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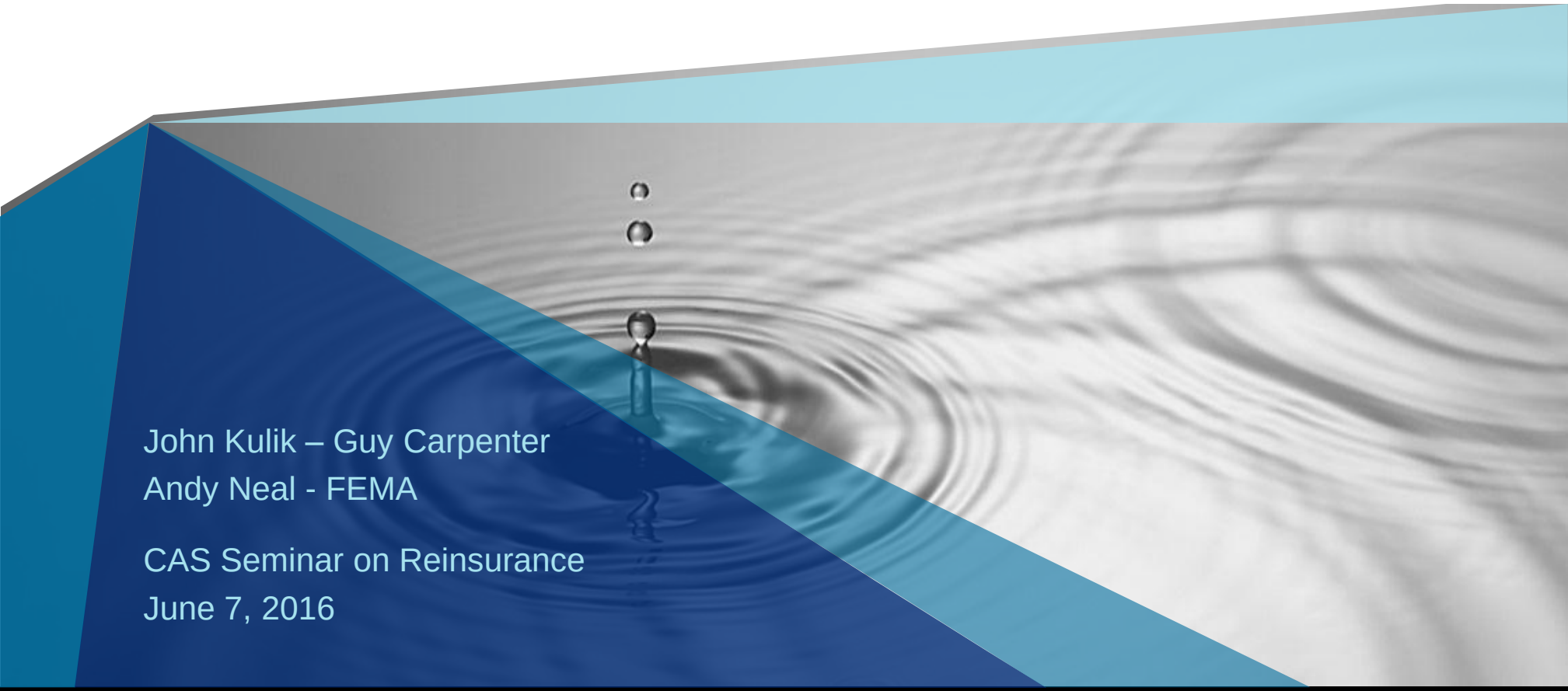
GUY CARPENTER

FEMA

NATIONAL FLOOD INSURANCE PROGRAM

National Flood Insurance Program – Update
Initial Steps Toward Sharing US Flood Risk with the Private Sector



John Kulik – Guy Carpenter
Andy Neal - FEMA

CAS Seminar on Reinsurance
June 7, 2016

MARSH & McLENNAN COMPANIES

OUTLINE

1 LOSS MODELING

- Estimation of Non-Modeled Loss Distributions
- Modeled loss Distributions
- Ensemble Model: NFIP View of Risk

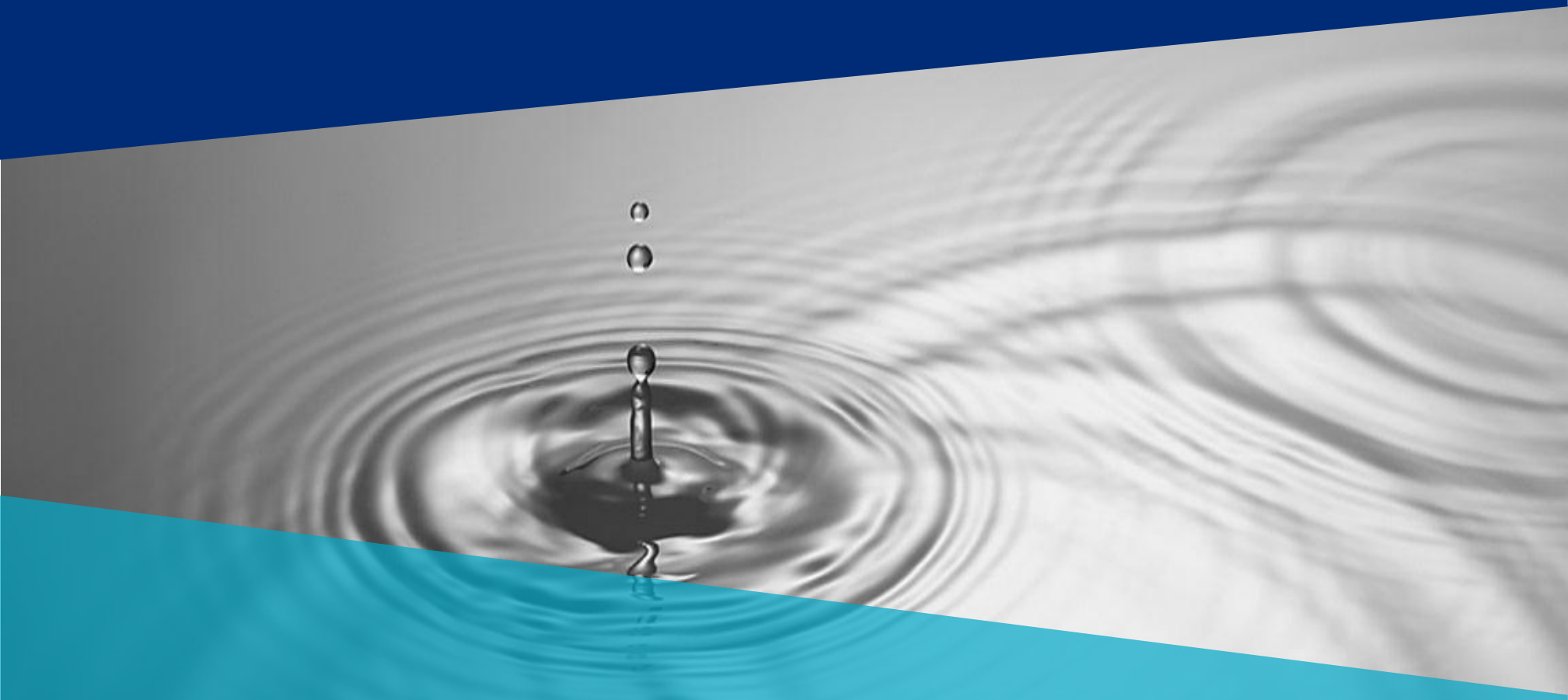
2 NFIP Financials: Stochastic Forecasts

- Revenue, Expense, and Loss Assumptions
- Projected Income Statement Means
- Projected Surplus Distributions

3 EVALUATING REINSURANCE

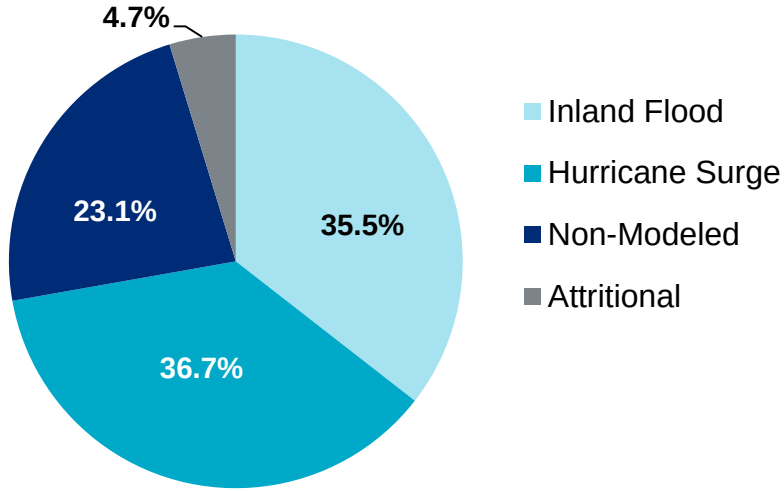
- Short Term Analysis
- Long Term Analysis

1 LOSS MODELING

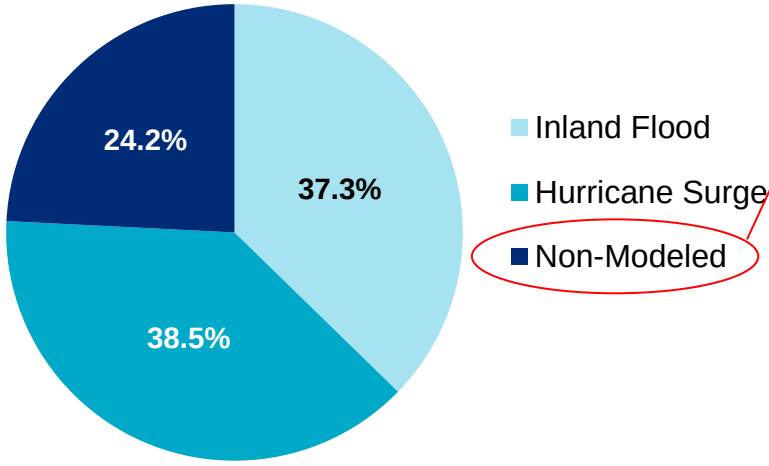


Historical NFIP Claims
By Peril / Type – net of deductibles

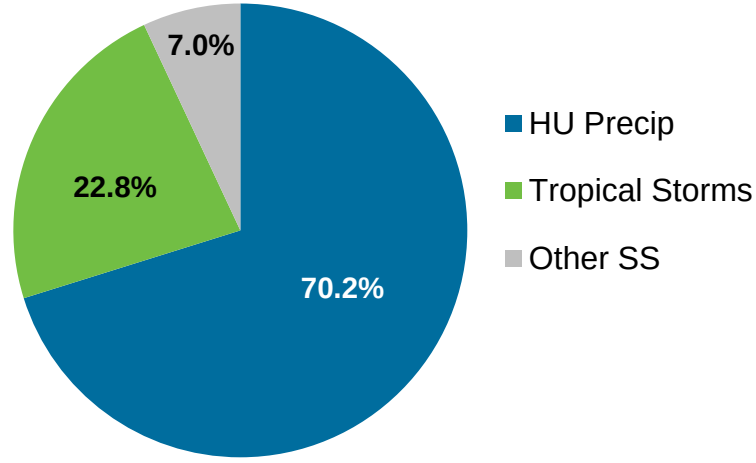
Attribution of NFIP Historical Losses by Peril (+ Attritional)



Attribution of NFIP Historical Losses by Peril (ex Attritional)

