Taming Catastrophe Risk
Portfolio Management and Pricing
Strategies for Catastrophe-Exposed Lines
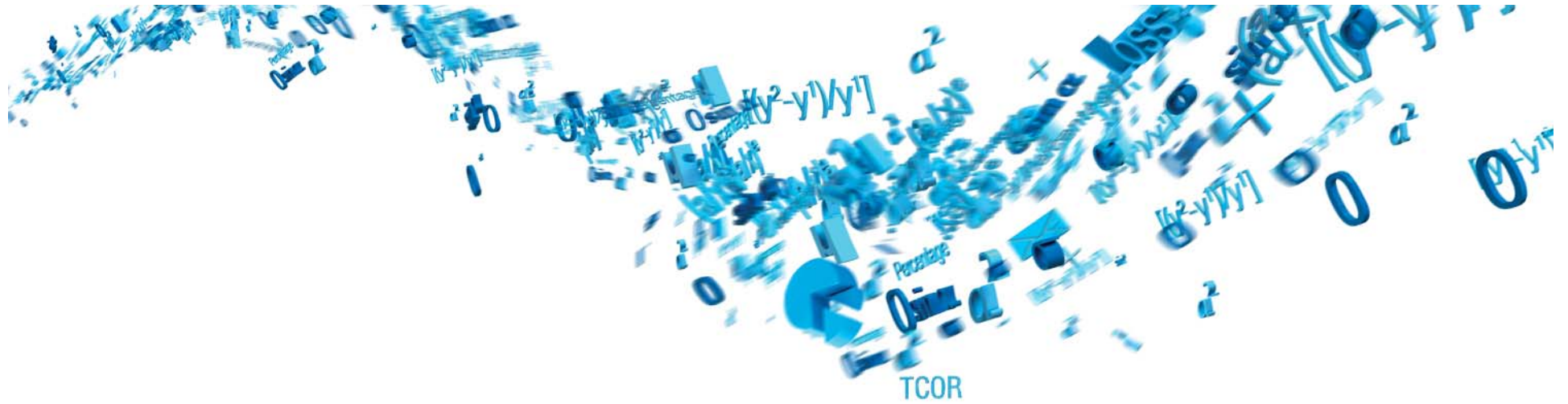
Bob Fox, ACAS, MAAA
CAS Annual Meeting
November 2015

Prepared by Aon Benfield
Analytics | Risk & Capital Strategy

Agenda

Section 1	Cat Score® Framework
Section 2	Applications

Section 1: Cat Score® Framework

Expected Losses

Catastrophe Loss Estimation

Models

Hurricane

Earthquake and Fire Following

Experience

Convective Storm

Winter Storm

Wildfire

Best Practices

Clean and complete data

Multi-model average (where permitted)

