



Delta Method – Step-by-Step Guide

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Delta Method – Step by Step – Illustrative Example

Classes	Penetration Level (MW Nameplate or ICAP) Year X
C1	15,000
C2	30,000
C3	5,000
TOTAL	50,000

Delta Method – Step by Step – Portfolio ELCC

Classes	Penetration Level (MW Nameplate or ICAP) Year X
C1	15,000
C2	30,000
C3	5,000
TOTAL	50,000

ELCC Model calculates Portfolio ELCC.

Portfolio ELCC is equal to 16,000 MW or 32% (16,000 MW / 50,000 MW)

Delta Method – Step by Step – Last-In ELCC

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC
C1	15,000	10%
C2	30,000	30%
C3	5,000	20%
TOTAL	50,000	

Last-In ELCC values are calculated by adding an increment of X MW of the class under examination in the presence of all other classes (for instance, for Last-In ELCC of C1, portfolio has 15,000 + X MW of C1, 30,000 MW of C2 and 5,000 MW of C3)

Delta Method – Step by Step – First-In ELCC

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC
C1	15,000	10%	20%
C2	30,000	30%	50%
C3	5,000	20%	100%
TOTAL	50,000		

First-In ELCC values are calculated by adding an increment of X MW of the class under examination in the absence of other classes
(for instance, for First-In ELCC of C1, portfolio has X MW of C1, 0 MW of C2 and 0 MW of C3)

Delta Method – Step by Step – Delta ELCC

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)
C1	15,000	10%	20%	-10%	-1,500
C2	30,000	30%	50%	-20%	-6,000
C3	5,000	20%	100%	-80%	-4,000
TOTAL	50,000				-11,500

Delta ELCC % = Last-In ELCC – First-In ELCC

Delta ELCC MW = Delta ELCC % x Penetration Level

In this example, each Delta ELCC value is an estimate of a class’s reliability value reduction when all classes interact in the portfolio. The Total Delta ELCC (-11, 500 MW) is an estimate of the portfolio’s total reduction in reliability value (as measured by adding up the individual class reductions)

Delta Method – Step by Step – PDI

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)
C1	15,000	10%	20%	-10%	-1,500
C2	30,000	30%	50%	-20%	-6,000
C3	5,000	20%	100%	-80%	-4,000
TOTAL	50,000				-11,500

Let's recall that the Portfolio ELCC was 16,000 MW. If we were to calculate the Portfolio ELCC using the First-In ELCC values, the Portfolio ELCC would be 23,000 MW. This means that due to the interaction of the classes the portfolio loses 7,000 MW in value (this is the Portfolio Diversity Interaction, PDI).

These 7,000 MW need to be subtracted from the First-In ELCC values. We will use the Delta ELCC % and the Delta ELCC (MW) values to accomplish this.

In this example, PDI **is** the reduction in the portfolio's reliability value relative to the First-In ELCC values (while Total Delta ELCC is just an estimate)

Delta Method – Step by Step – PDI Share

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)	Share Delta ELCC of Total Delta ELCC	PDI Share (MW)	PDI Share as % of Penetration Level
C1	15,000	10%	20%	-10%	-1,500	13%	-913.0	-6%
C2	30,000	30%	50%	-20%	-6,000	52%	-3,652.2	-12%
C3	5,000	20%	100%	-80%	-4,000	35%	-2,434.8	-49%
TOTAL	50,000				-11,500		-7,000	

Share Delta ELCC of Total Delta ELCC is self-explanatory. It measures the contribution of each class to the total reduction in portfolio value (calculated by adding up the individual class reductions) PDI Share is the share of the PDI value allocated to each class based on the Share Delta ELCC of Total Delta ELCC values.

PDI Share as % of Penetration Levels is self-explanatory

Delta Method – Step by Step – Final ELCC

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)	Share Delta ELCC of Total Delta ELCC	PDI Share (MW)	PDI Share as % of Penetration Level	Final ELCC
C1	15,000	10%	20%	-10%	-1,500	13%	-913.0	-6%	14%
C2	30,000	30%	50%	-20%	-6,000	52%	-3,652.2	-12%	38%
C3	5,000	20%	100%	-80%	-4,000	35%	-2,434.8	-49%	51%
TOTAL	50,000				-11,500		-7,000		

The Final ELCC value is calculated as the First-In ELCC minus the PDI Share as % of Penetration Level value.