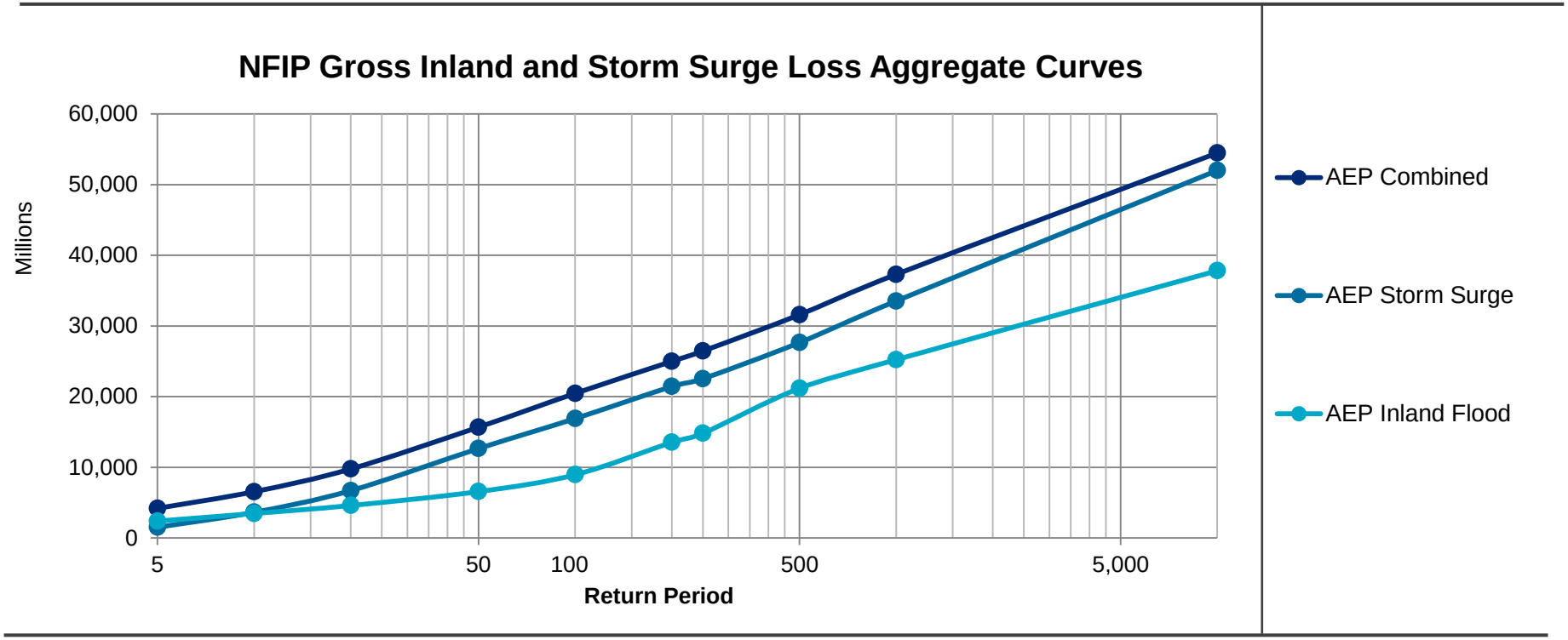


Attribution of Non-Modeled NFIP Historical Losses by Peril



Modeled Perils
NFIP Storm Surge and Inland Flood

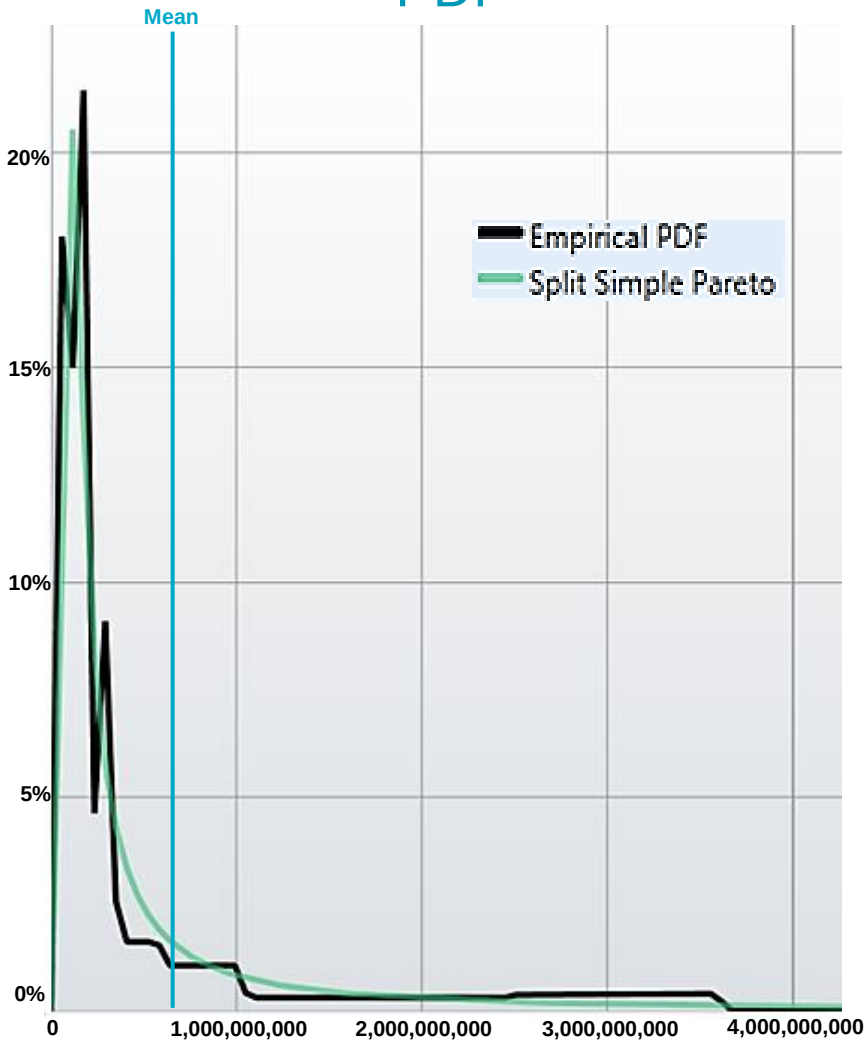
- Storm Surge curve is blending of latest versions of the major vendors
- The inland model curve is the latest AIR Touchstone v3.1 without adjustments



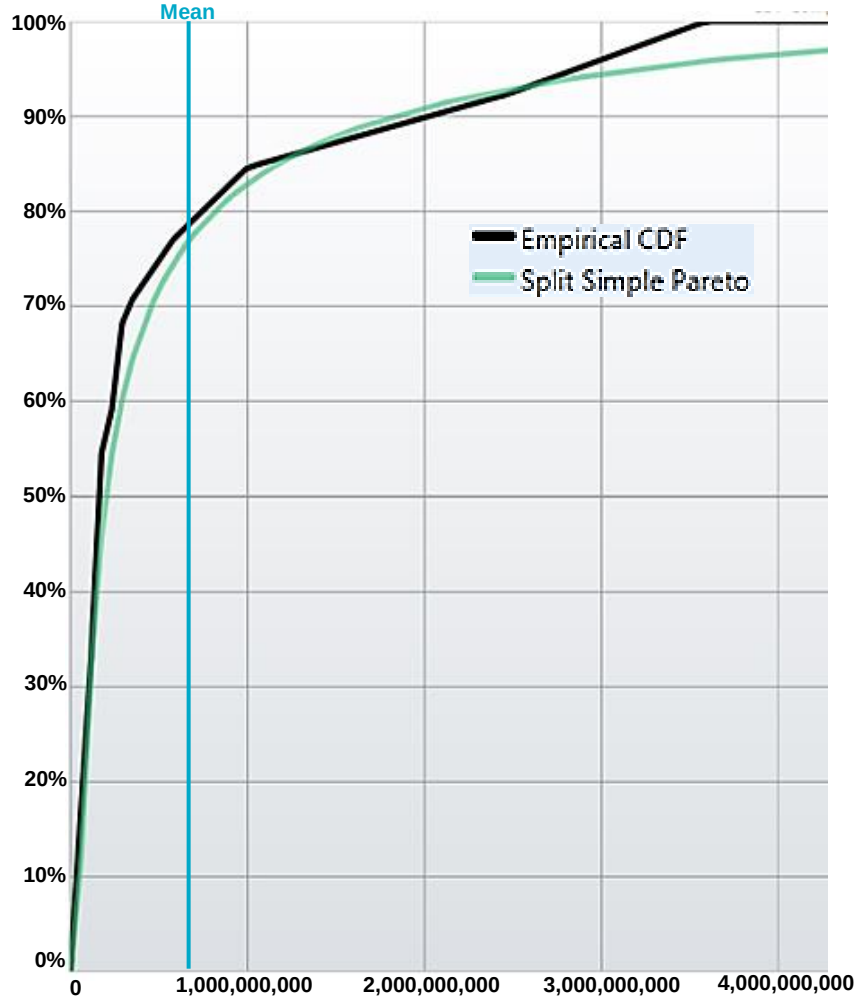
Vendor models compared and tested to determine any adjustments and weights