- Two independent views better than one
- Tempers impacts of model changes

Assign full credibility

- Based on years of simulation rather than years of experience
- Encompass all available information
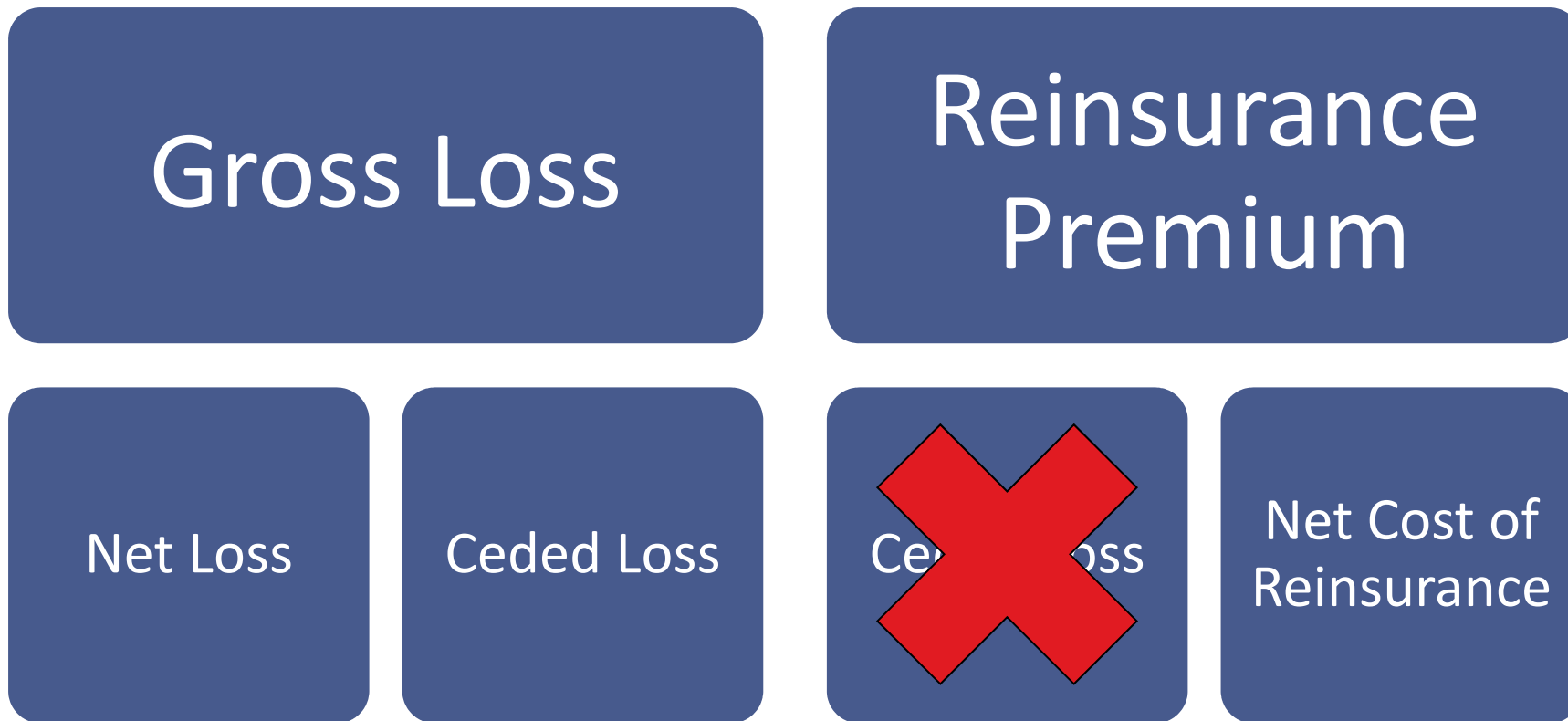
Use notional modeling where appropriate

- Allows for evaluation of a rating factor while holding others constant

Pay attention to "switches"

