CIRs For ELCC Resources:
Cost Assessment Of Potential Impacts To PJM Load Customers Of Solution Packages

Discussion Topics

1. Revised transmission cost estimates
2. Transitional costs to load
   - Transmission
   - Capacity
3. Next Steps

Revised Transmission Cost Estimates
CIR/ELCC Future Study

- 2021 Offshore Wind Transmission Study stated that the transmission cost to support state RPS would be on the order of $2-3B based on current generator deliverability test (summer, winter and light load)
- CIRs for ELCC Resources future scenario study (active queue projects and their commercial probabilities) stated that the transmission cost would be on the order $11-14B
  - $11B based on the current generator deliverability test with existing CIRs (summer only)
  - $14B based on the proposed generator deliverability test with higher CIRs (summer only)

Revised Transmission Cost Estimates
CIR/ELCC Future Study

- The transmission cost estimate from the CIR/ELCC study was intended to provide a ballpark idea of the transmission upgrade costs using the new generator deliverability test
  - Assumptions to estimate costs were overly conservative
  - Results were not intended to provide a cost estimate to meet state RPS

Revised Transmission Cost Estimates
CIR/ELCC Future Study

- PJM Planning's initial investigation into the cause of the large cost estimate difference revealed two primary reasons for the differences
  - The CIR/ELCC study assumed a higher generation amount and geographically different profile than the offshore wind study
  - The CIR/ELCC study assumed that transmission overloads associated with terminal equipment, line fault with stuck breaker contingencies and bus faults would require either reconductoring or rebuilding the circuit, whereas the offshore wind study assumed these costs would be insignificant relative to the other transmission costs, which is the standard assumption PJM uses in long-term, informational scenario studies

Wind & Solar Study Comparison

Offshore Wind Study Nameplate MW

	PJM South	PJM West	PJM East	Total
Onshore Wind	730	12,005	1,795	14,530
Offshore Wind	5,200	0	9,216	14,416
Non-BTM Solar	14,516	2,343	8,622	25,481
Storage	3,100	1,158	2,933	7,191
	23,546	**15,506**	**22,566**	**61,618**

CIR/ELCC Study Nameplate MW

	PJM South	PJM West	PJM East	Total
Onshore Wind	777	14,799	2,482	18,058
Offshore Wind	2,873	10	4,975	7,858
Non-BTM Solar	13,230	25,028	8,256	46,515
Storage	1,102	1,845	1,602	4,550
	17,983	**41,683**	**17,315**	**76,981**

Revised Transmission Cost Estimates For Future Queue Scenario Study

- PJM Planning has developed revised cost estimates for the CIR/ELCC study using the more realistic assumptions related to circuit reconductor/rebuilds
- The revised estimates now show that the transmission upgrade cost for the CIR/ELCC study may range from $4.7-$6.7B
  - $4.7B based on the current generator deliverability test with existing CIRs
    - $29M increase with higher CIRs alone
    - Net savings with new summer generator deliverability test alone
  - $6.7B based on the proposed generator deliverability test when combined with higher CIRs for wind and solar resources with an ISA
- See Appendix 1 for two extreme examples of the cost estimate revision

Revised Transmission Cost Estimates
CIR/ELCC Future Study

- Note that the $2B increase is driven by the combination of several factors:
  - The assumption of which queue projects in Fast Track and Transition Cycle 1 will move forward
  - The new summer generator deliverability test
  - Higher CIRs for existing and ISA wind and solar resources

Revised Transmission Cost Estimates
CIR/ELCC Future Study

- When the new summer generator deliverability test and the higher CIRs for existing and ISA wind and solar resources are considered separately from one another, they do not result in a significant transmission cost increase (~ $29M as highest individual impact)
- The reason for the large cost increase when combining the two changes is that the new generator deliverability test supports much more expansive wind and solar dispatches than are allowed under the old generator deliverability test

Key Takeaways From Review

- PJM's original estimate of $11B as the cost to integrate the future queue scenario used overly conservative assumptions and a more realistic estimate is $4.7B
- The additional long-term RTEP transmission costs, after all queue projects through the AG1 queue either move forward or drop out, to support higher CIRs for wind and solar resources that have an ISA today under the new generator deliverability test are estimated to be $2B

PJM Package: Transitional Costs To Load Customers

- In order to grant wind and solar resources with an ISA higher CIRs and maintain their current accredited UCAP under the PJM package, load will both face near-term and long-term transmission costs
  - The near-term transmission costs to support higher CIRs in the RTEP are estimated to be $7M (without Fast Track and Transition Cycle 1 units)
  - The additional long-term RTEP transmission costs to support higher CIRs under the new generator deliverability test after wind and solar resources through the AG1 queue either sign ISAs at their current CIR levels or withdraw from the queue are estimated to be on the order of $2B
- PJM is exploring opportunities to rebalance the $2B cost between load and generation