Non-Modeled Perils – Loss Estimation
NFIP Named Tropical Storm – Fitted Severity

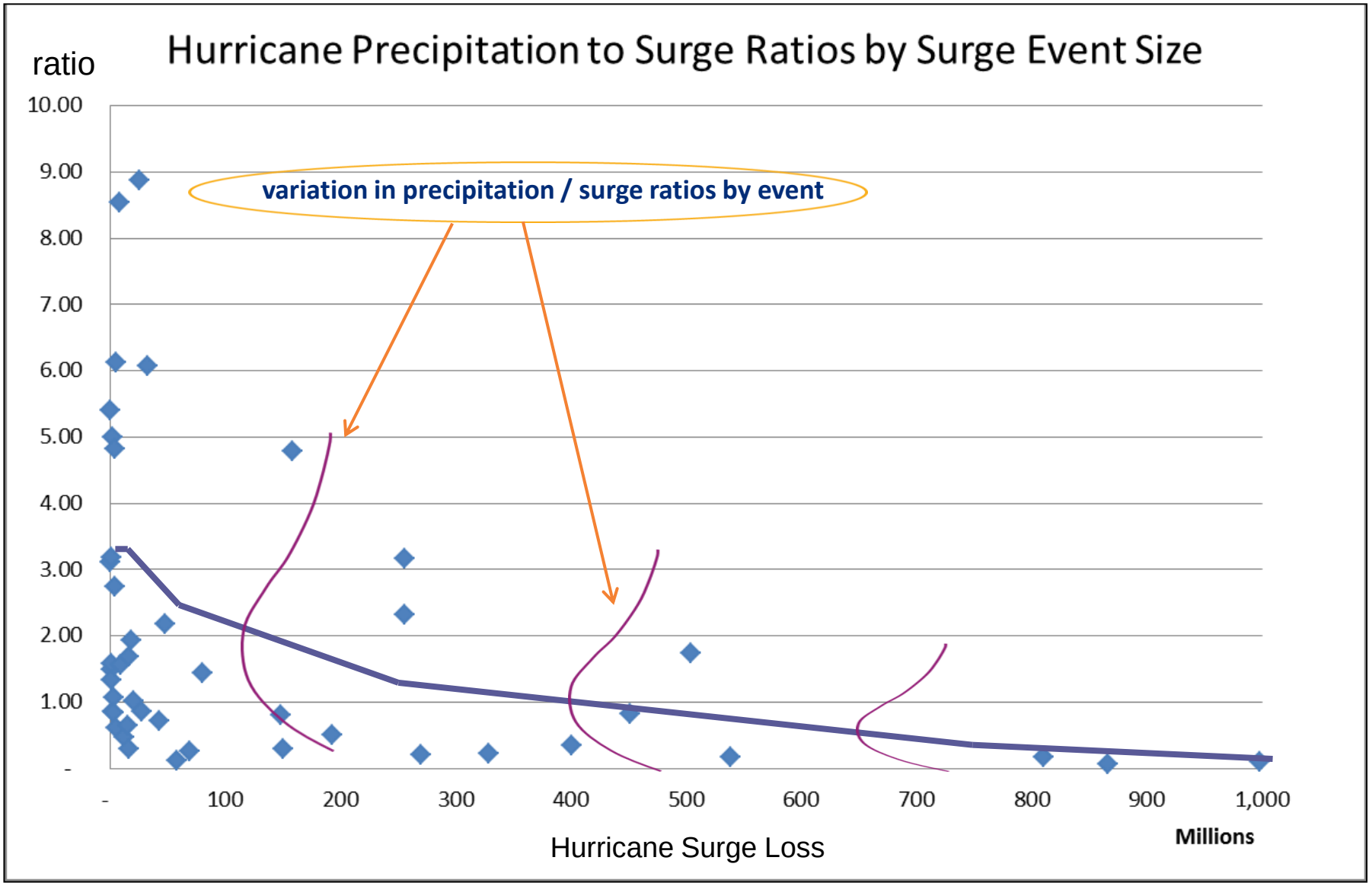
PDF



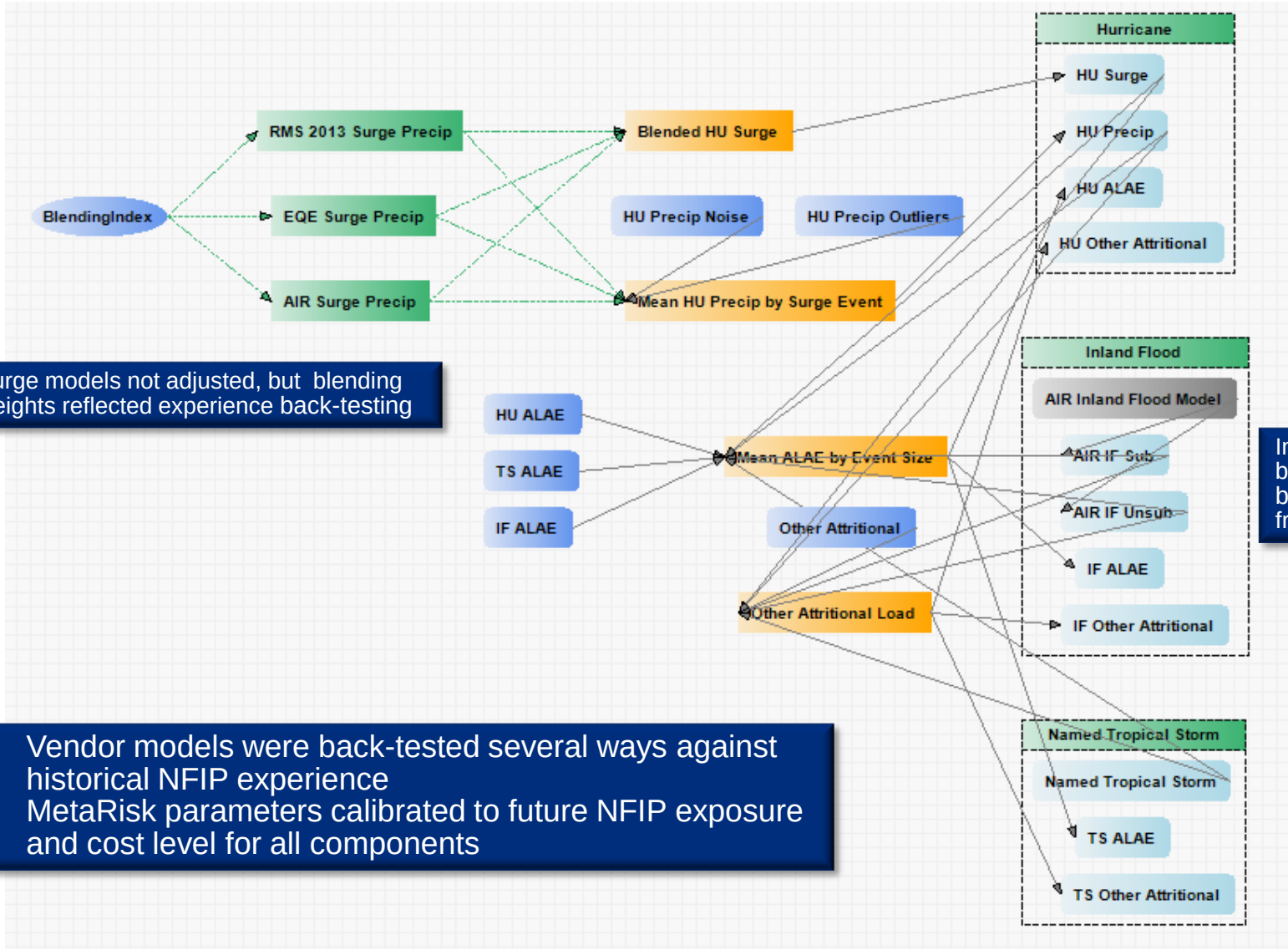
CDF



Non-Modeled Perils – Loss Estimation
NFIP Hurricane Precipitation



NFIP Ensemble Loss and ALAE Model
By Peril and All Combined

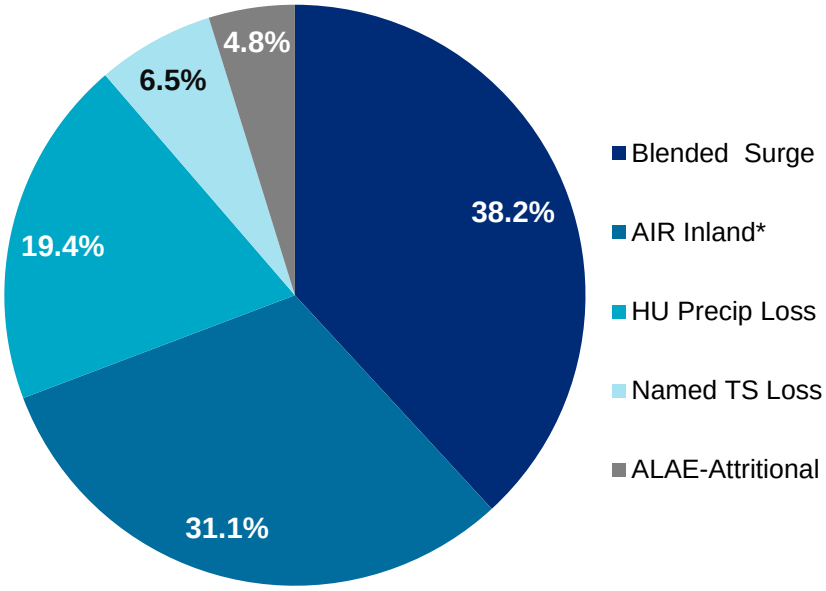


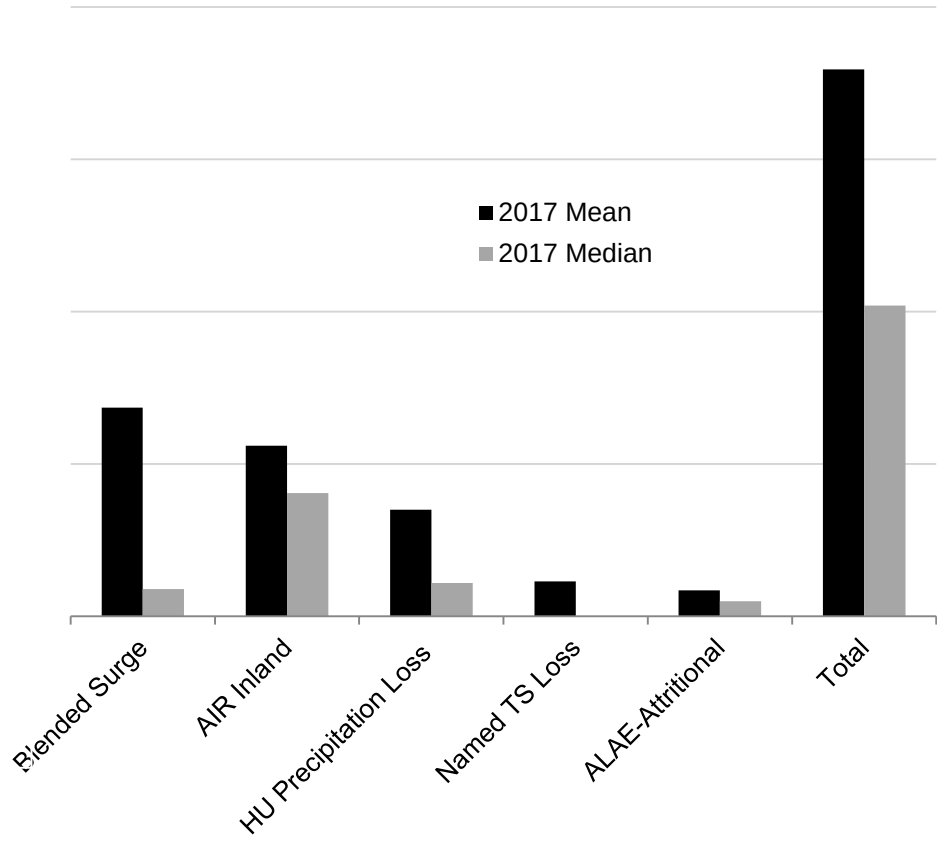
- Vendor models were back-tested several ways against historical NFIP experience
- MetaRisk parameters calibrated to future NFIP exposure and cost level for all components

NFIP Ensemble Model
By Peril and All Combined

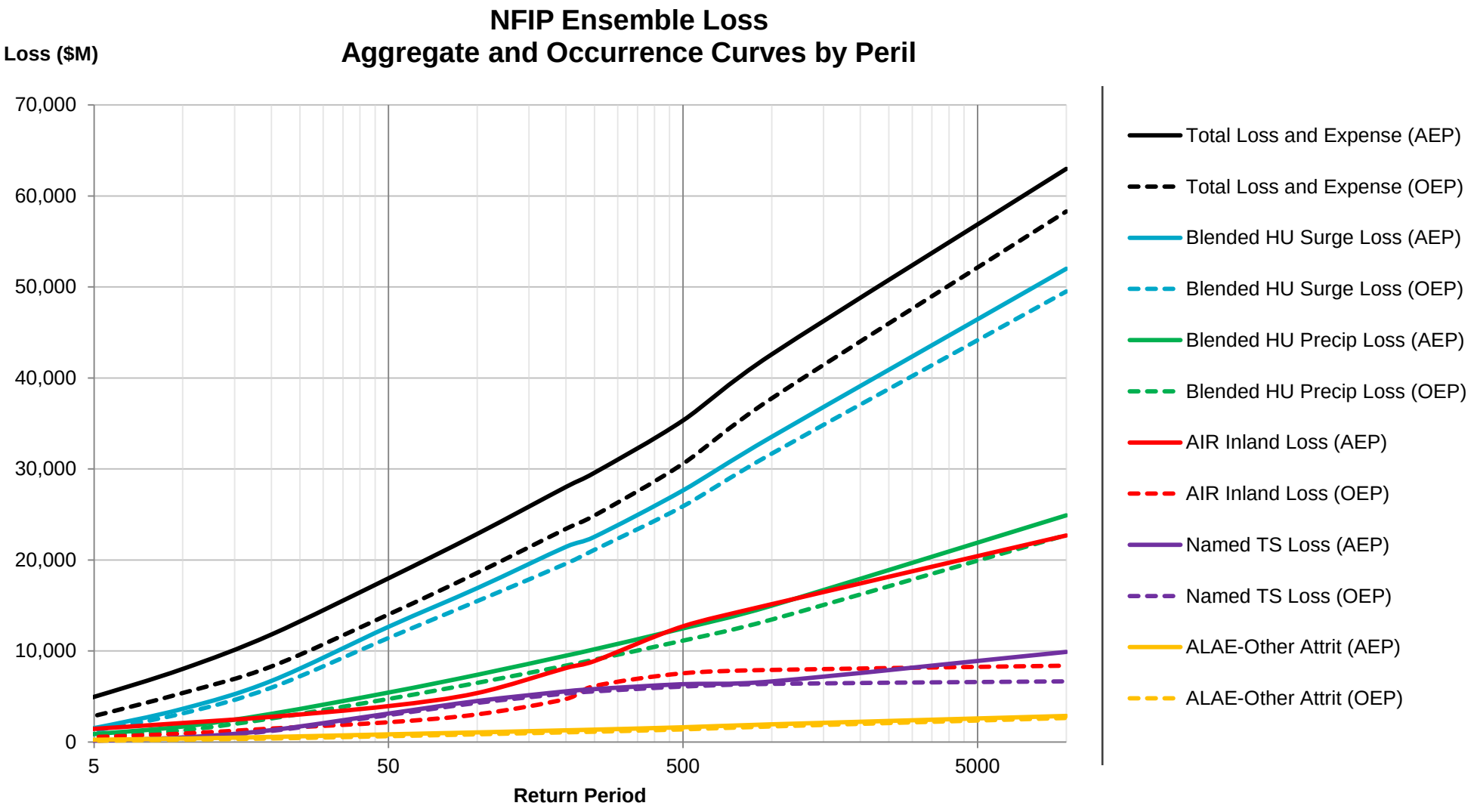
- model output reflects final weightings, adjustments, and recalibrations updated in 2016
- very significant reduction in AAL and entire ensemble CDF from FIRS completed in 2014
  - *remains a "work in progress" as US flood modeling continues to develop and improve*