- Demand surge, storm surge, hurricane frequency

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Net Cost of Reinsurance

Net Cost of Reinsurance

Gross Loss	Reinsurance Premium

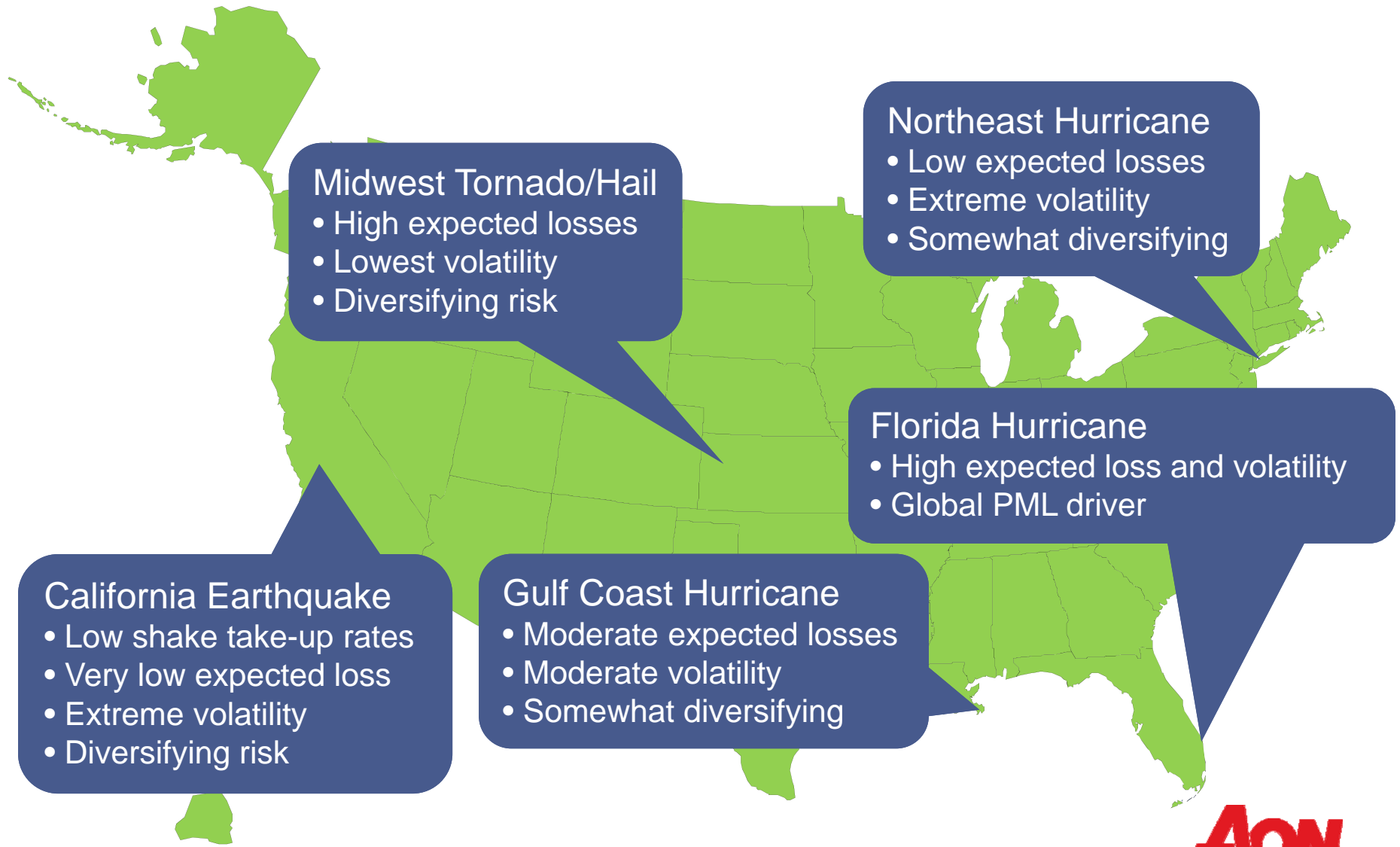| Net Loss	Ceded Loss	Ce~~ded L~~oss	Net Cost of Reinsurance