LS Power & E-Cubed Packages: Transitional Costs To Load Customers

- PJM estimates that there would be ~1,300 MW reduction in UCAP for wind and solar units with an ISA that would result by capping these resources at their current CIR level in the ELCC studies
  - See 5/19 special PC informational posting for CIR Impact On Wind & Solar UCAP Values
- PJM performed a 2022/23 BRA sensitivity simulation of the removal of 1,300 MW of wind and solar UCAP across the RTO and determined that the incremental cost to load of replacing this UCAP would be on the order of $230M for one year
- If the transition period for these resources to obtain higher CIRs is five years, as would be the case under LS Power & E-Cubed packages, then PJM estimates costs to load based on the 2022/23 BRA sensitivity simulation would be on the order of $1.1B for the transition period alone

Cost Comparison Of Solution Packages: Transitional Costs To Load Customers

- Considering both the transmission and capacity market costs over the estimated five year transition period, the PJM package reflects a net $0.9B cost to load (considering avoidance of $1.1B capacity costs)
  - Expected energy market savings under PJM package not considered
  - Expected additional headroom value not accounted for
- The long-term benefits of the PJM package were not quantified but are expected to be manifold due to the increased CIRs and access to wind and solar provided by the $2B transmission

Package Sponsor	Transitional Costs ($B)		
	Transmission	Capacity	Net
PJM	$2.0	$0.0	$2.0
LS Power	$0.0	$1.1	$1.1
E-Cubed	$0.0	$1.1	$1.1

Next Steps

- July special PC session on CIRs For ELCC Resources
- First read of solution packages and revised generator deliverability procedures at August PC (too be determined)
- Current approval schedule still supports
  - Implementation of new CIR rules in 2025/26 BRA scheduled for June 2023
  - Implementation of revised generator deliverability procedure in 2023 RTEP

Appendix 1: Extreme Cost Estimate Revision Examples

Extreme Cost Estimate Revision Examples

- Example 1: A 91 mile, 765 kV line exceeded the rating in the power flow model and the original estimate was to reconductor the line at $726M
  - It was subsequently determined that the rating for this line was limited by terminal equipment and therefore the costs to remove the terminal equipment limitation would be insignificant relative to the overall transmission cost estimates identified in the CIR/ELCC study

Extreme Cost Estimate Revision Examples

- Example 2: A 73 mile, 765 kV line exceeded the rating in the power flow model and the original estimate was to reconductor the line at $584M.
  - It was subsequently determined that the contingency for this line overload was driven by a stuck breaker and therefore the costs to resolve the overload would most likely involve installing an additional breaker and the associated costs would be insignificant relative to the overall transmission cost estimates identified in the CIR/ELCC study

Appendix 2: Long-Term Transmission Costs To Load Example

Transmission Costs To Load Customers

- Example of long-term transmission cost:
  - A 100 MW MFO wind unit with ISA transitions from 13 to 38 MW CIRs and is studied in 2023 RTEP
  - A second 100 MW MFO wind unit in Transition Cycle 1 requests 13 MW CIRs at same location and it is studied under old RTEP assumptions along with the 13 MW CIRs from the first wind unit for a total of 26 MW CIRs at this location
  - In Transition Cycle 2, the higher CIRs for the first wind unit are introduced and there are now 51 MW at this location, which haven't been studied before and may ultimately require a baseline upgrade once the second wind unit signs an ISA

Appendix 3: CIR/ELCC Study Summer Violation Comparison

Summer Violation Comparison

- Tables in this appendix refer to the two methods of determining summer overloads in the CIR/ELCC future queue scenario study of interconnection requests through the AG1 queue
  - Status Quo: Use current generator deliverability and CIRs
  - New Sum Sensitivity: Use new generator deliverability and higher CIRs for existing and ISA wind and solar units
- Both methods do not consider overloads driven by terminal equipment limitations or contingencies involving line fault with stuck breakers and bus faults

# Summer Overloads	Status Quo	New Sum Sensitivity
Single	76	149
Tower	99	42
Total	175	191

Summer Violation Comparison

Violations Under Status Quo

KV	PJM East	PJM West	PJM South	Total
500	1	0	9	10
345	0	40	0	40
230	19	0	47	66
138	2	21	2	25
115	8	0	12	20
765/345	0	1	0	1
500/230	0	0	3	3
345/138	0	3	0	3
230/115	1	0	5	6
138/69	0	0	1	1
115/69	0	0	0	0
Total	31	65	79	175

Violations Under New Sum Sensitivity

KV	PJM East	PJM West	PJM South	Total
500	3	0	13	16
345	0	58	0	58
230	13	0	67	80
138	0	12	1	13
115	2	0	9	11
765/345	0	1	0	1
500/230	2	0	5	7
345/138	0	1	0	1
230/115	0	0	2	2
138/69	0	0	0	0
115/69	0	0	2	2
Total	20	72	99	191

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