Contribution to NFIP Ensemble Gross AAL

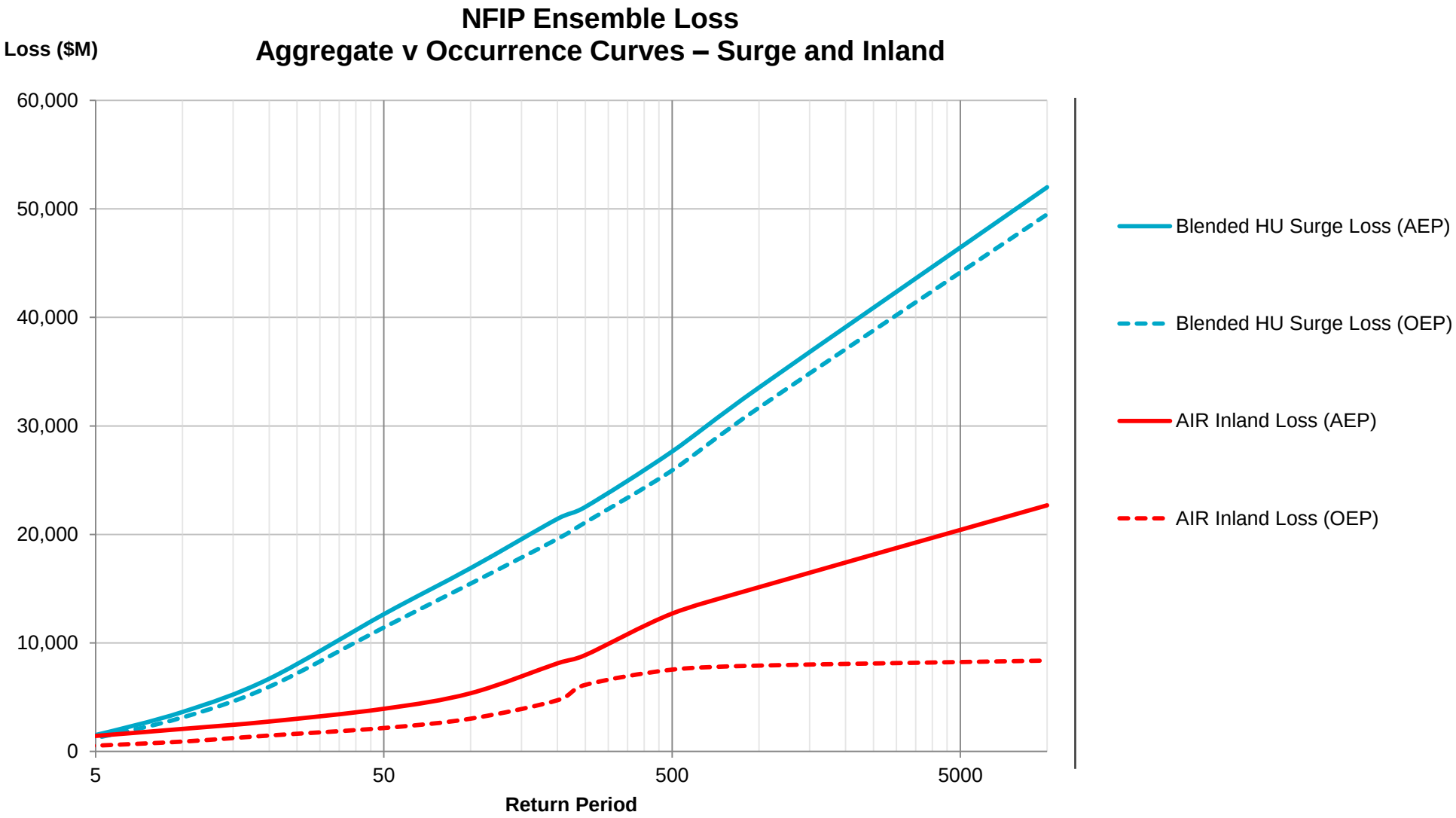




NFIP Ensemble Model
AEP and OEP by Peril and Combined

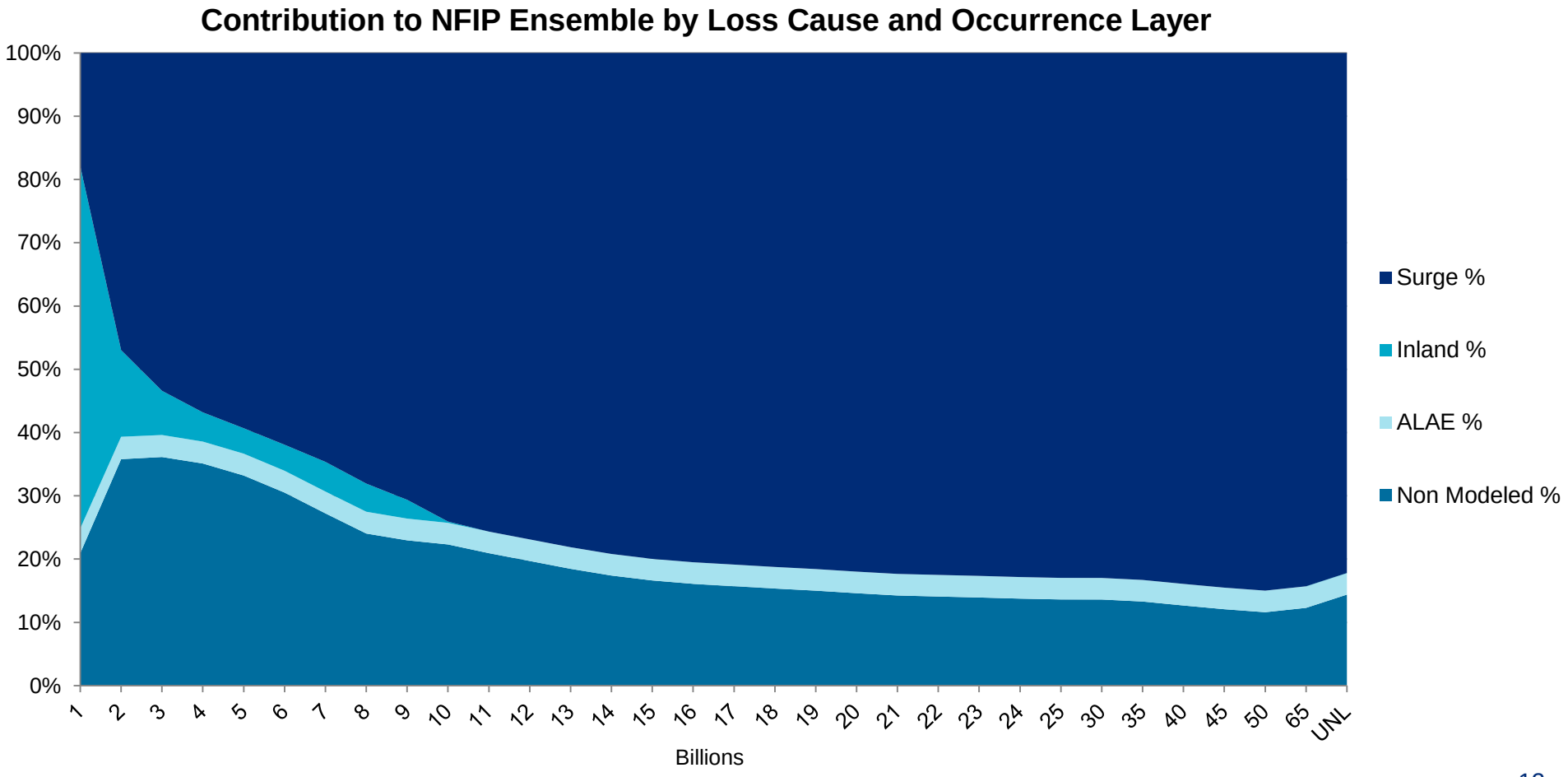


NFIP Ensemble Model
AEP v OEP – Low Frequency v High Frequency Perils

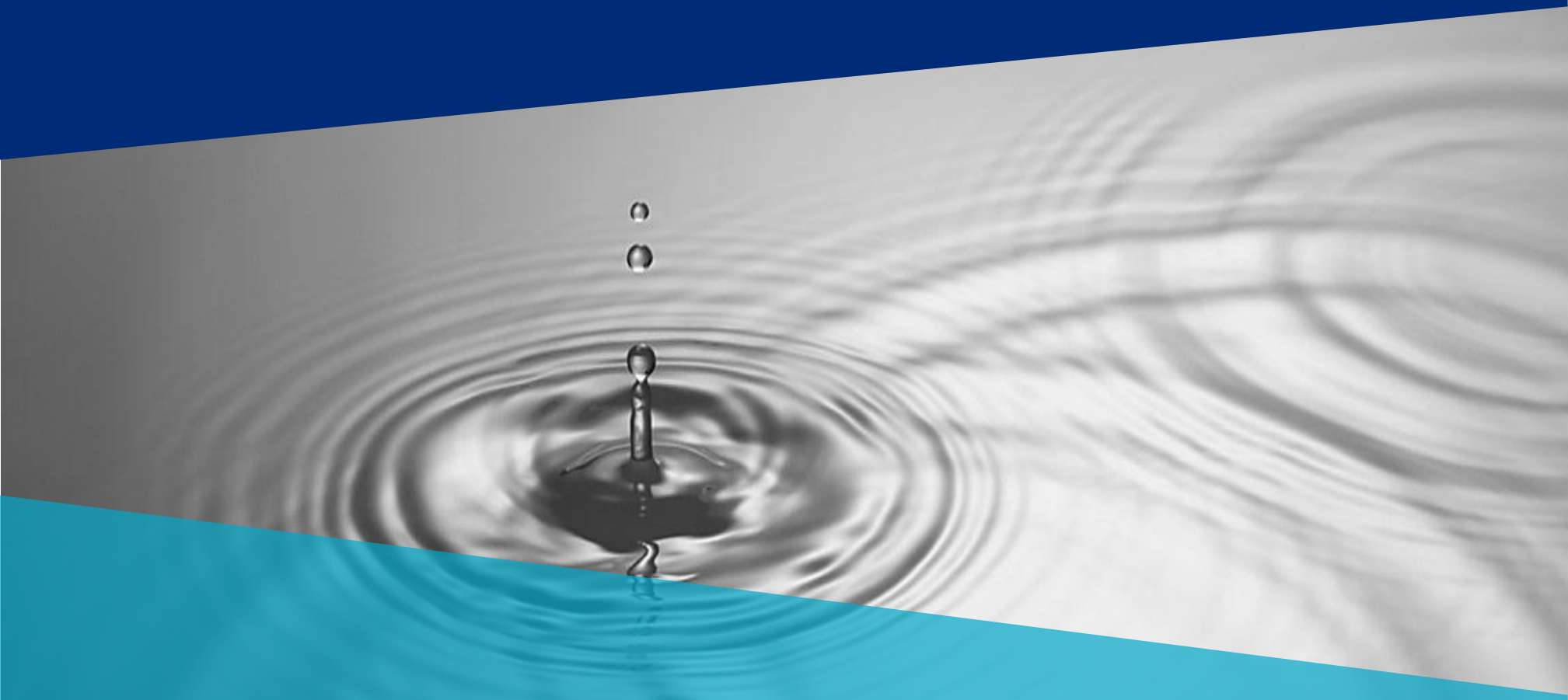


NFIP Ensemble Model
By Peril and Incremental Occurrence Layers

- inland and non-modeled exposure diminish significantly as occurrence layer attachment increases
- thus beyond lower attachments, occurrence layers can be more confidently priced in the near term