We don't care what expenses, profit provisions, and model/settings are built into the reinsurance premium. We just need to eliminate the overlap.
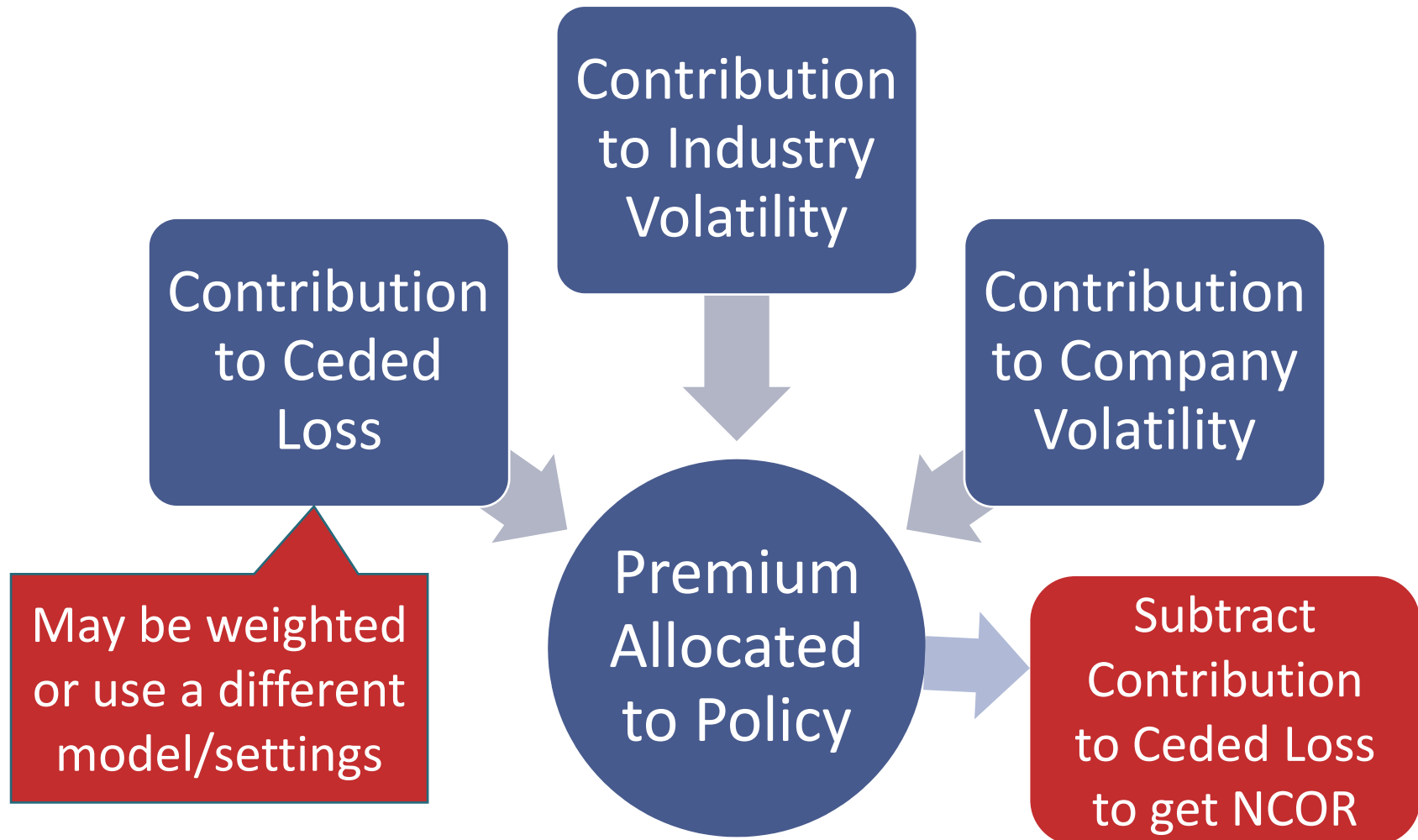
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Typical Allocation

Subtract ceded losses from premium to get NCOR

Allocate on ceded loss or AAL

Allocation Intuition

Midwest Tornado/Hail
- High expected losses
- Lowest volatility
- Diversifying risk

Northeast Hurricane
- Low expected losses
- Extreme volatility
- Somewhat diversifying

Florida Hurricane
- High expected loss and volatility
- Global PML driver

California Earthquake
- Low shake take-up rates
- Very low expected loss
- Extreme volatility
- Diversifying risk

Gulf Coast Hurricane
- Moderate expected losses
- Moderate volatility
- Somewhat diversifying

