable that some of the costs that respondents associated with OFA may to some degree be incurred anyway, e.g., through periodic reviews of risk management strategies.

Appendix A – Summary of OFA

The following is a broad summary of the market design impact of OFA that was provided to survey respondents.

It is intended to serve solely as an aid in responding to this survey. For a definitive discussion of these matters, readers should refer to the OFA market design documentation published by AEMC.

- All generators will continue to be settled at their regional reference price, as they are today.
- Scheduled and semi-scheduled generators will be impacted by OFA.
  - ⇒ Generators may choose to purchase firm access.
    - To the extent that a generator's output is not covered by firm access, and constraints force it to be backed off, it receives its local price – by paying out the difference between the regional reference price and the local price (i.e., the market value of the transmission constraint) to a generator that has firm access.
    - To the extent that a generator with firm access is constrained off, it will receive the difference between the local price and the regional reference price (i.e. the market value of the transmission constraint).
    - In each case the generator will settle these compensation payments through AEMO's settlement system. Settlement will operate to the same half-hour timeframe as the energy market.
  - ⇒ Ideally, the non-firm generator payments will fund payments to firm generators, though to the extent that limitations in predicting available capacity result in shortfalls, payments to firm generators may be reduced.
- Firm access will be a financially-settled product with a defined quantity, location and duration.
  - ⇒ Intra-regional firm access products are defined from a generator connection point to the reference node in the same NEM region.
  - ⇒ Inter-regional firm access products are defined between reference nodes in different NEM regions.
  - ⇒ Access settlement will be based on 'flowgates', which are defined dynamically as points on the network where network congestion occurs during the dispatch process. These are represented by transmission constraints in the NEM Dispatch Engine. While this model will be relevant to a generator's valuation of firm access, knowledge of it is not required to use firm access.
- Generators will be able to procure firm access in three ways:
  - ⇒ Intra-regional long-term access: will be procured from a TNSP, and may require that the TNSP build capacity. A regulated access pricing process will define the costs, though these will vary with the details of the access arrangements. Settlement of these access charges will be between the generator and the TNSP.
  - ⇒ Inter-regional long-term access: will be procured by market participants through a AEMO-run auction, and would require the relevant TNSPs to provide the cleared level of capacity. A regulated access pricing process would define the costs.
  - ⇒ Short-term access (out to 3 years) for both inter-regional and intra-regional access: will be procured through a periodic NEM auction (allowing holders of access, both TNSPs and generators, to sell surplus capacity); or by trading access bilaterally (with TNSP approval). Settlement will be conducted through AEMO as central counter-party. [While not finalised, it should be assumed that when a generator sells through this arrangement its access right is assigned to the buyer so that the seller no longer has any obligations to pay a TNSP for that right].
- TNSP's will have financial incentives to maintain the availability of firm access.

- A TNSP's revenue allowance would reflect its expenditure required to meet both the firm access and reliability standards. TUoS revenue = network aggregate annual revenue requirement – forecast firm access revenue.
- A transitional arrangement will exist with generators initially awarded firm access based on some reflection of past usage, with these transitional instruments being sculpted to decline over time.

Note that:

- The pricing model used by TNSPs to value access will be made available to participants.
- It is intended that TNSPs will produce regular planning reports which will provide information on the capacity availability and utilisation.
- The AER will be given additional roles and responsibilities to oversee this activity.
- AEMO data on constraint congestion will be made available in real-time.

Appendix B – Impacted Capabilities

The following table lists operational capabilities that could potentially be impacted by OFA. It is recognised that every generator is different in its processes, and the way it structures its organisation – some organisations will have impact in only some of those areas, while others may have impact in additional areas not identified. Each impacted capability could have implications for:

- Systems: including changes to application software, hardware and infrastructure software, networks, etc., and ongoing operation of any new applications and infrastructure.
- Business processes: including definition and implementation of process changes, and ongoing operation of new processes, including manual and semi-automated processes (e.g. use of spreadsheet models, etc.).
- People: both from an implementation (e.g. training of staff, hiring of new personnel) and operations (e.g. ongoing staff cost) perspective.

Capability Area	Potential Capability Impacts	
Trading Front Office – pre-trade, trade execution and post-trade deal capture	Market data management	Need to track results of transmission access auctions, and develop forward curve to support pre-trade analytics.
	Models for pricing and valuation	Need methodology to determine what value to place on access and: • strategy for acquiring long-term intra-regional capacity in bilateral negotiations with TNSP • strategy for participating in auctions for short-term intra-regional capacity, as a buyer or seller • strategy for participating in auctions for inter-regional capacity, as a buyer or seller.
	Spot market bidding strategies	NEM energy market is unchanged. However, OFA may impact the value placed on bids/offers.
	Bid/offer submission for new auctions	Need to interface with new auction process for short-term transmission access – both intra- and inter-regional. Decommission old settlement residue auction processes/systems.
	Deal capture	Will require templates to track intra-regional and inter-regional access trades in the deal capture system.
	Forward market strategies	OFA will require evaluation, and potentially modification, of hedging/forward trading strategies.
Trading Mid Office – risk management and controls	Portfolio management and valuation	Need to consider new transmission products within portfolio valuation (potentially including the option to shift access within a portfolio).
	Risk reporting	Need to include new transmission products within risk reporting

Capability Area	Potential Capability Impacts	
Trading Back Office – settlement and reporting	Settlement – TNSP	Access charge settlement associated with purchasing access directly from the relevant TNSP.
	Settlement – AEMO	Access settlement via AEMO for: • Purchase of intra-regional and inter-regional access rights in the AEMO-operated auction. • Compensation associated with holding or not holding access rights.
	Shadow settlement	Modification of shadow settlement systems for verification of charges.
	Reporting	Modifications to management and regulatory reporting, as well as potentially to third-parties (e.g. AFMA).
New asset development	Transmission connection evaluation	Modified processes for evaluating the value of transmission access for potential new assets, and negotiating with TNSPs to secure access.
IT Administration	Maintenance and support	Ongoing maintenance and support of new and/or modified applications, and any additional required infrastructure.

As can be seen from the table above, the bulk of identified capability impacts are associated with the various stages of the trading process.

Other areas of potential cost, not directly driven by operational capability, include

Cost Category	Potential Impact
Legal (and Market Policy)	Changes to vesting contracts and other pre-existing contracts (where such contracts provide for re-opening in the event of substantial market design change). Note: does not apply to standardised contracts such as futures.
Project Management	Project management of the implementation programme.
Readiness	Participant's monitoring and coordination of its own readiness. Participation in market readiness programme, including potentially a Market Trial of the new arrangements
Corporate Strategy/Policy	Evaluate impacts on corporate policies and or strategy (e.g. in such areas as hedging and new investment). Promulgate recommended changes through management and board.