2 NFIP Financials: Stochastic Forecasts



NFIP Financials
Stochastic Forecasts

REVENUE

Surcharges – flat $ charges by occupancy

Assessments – flat % charges

Unsubsidized rate increases = inflation

Subsidized rate increases > inflation
(until full risk level reached)

Newly mapped policy additions each year

FORECASTING VARIABLES and ASSUMPTIONS

EXPOSURE

Added newly mapped policies annually

- no other exposure increases assumed

Demand elasticity formula applied to:

- Premium + surcharges + assessments increases > inflation by segment
- Losses - overall average exposure reduction with a newly mapped offset

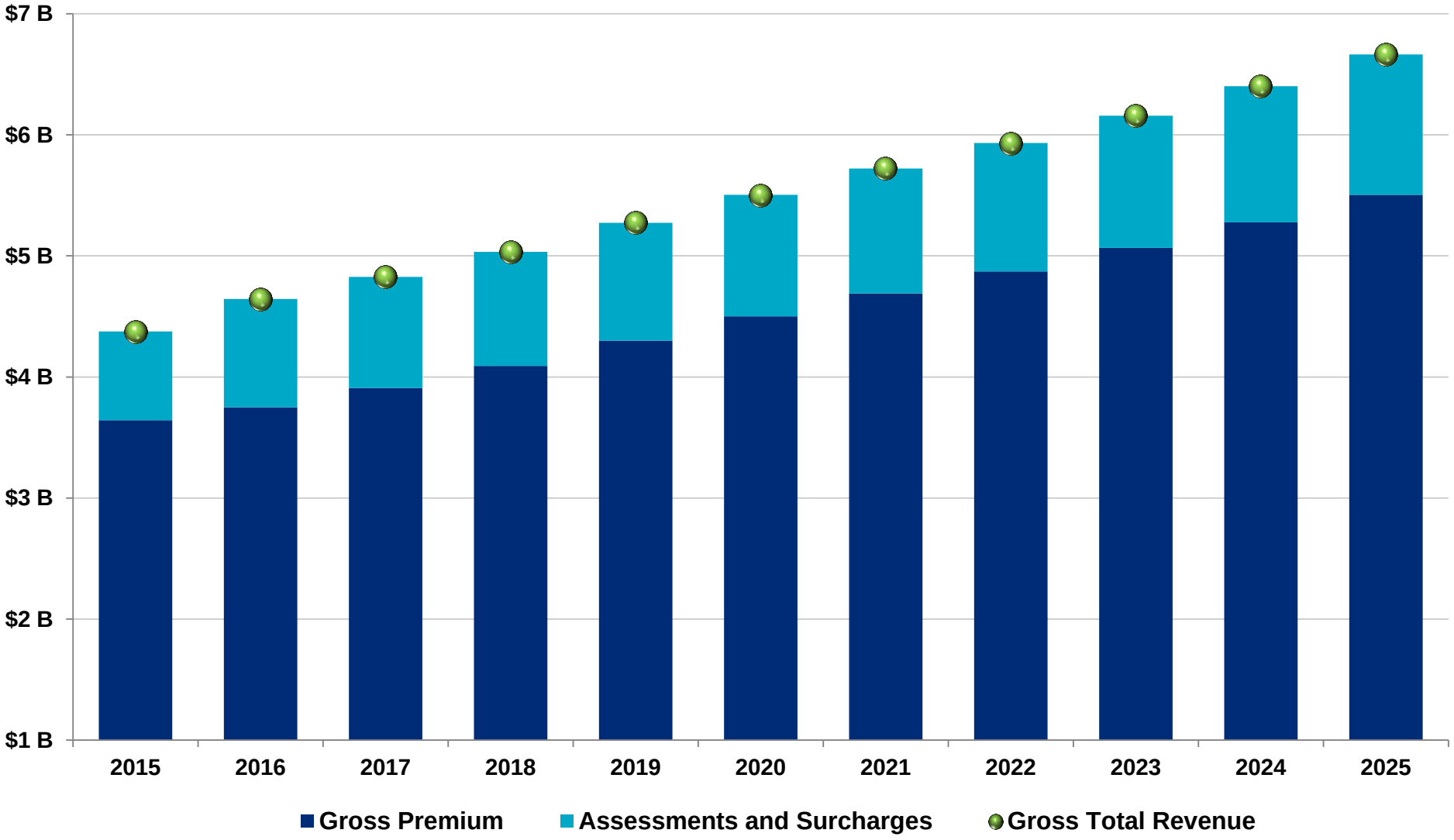
LOSSES, EXPENSES, and INTEREST RATES

Losses per exposure increased by stochastic CPI inflation annually

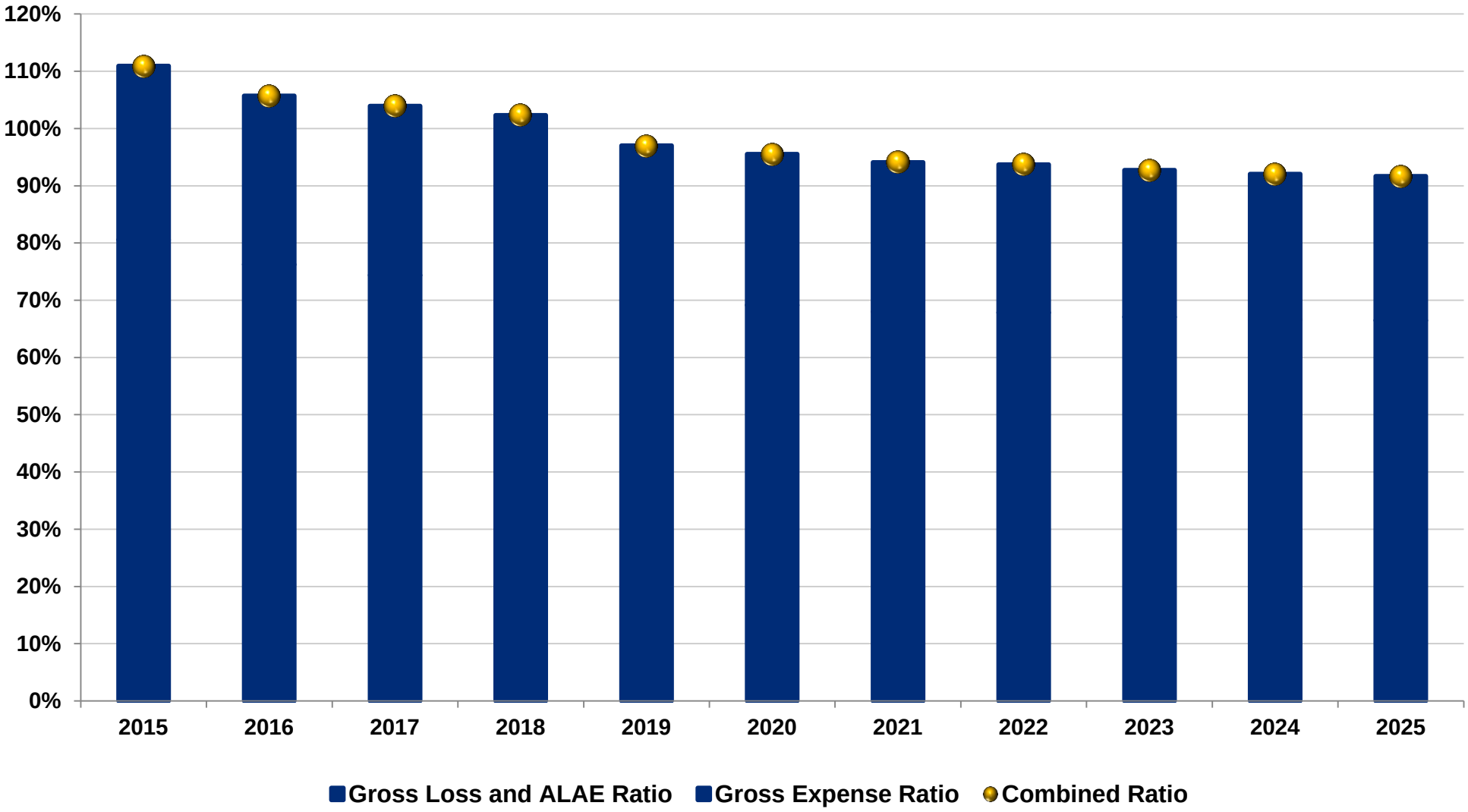
Planned expense ratio reductions to subsidized policies beginning 2019

Stochastic yield rates applied annually to investment income/debt accrual

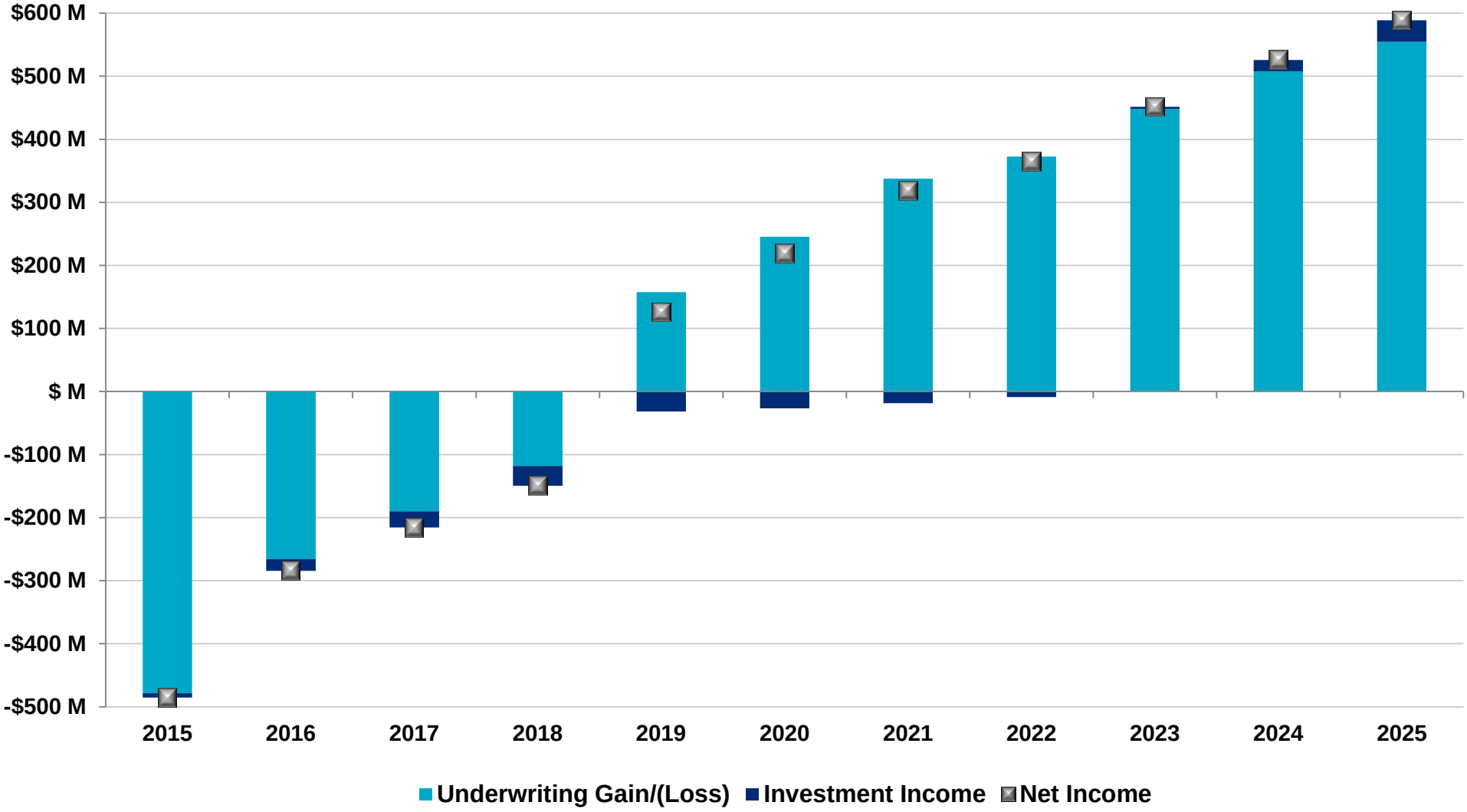
NFIP Revenue Projections
Premium, Assessments, and Surcharges