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Aon Benfield Allocation

Contribution to Ceded Loss

Contribution to Industry Volatility

Contribution to Company Volatility

May be weighted or use a different model/settings

Premium Allocated to Policy
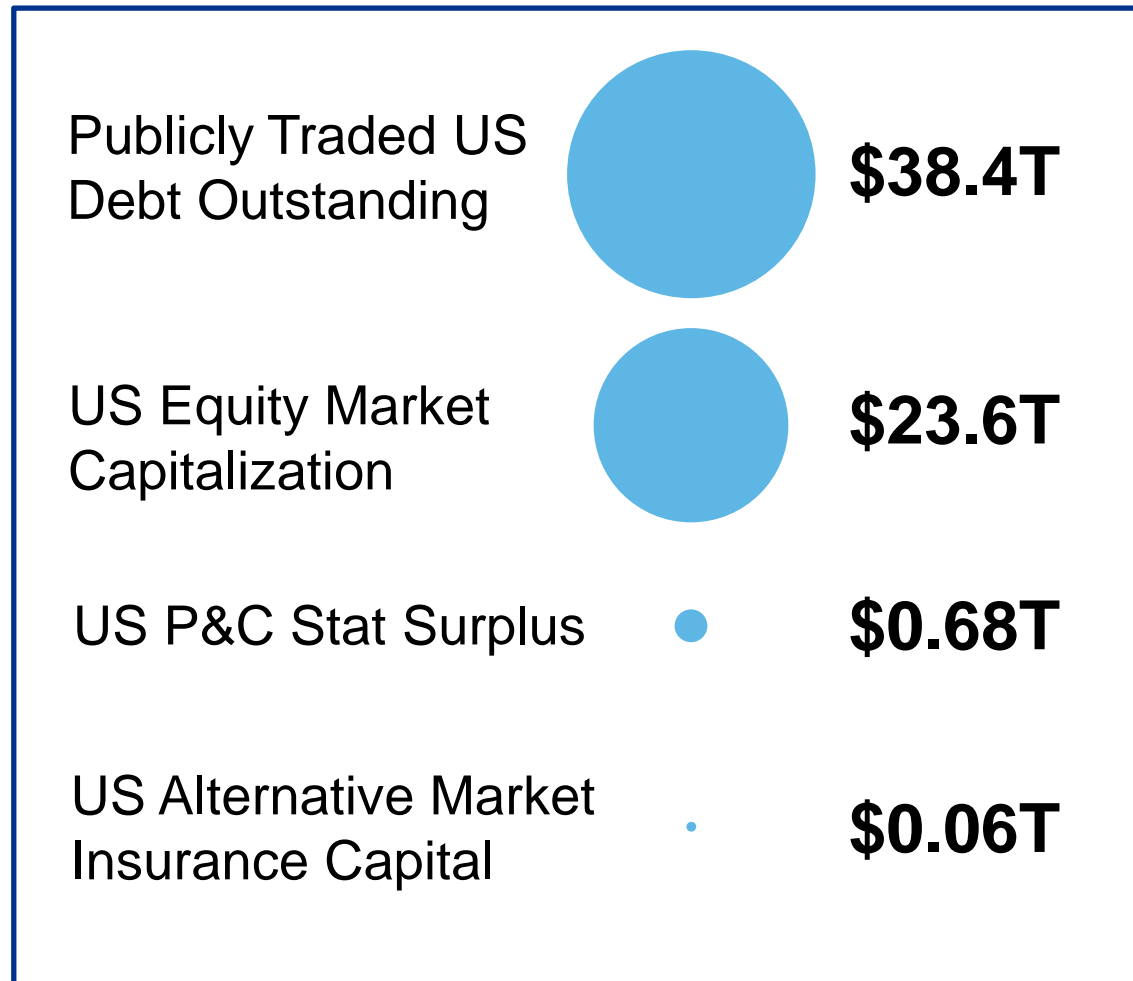
Subtract Contribution to Ceded Loss to get NCOR

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The New Reinsurance Market

- Alternative market capital has overwhelmed the reinsurance market, driving rates down dramatically over the past few years

- Our model has responded accordingly, with the hurricane volatility coefficient dropping 55-65% over that time

- Intuitively, as the cost of capital comes down, the biggest reductions should be seen in the most volatile and industry-correlated states
  - Florida has seen the largest reductions
  - Convective storm states not meaningfully impacted