The Final ELCC value captures by how much the First-In ELCC value must decrease based on how well/poorly each class interacts with all the other classes.

These Final ELCC values also ensure that the Portfolio ELCC value is met:

$$14\% \times 15,000 + 38\% \times 30,000 + 51\% \times 5,000 = 16,000 \text{ MW}$$

Delta Method – Step by Step – New Portfolio

Previous Portfolio

New Portfolio

Classes	Penetration Level (MW Nameplate or ICAP) Year X
C1	15,000
C2	30,000
C3	5,000
TOTAL	50,000

Classes	Penetration Level (MW Nameplate or ICAP) Year X
C1	20,000
C2	50,000
C3	8,000
TOTAL	78,000

ELCC Model calculates Portfolio ELCC

Portfolio ELCC is equal to 16,000 MW or 32% (16,000 / 50,000)

ELCC Model calculates Portfolio ELCC

Portfolio ELCC is equal to 19,500 MW or 25% (19,500 / 78,000)

Overall, the new portfolio has a lower % ELCC (25%) because there are many more ELCC resources in it.

Delta Method – Step by Step – Final ELCC New Portfolio

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)	Share Delta ELCC of Total Delta ELCC	PDI Share (MW)	PDI Share as % of Penetration Level	Final ELCC
C1	20,000	10%	20%	-10%	-2,000	10%	-1,813.5	-9%	11%
C2	50,000	25%	50%	-25%	-12,500	65%	-11,334.2	-23%	27%
C3	8,000	40%	100%	-60%	-4,800	25%	-4,352.3	-54%	46%
TOTAL	78,000				-19,300		-17,500		

Assuming that the First-In ELCC values do not change, the Total Delta ELCC (-19,300 MW) and the Total PDI (-17,500 MW) are more negative than in the Previous Portfolio. This is mainly because the the Portfolio ELCC % has dropped from 32% to 25%.

C2's Last-In value has decreased to 25% (from 30%), therefore it is straightforward to understand why its Final ELCC has dropped to 27% (from 38%). The decrease in Final ELCC value is more pronounced than the decrease in Last-In value because the overall Portfolio has a lower ELCC %.

Delta Method – Step by Step – Final ELCC New Portfolio

Classes	Penetration Level (MW Nameplate or ICAP) Year X	Last-In ELCC	First-In ELCC	Delta ELCC (%)	Delta ELCC (MW)	Share Delta ELCC of Total Delta ELCC	PDI Share (MW)	PDI Share as % of Penetration Level	Final ELCC
C1	20,000	10%	20%	-10%	-2,000	10%	-1,813.5	-9%	11%
C2	50,000	25%	50%	-25%	-12,500	65%	-11,334.2	-23%	27%
C3	8,000	40%	100%	-60%	-4,800	25%	-4,352.3	-54%	46%
TOTAL	78,000				-19,300		-17,500		

C3's Last-In value has increased to 40% (from 20%). However, its Final ELCC has dropped to 46% (from 51%). This occurs because the decrease in the Portfolio ELCC (from 32% to 25%, as mentioned earlier) outweighs the increase in C3's Last-In value. An even higher Last-In value for C3 could have potentially triggered an increase in C3's Final ELCC.

A similar explanation applies to C1, which has a constant Last-In value but still sees a decrease in Final ELCC.

- Compared to other heuristics, the Delta Method is a good heuristic to allocate the Portfolio ELCC to each ELCC Class because
 - It is intuitive.
 - It balances concerns related to the performance of the entire ELCC Portfolio and those related to the performance of each individual ELCC Class.
- Classes whose Last-In ELCC values tend to decrease as the classes' penetration level increase will see reductions in their Final ELCC values
- Classes whose Last-In ELCC values remain identical or increase as the classes' penetration level increase have the possibility of seeing increases in their Final ELCC values (if the overall Portfolio ELCC % has not decreased significantly)

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