Projected NFIP Mean Underwriting Results
Loss, Expense, and Combined Ratios

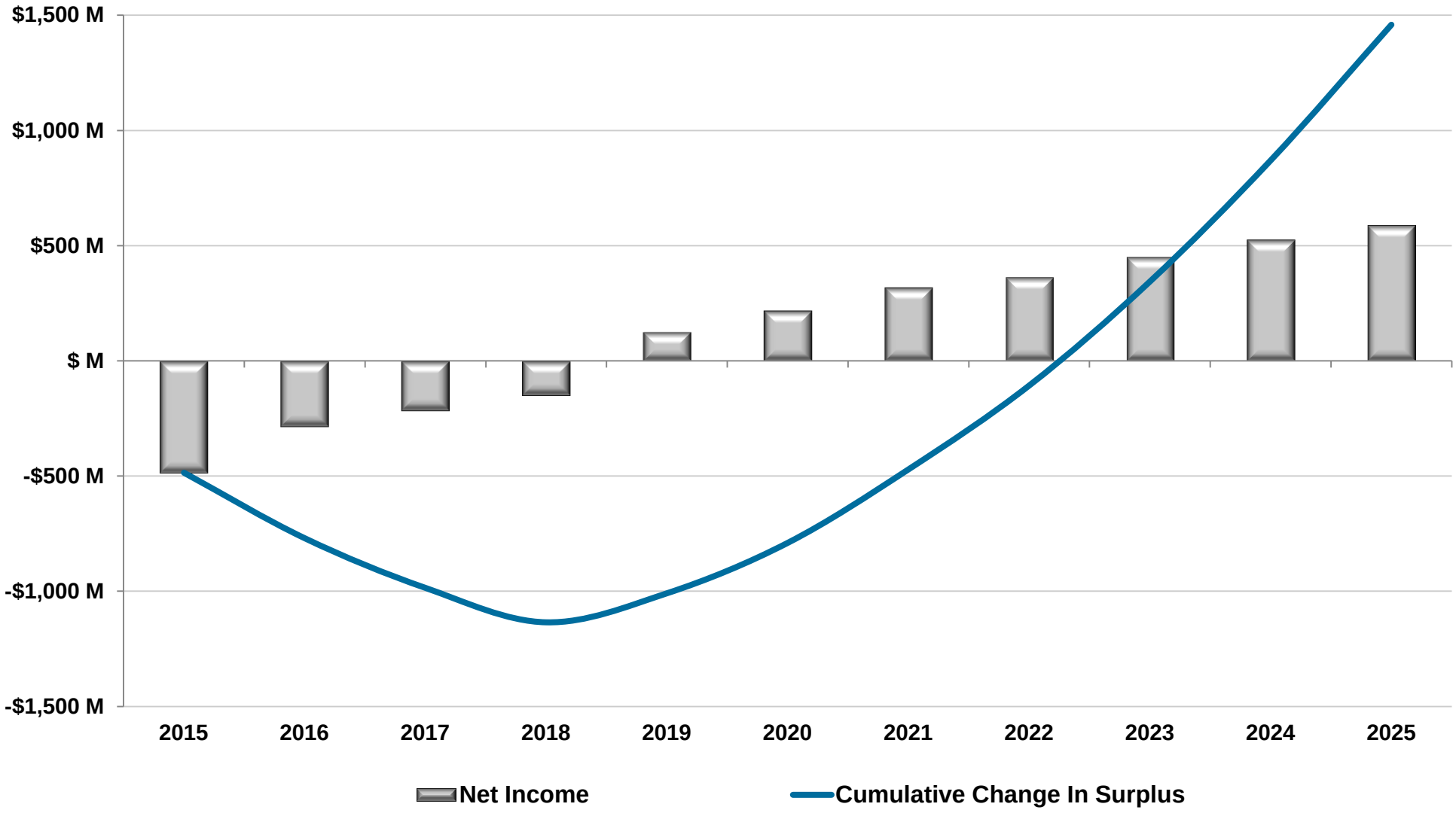


Projected NFIP Mean Operating Income
Underwriting Gain/(Loss), Investment Income, and Net Income

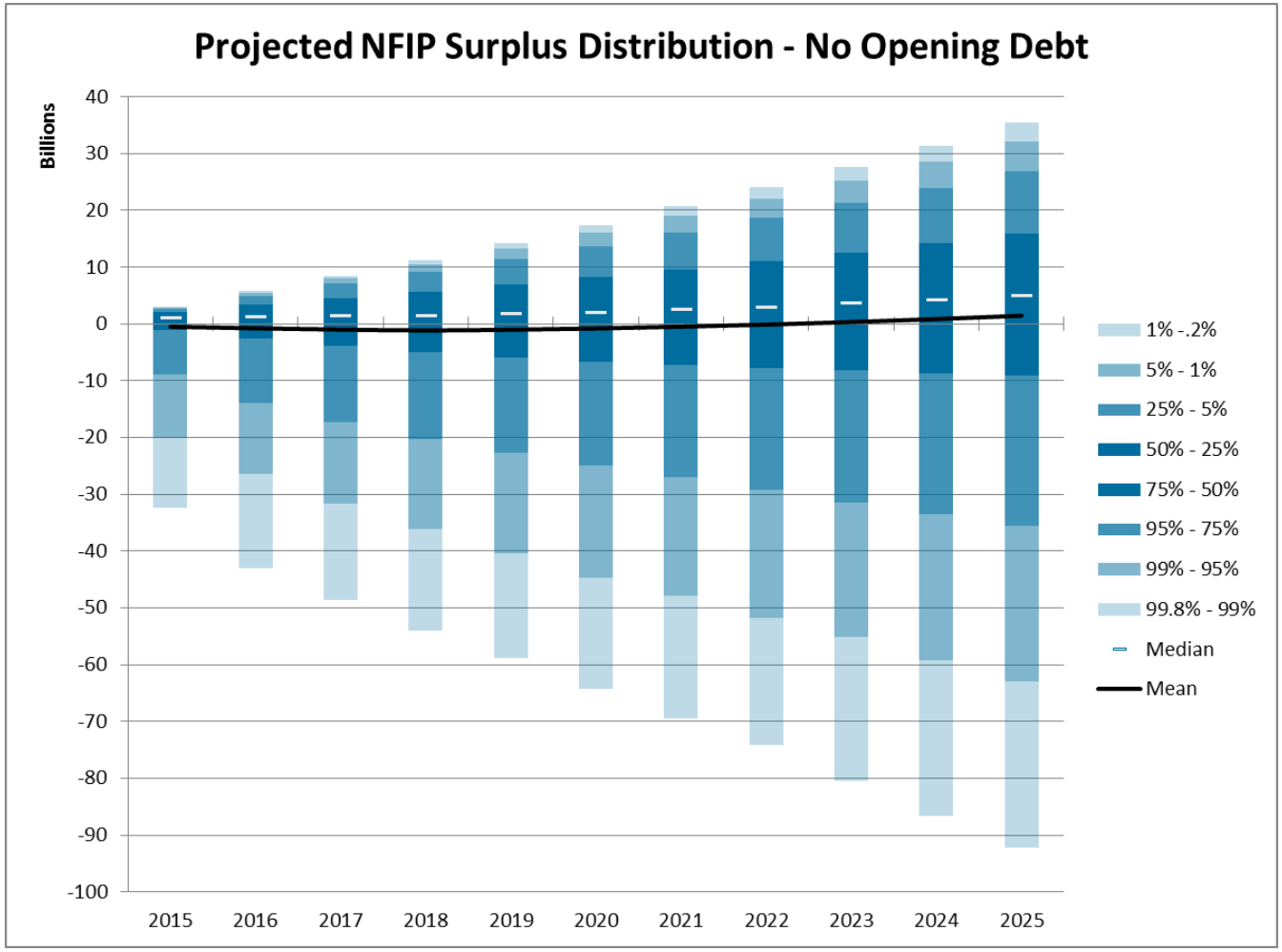


Projected NFIP Mean Cumulative Surplus Change

Net Income and Cumulative Surplus Change

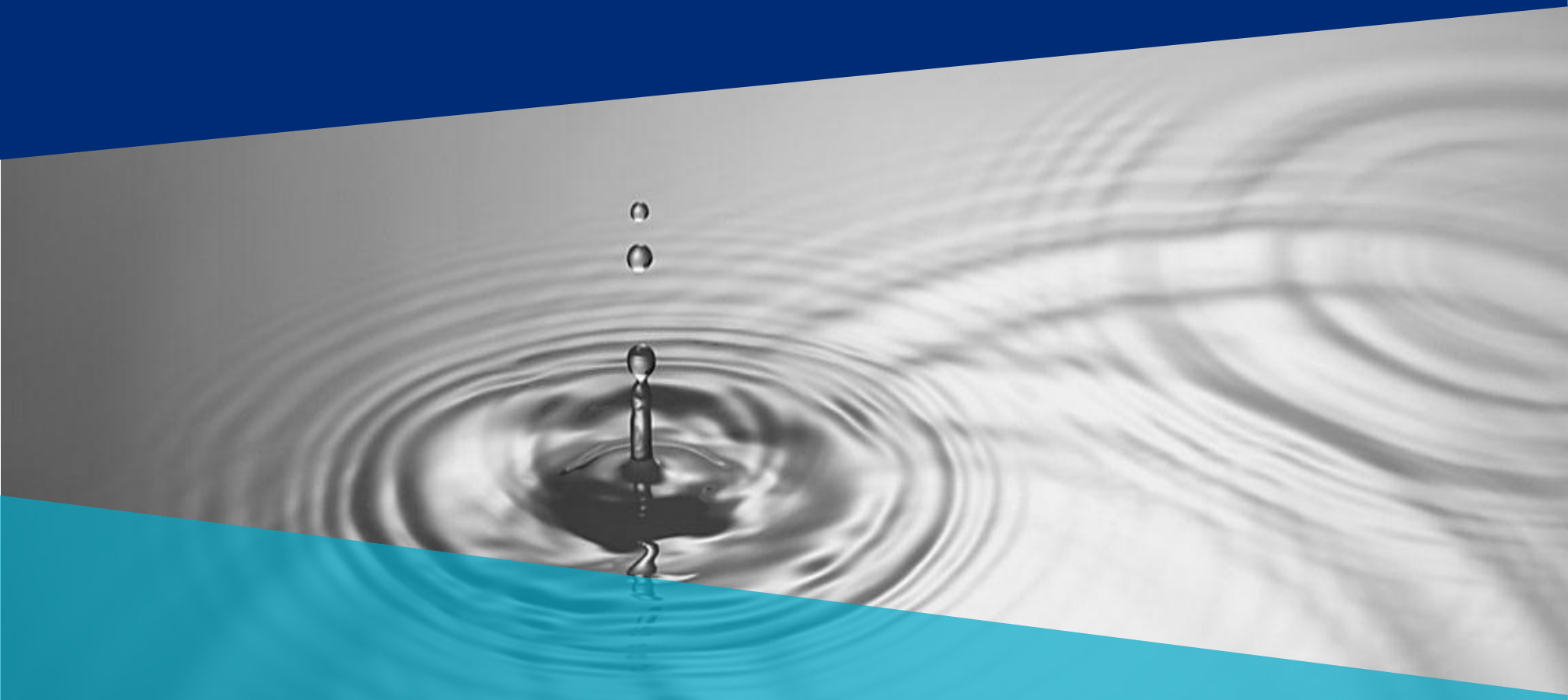


Projected NFIP Surplus Distribution – Cone of Uncertainty
Excluding Current Debt



The possibility of deficits is still significant despite mean surplus turning positive