Publicly Traded US Debt Outstanding — **$38.4T**

US Equity Market Capitalization — **$23.6T**

US P&C Stat Surplus — **$0.68T**

US Alternative Market Insurance Capital — **$0.06T**

Best Practices

Increase premium for expected reinstatements

- In practice deducted from reinsurance recoverables

Increase expected losses for "Cat LAE"

- LAE associated with cat event typically recoverable

Allocate appropriately

Treat as a fixed expense

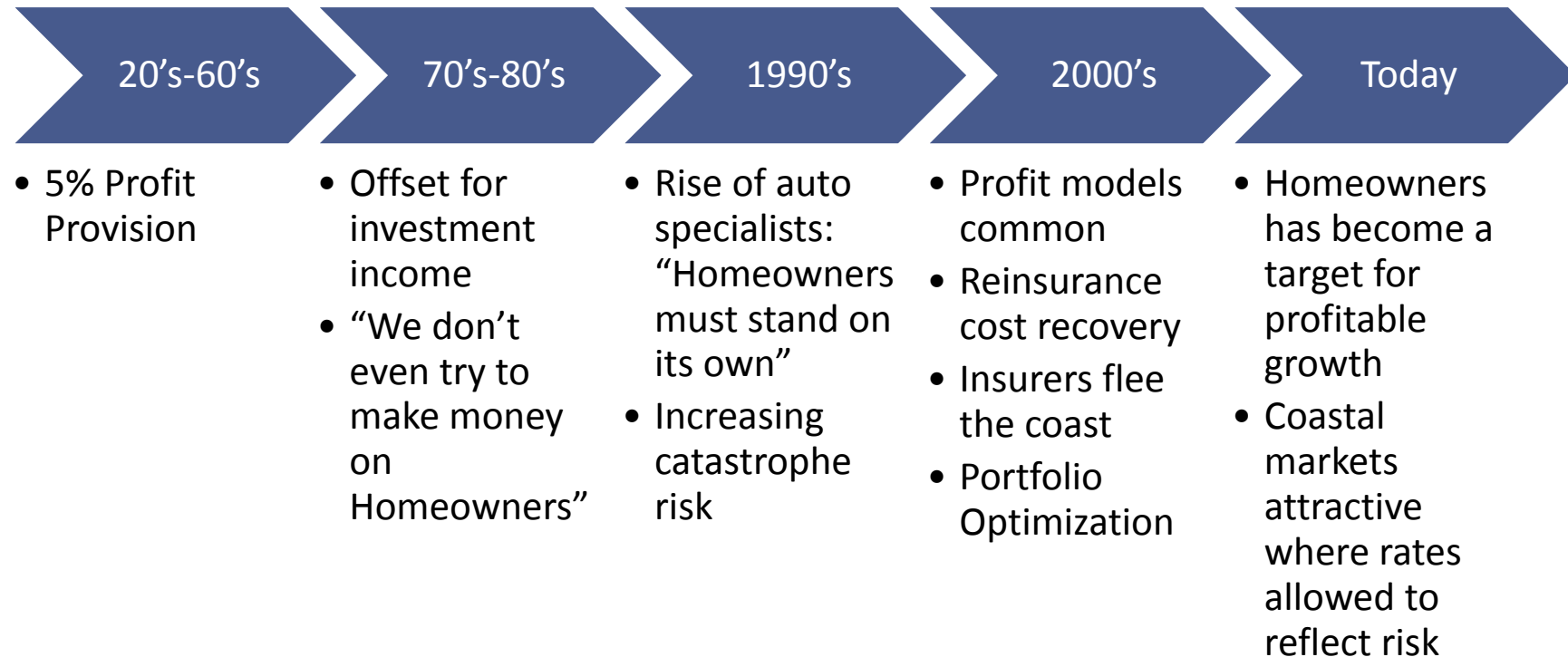- End of treaty adjustments don't imply a variable cost

Allocate geographically within state

Does Catastrophe Reinsurance Increase or Decrease the Cost of Insurance for Policyholders?

Cost of Capital

History of Homeowners Profitability

20's-60's	70's-80's	1990's	2000's	Today
• 5% Profit Provision	• Offset for investment income • "We don't even try to make money on Homeowners"	• Rise of auto specialists: "Homeowners must stand on its own" • Increasing catastrophe risk	• Profit models common • Reinsurance cost recovery • Insurers flee the coast • Portfolio Optimization	• Homeowners has become a target for profitable growth • Coastal markets attractive where rates allowed to reflect risk

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Actuarial Profit Models

Significant development

- Recognized the necessity of capital to support risk, and the cost of acquiring or holding that capital

Significant Oversight

- WE failed to recognize the catastrophe risk inherent in shorter-tailed property lines

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Pricing For Catastrophe Risk

Impact of Reinsurance

	Current Reinsurance
(1) Current Level Projected Earned Premium	150
(2) Credibility-Weighted Expected Attritional Losses & DCC	50
(3) Expected Catastrophe Losses & DCC	30
(4) Fixed Expenses	10
(5) Net Cost of	20
(6) Variable Exp	25%
(7) Premium Re	147
(8) Assumed Premium-to-Surplus Ratio	1.5
(9) Required Surplus	98
(10) Target Return on Surplus	15%
(11) Required Return	15
(12) Profit Provision	9.8%
(13) Adequate Premium	169
(14) Indicated Rate Need	12.4%

We retained more risk, but decreased our profit provision!

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Pricing For Catastrophe Risk

If the profit provision doesn't reflect cat risk, some other provision is needed
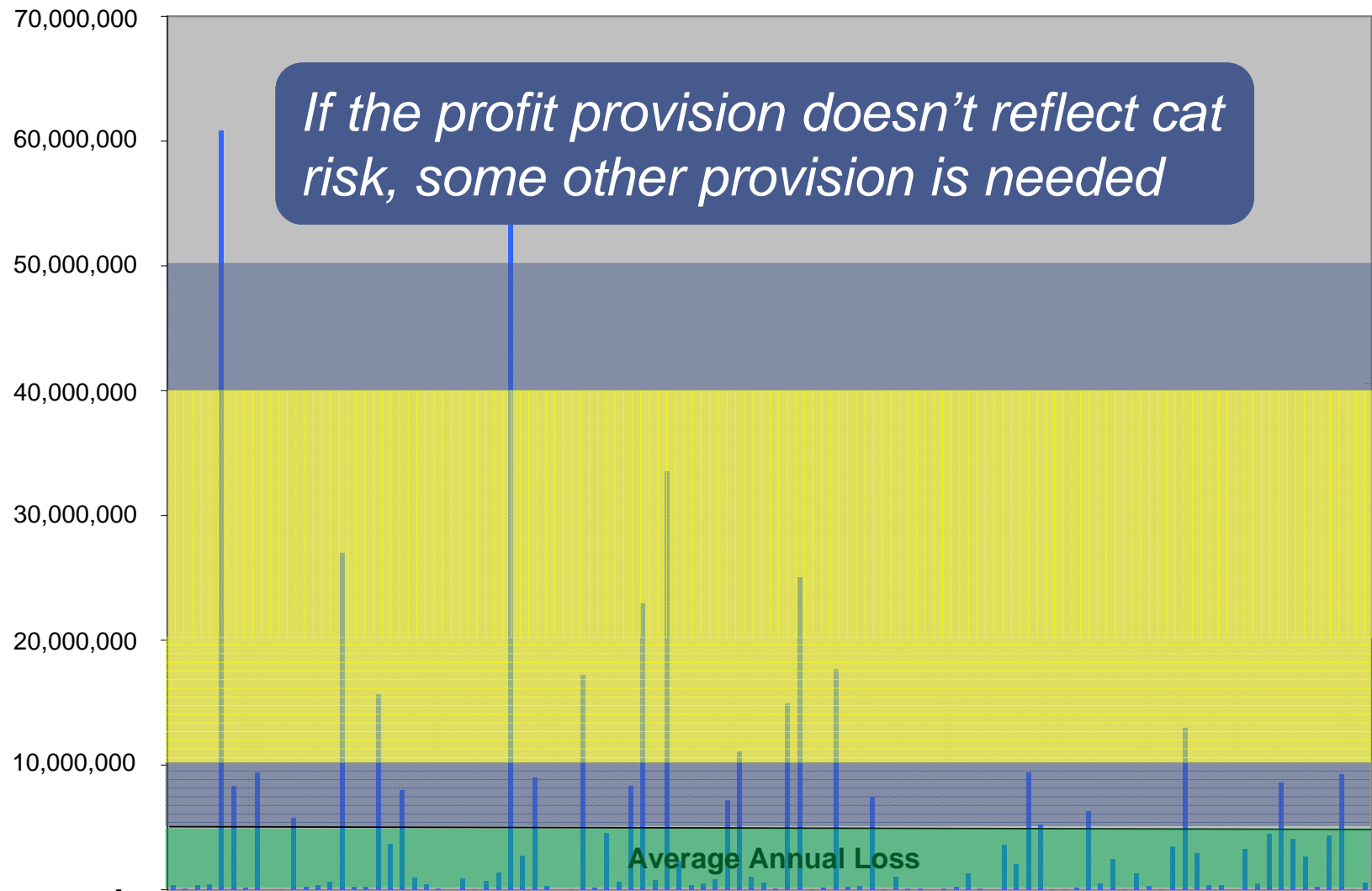
Average Annual Loss