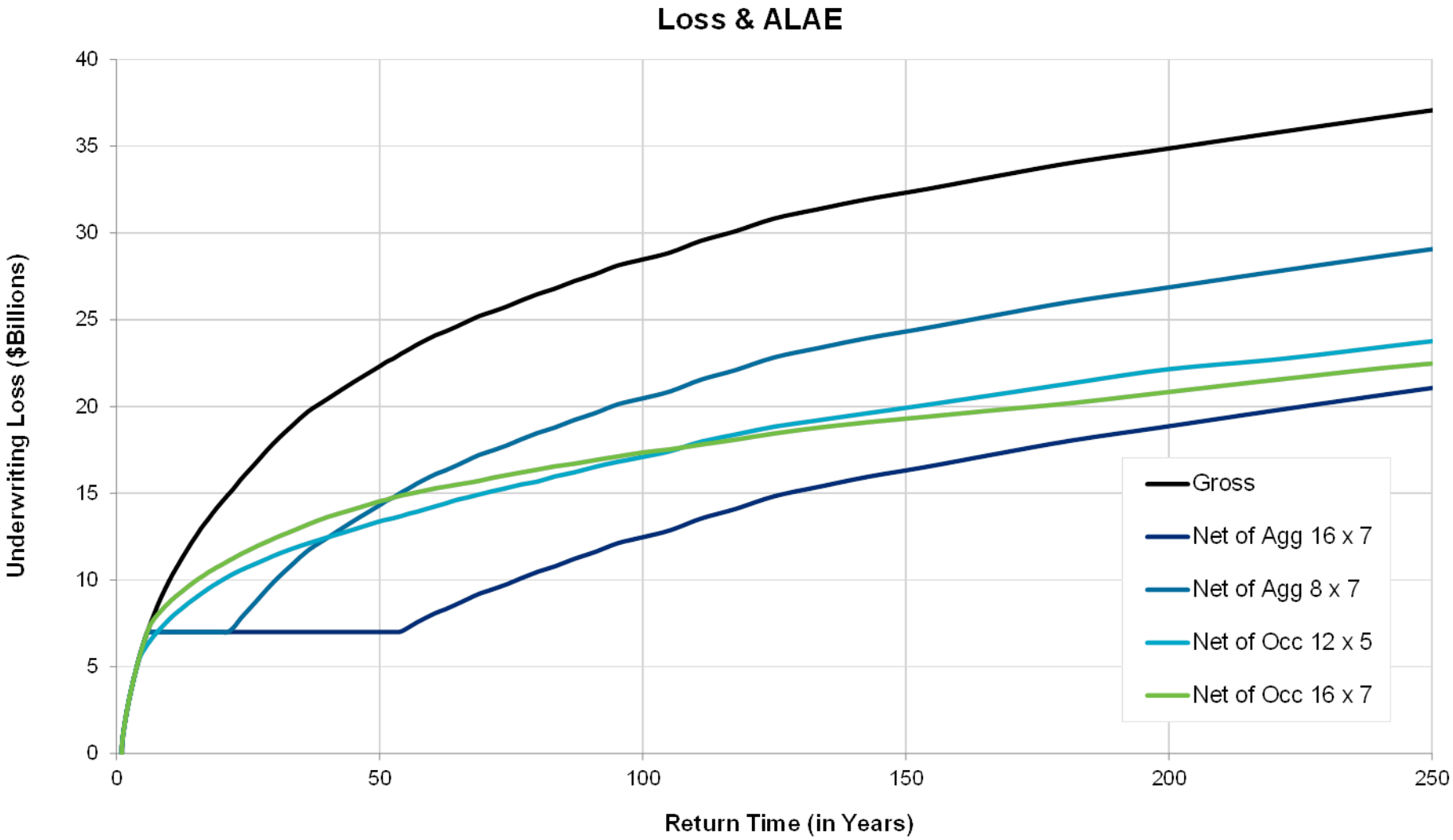
3 EVALUATING REINSURANCE



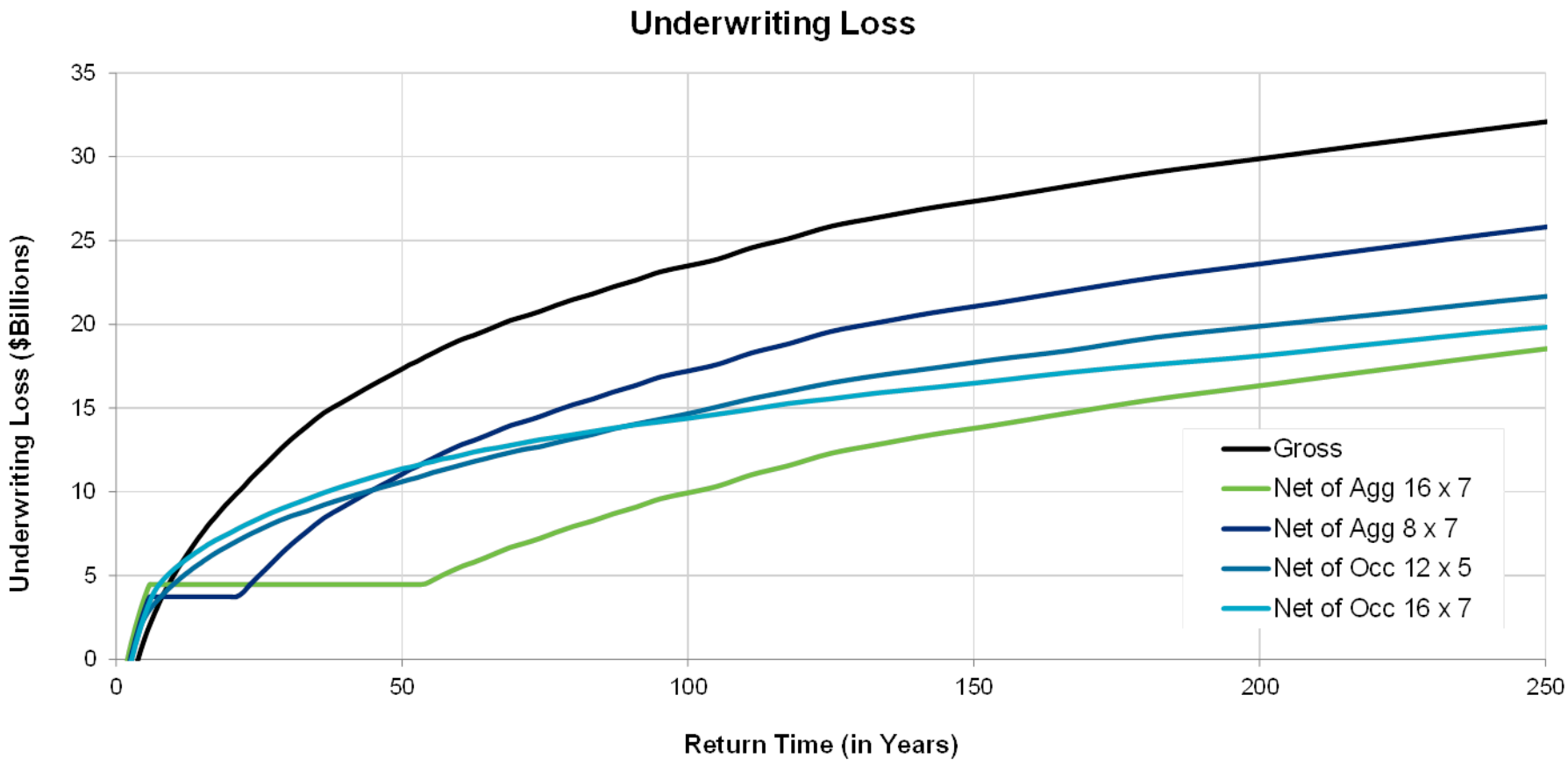
NFIP – Evaluating Reinsurance
Short Term View – Analytical Approach

- apply several straightforward reinsurance structures to NFIP losses and revenue
- estimate market pricing for the structures using industry database
- analyze the distribution of losses and underwriting profit gross and net of each structure
- apply GC reinsurance decision tool using metrics and weights selected with FIMA
  - *compare gross (no reinsurance) against net of reinsurance scores side-by-side*
- while comparisons between structures are interesting, the primary purpose of this initial analysis is to analyze reinsurance value across a range of common types and terms
- $ amounts are 2025 projections, thus limited accuracy
  - *the loss and expense ratio distributions are more relevant to the analysis*

Evaluating Reinsurance – Short Term View
Gross and Net Loss Distributions



Evaluating Reinsurance – Short Term View
Gross and Net Underwriting Profit Distributions



- *view underwriting loss rather than profit to position the distribution tail similarly to loss*
- *the reinsurance costs are seen where the net lines are above the gross line (on the left)*
- *the reinsurance benefits are seen where the net lines fall below the gross line*

Evaluating Reinsurance – Short Term View
Comparison of Gross and Net for Selected Metrics and Weights

Reinsurance Decision Tool

FEMA
NFIP Reinsurance Options 2025

Program: Reinsurance Options
Agg, Occ XOLs

Results of Metric Calculations

Min/ Max	Metric	Gross no reinsurance	Agg 16 x 7	Agg 8 x 7	Occ 12 x 5	Occ 16 x 7
Min	Net Loss and ALAE TVaR 99.0%	38,980 M	22,980 M	30,980 M	26,144 M	24,634 M
Min	Exp Policyhr Deficit @ $7B	2,363 M	311 M	751 M	1,407 M	1,820 M
Min	TVaR of Net Loss @ $7B	13,768 M	16,724 M	16,102 M	10,814 M	10,608 M
Min	Probability Net Loss > $7B	17.2%	1.9%	4.7%	13.0%	17.2%
Min	Cost of Reinsurance (Net-Gross UW Loss) Mean	0 M	1,471 M	986 M	828 M	894 M
Min	Net Loss and ALAE Mean	4,429 M	3,449 M	3,692 M	3,726 M	3,887 M

Scores Based On Calculation Results

Weight	Metric	Gross no reinsurance	Agg 16 x 7	Agg 8 x 7	Occ 12 x 5	Occ 16 x 7
10%	Net Loss and ALAE TVaR 99.0%	0.00	1.00	0.50	0.80	0.90
40%	Exp Policyhr Deficit @ $7B	0.00	1.00	0.79	0.47	0.26
0%	TVaR of Net Loss @ $7B	0.48	0.00	0.10	0.97	1.00
0%	Probability Net Loss > $7B	0.00	1.00	0.82	0.27	0.00
40%	Cost of Reinsurance (Net-Gross UW Loss) Mean	1.00	0.00	0.33	0.44	0.39
10%	Net Loss and ALAE Mean	0.00	1.00	0.75	0.72	0.55
	Overall Score - Unweighted	**0.25**	**0.67**	**0.55**	**0.61**	**0.52**
	Overall Score - Weighted	**0.40**	**0.60**	**0.57**	**0.52**	**0.41**

- *All of the reinsurance options score better than gross no reinsurance*
- *The two unweighted metrics are components of the expected policyholder deficit (EPD)*
- *The $7B EPD threshold is slightly below current borrowing authority*

Evaluating Reinsurance – Short Term View
Alternative $10B EPD Threshold with Same Metrics and Weights

Reinsurance Decision Tool

FEMA
NFIP Reinsurance Options 2025

Program: Reinsurance Options
Agg, Occ XOLs

Results of Metric Calculations

Min/ Max	Metric	Gross no reinsurance	Agg 16 x 7	Agg 8 x 7	Occ 12 x 5	Occ 16 x 7
Min	Net Loss and ALAE TVaR 99.0%	38,980 M	22,980 M	30,980 M	26,144 M	24,634 M
Min	Exp Policyhr Deficit @ $10B	1,761 M	265 M	638 M	750 M	940 M
Min	TVaR of Net Loss @ $10B	17,729 M	20,177 M	19,255 M	15,046 M	14,281 M
Min	Probability Net Loss > $10B	9.9%	1.3%	3.3%	5.0%	6.6%
Min	Cost of Reinsurance (Net-Gross UW Loss) Mean	0 M	1,471 M	986 M	828 M	894 M
Min	Net Loss and ALAE Mean	4,429 M	3,449 M	3,692 M	3,726 M	3,887 M

Scores Based On Calculation Results

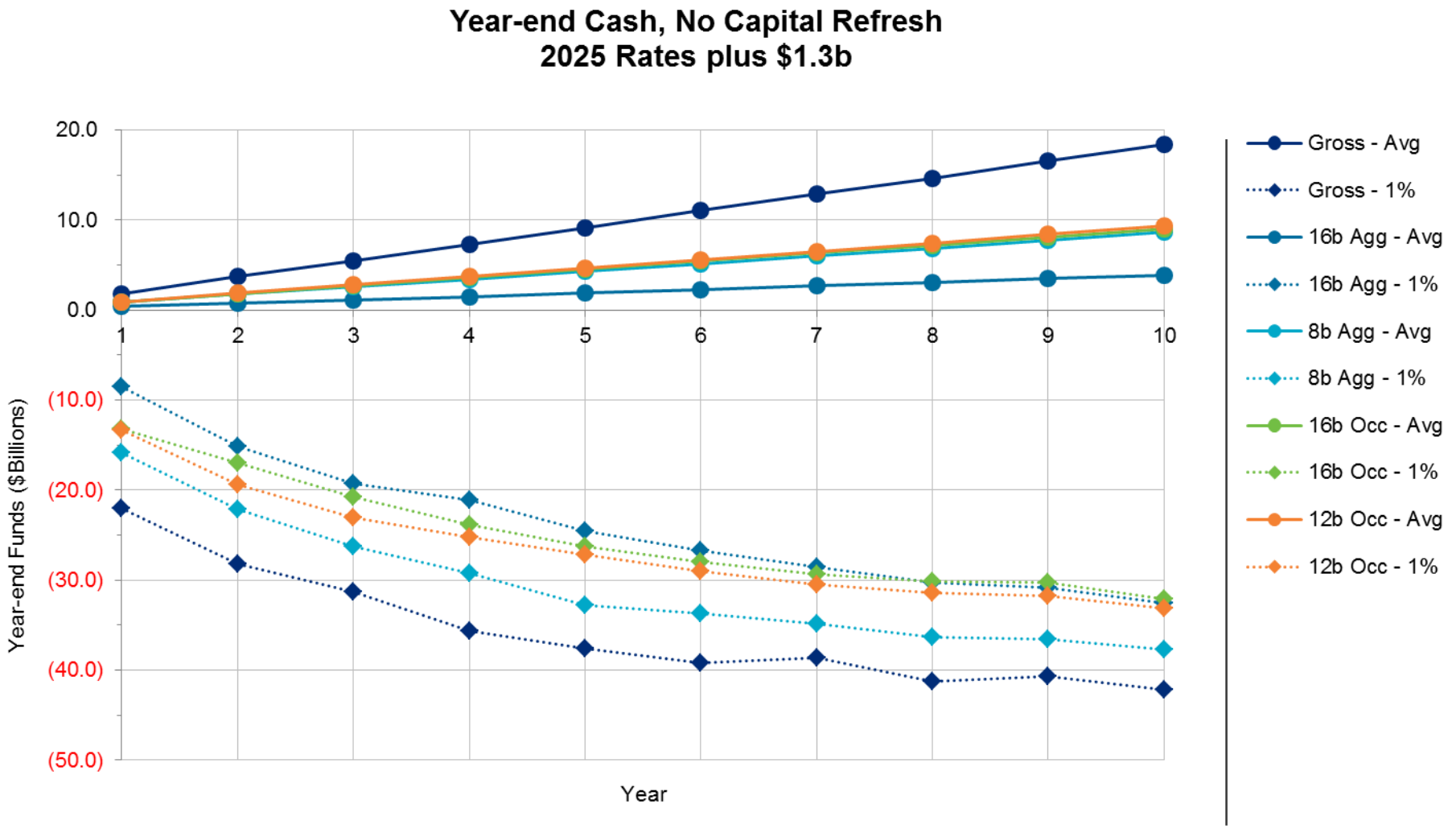
Weight	Metric	Gross no reinsurance	Agg 16 x 7	Agg 8 x 7	Occ 12 x 5	Occ 16 x 7
10%	Net Loss and ALAE TVaR 99.0%	0.00	1.00	0.50	0.80	0.90
40%	Exp Policyhr Deficit @ $10B	0.00	1.00	0.75	0.68	0.55
0%	TVaR of Net Loss @ $10B	0.42	0.00	0.16	0.87	1.00
0%	Probability Net Loss > $10B	0.00	1.00	0.77	0.57	0.39
40%	Cost of Reinsurance (Net-Gross UW Loss) Mean	1.00	0.00	0.33	0.44	0.39
10%	Net Loss and ALAE Mean	0.00	1.00	0.75	0.72	0.55
	Overall Score - Unweighted	**0.24**	**0.67**	**0.54**	**0.68**	**0.63**
	Overall Score - Weighted	**0.40**	**0.60**	**0.56**	**0.60**	**0.52**

- *All of the reinsurance options continue to score better than gross no reinsurance*
- *The $10B EPD threshold adds other fund balances to the remaining borrowing authority*
- *The relative scores between the reinsurance structures change at the higher threshold*

NFIP – Evaluating Reinsurance
Long Term View – Analytical Approach

- view the same straightforward reinsurance structures and estimated market pricing
- generate 10 years of financials at adequate rate level
  - *establish adequacy of revenue to support reinsurance purchase, add any shortfall*
  - *replenish capital when the existing debt ceiling is exhausted*
  - *compare probabilities of exhausting debt ceiling and replenishment $s*
- while comparisons between structures are interesting, the primary purpose of this analysis is to analyze reinsurance value across a range of common types and terms
- long-term $ amounts are 2025 projections, thus limited accuracy
  - *the loss and expense ratios are less inaccurate and more relevant to the analysis*
  - *indications are sensitive to the level of rate adequacy*

Evaluating Reinsurance – Long Term View
10 Year Value Metrics without Capital Replenishment



Evaluating Reinsurance – Long Term View
10 Year Value Metrics with Capital Replenishment

Figures in $Billions

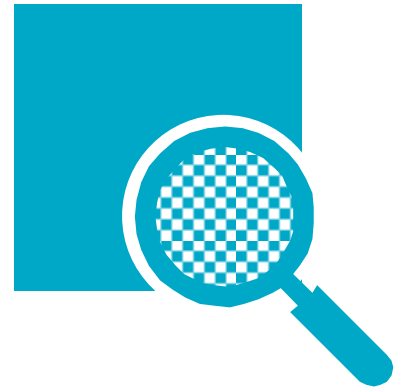
Metric	Gross	Agg 16x7	Agg 8x7	Occ 16x7	Occ 12x5
Reinsurance Deposit	0	2.4	1.7	1.4	1.5
Annual Net Margin	1.8	.40	.80	1.0	1.0
Pr (1+ replenishment)	18.6%	11.5%	13.8%	16.5%	14.8%
Pr (2+ replenishment)	2.9%	0.8%	1.4%	2.0%	1.5%
Capital Replenishment:					
Avg per 10 year string	4.0	1.9	2.7	2.3	2.0
Avg per replenishment	21.3	16.1	19.5	13.9	13.2
Change over Gross					
Pr (1 + replenishment)		**-38%**	**-26%**	**-11%**	**-21%**
Pr (2+ replenishment)		**-73%**	**-53%**	**-32%**	**-50%**
Capital per 10 year string		**-53%**	**-32%**	**-42%**	**-51%**
Capital per replenishment		**-24%**	**-8%**	**-34%**	**-38%**

- Reinsurance reduces frequency of need to increase debt ceiling
- Reinsurance also reduces severity of the debt ceiling increase (when increased)
- Must have revenue margin sufficient to support reinsurance purchase
  - *this example has $1.3b more revenue than 2025 rate levels*
  - *$2.8b more revenue needed to reduce gross Pr (1+ replenishment) to 11.5%*
    - *Reinsurance saves $1.5b in revenue increase needed for comparable protection*

NFIP – Value of Reinsurance
Recap of Alternative Views

Short-Term Analysis

- scored gross and net of reinsurance alternatives for selected metrics and weights
- all reinsurance options scored better than gross
  - *even if reinsurance cost turns gross mean UW profit to net mean UW loss*
- negative mean cash flow acceptable only in short term
- long term analysis needed if rate adequacy is questionable



Long-Term Analysis

- compared multi-year financial projections gross and net of reinsurance, with and without capital replenishment
  - *accounts for rate inadequacy*
- all reinsurance options improved debt management
  - *after increasing revenue to adequate level*
  - *reduced probability of exhausting the debt ceiling*
  - *reduced severity of required capital replenishment*
  - *lower cost than additional gross revenue needed*

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This report is not intended to be a complete actuarial communication. Upon request, we can prepare one. We are available to respond to questions regarding our analysis.

There are many limitations on actuarial analyses, including uncertainty in the estimates and reliance on data. We will provide additional information regarding these limitations upon request.

As with any actuarial analysis, the results presented herein are subject to significant variability. While these estimates represent our best professional judgment, it is probable that the actual results will differ from those projected. The degree of such variability could be substantial and could be in either direction from our estimates.

The estimated cash flows may vary significantly from amounts actually collected, particularly in the event that a reinsurer is unwilling or unable to perform in accordance with the terms of the reinsurance contract.

In performing this analysis, we relied on FEMA for historical NFIP claims data, current financial data and information, and information and assumptions regarding future NFIP revenue and expense levels. We did not perform an independent review of these estimates.

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In performing this analysis, we relied on AIR for estimates regarding claim inflation and exposure trend of historical NFIP claims and exposures to current cost and exposure levels, as well as the amount of historical NFIP losses for subperils for which their current software models do not provide estimates. We did not perform an independent review of these estimates.

In performing this analysis, we relied on Moody's for estimates regarding economic scenarios of future interest rates and inflation rates. We did not perform an independent review of these estimates.

The results in this report are generated with software models provided by Risk Management Solutions, Inc.
The technology and data used in providing this information is based on the scientific data, mathematical and empirical models, and encoded experience of earthquake engineers, wind engineers, structural engineers, geologists, seismologists, meteorologists, and geotechnical specialists. As with any model of complex physical systems, particularly those with low frequencies of occurrence and potentially high severity outcomes, the actual losses from catastrophic events may differ from the results of simulation analyses. Furthermore, the accuracy of predictions depends largely on the accuracy and quality of the data input by the user. This information is being provided under license to Guy Carpenter & Company, LLC from Risk Management Solutions Inc., is considered confidential to Risk Management Solutions, Inc., and may not be shared with any third party without the prior written consent of Guy Carpenter & Company, LLC. Furthermore, this information may only be used for the specific business application specified by Guy Carpenter & Company, LLC and for no other purpose and may not be used under any circumstances to support development of or calibration of a new or existing product or service offering that competes with Risk Management Solutions, Inc. THIS INFORMATION IS PROVIDED "AS IS", AND RISK MANAGEMENT SOLUTIONS, INC. DISCLAIMS ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, WITH RESPECT TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL RISK MANAGEMENT SOLUTIONS, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND ARISING FROM ANY USE OF THIS INFORMATION.

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