Market Price of Risk

- Extension of reinsurance pricing
- Reference to cat bond pricing

Cost of Net Required Capital

- Actual capital held
- Assumed P/S ratio or PML/TVAR target
- Rating agency model
- RBC Cat Charge

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AM Best Stressed BCAR

Current Structure

- First Event – Maximum of
  - 100-Year Hurricane or Convective Storm
  - 250-Year Earthquake
- Second Event – Maximum of
  - 100-Year Hurricane, Convective Storm or Earthquake
- Both net of reinsurance recoverables and reduced for tax savings

Planned Changes

- First Event – All Perils Net PML Varies by Rating

Rating Level	B	B+/B++	A-/A	A+	A++
PML Threshold Confidence Interval	50-yr 98%	100-yr 99%	200-yr 99.5%	500-yr 99.8%	1000-yr 99.9%

- Second Event – TBD

Cost of Catastrophe Capital Calculations

Capital Cost Calculation

	A.M. Best
1. Required Catastrophe Capital[1]	102,960
2. Target GAAP ROE	12.0%
3. SAP/GAAP Ratio[2]	82.0%
4. Federal Income Tax Rate[2]	27.4%
5. Investment Rate of Return[2]	2.5%
6. Pre-tax Underwriting Return = [(2)/(3)]/[1-(4)]-(5)	17.7%
7. Cost of Required Catastrophe Capital	18,180

(000s)

[1] Required Cat Capital is two times the 100 year net post-cat HU PML

Implementation Options

Increased Profit Provision

- Assumes variable with premium
  - 10% higher rates require 10% more capital and 10% more profit
- Allocates on premium unless profit provision varied by territory

Fixed Risk Margin

- Independent of premium
- Allocate to territories driving retained volatility

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Cat Capital Allocation

VaR	Ignore	Reinsurance Cost Load	Ignore	Single event focus
TVaR	Ignore	Reinsurance Cost Load	Risk Load	Ignores low layer volatility
Marginal Volatility	Risk Load	Reinsurance Cost Load	Risk Load	Loads at entire EP Curve
Capital Tranche	Risk Load X	Reinsurance Cost Load	Risk Load Y	Separate loads low return period layer, XS return period layers

US Peril - Likelihood

All Other Perils

Other Wind

VaR Threshold

CA EQ

Northeast Hurricane

Gulf Hurricane

New Madrid EQ

FL Hurricane

Retained	Reinsured	Retained

Layer of Capital

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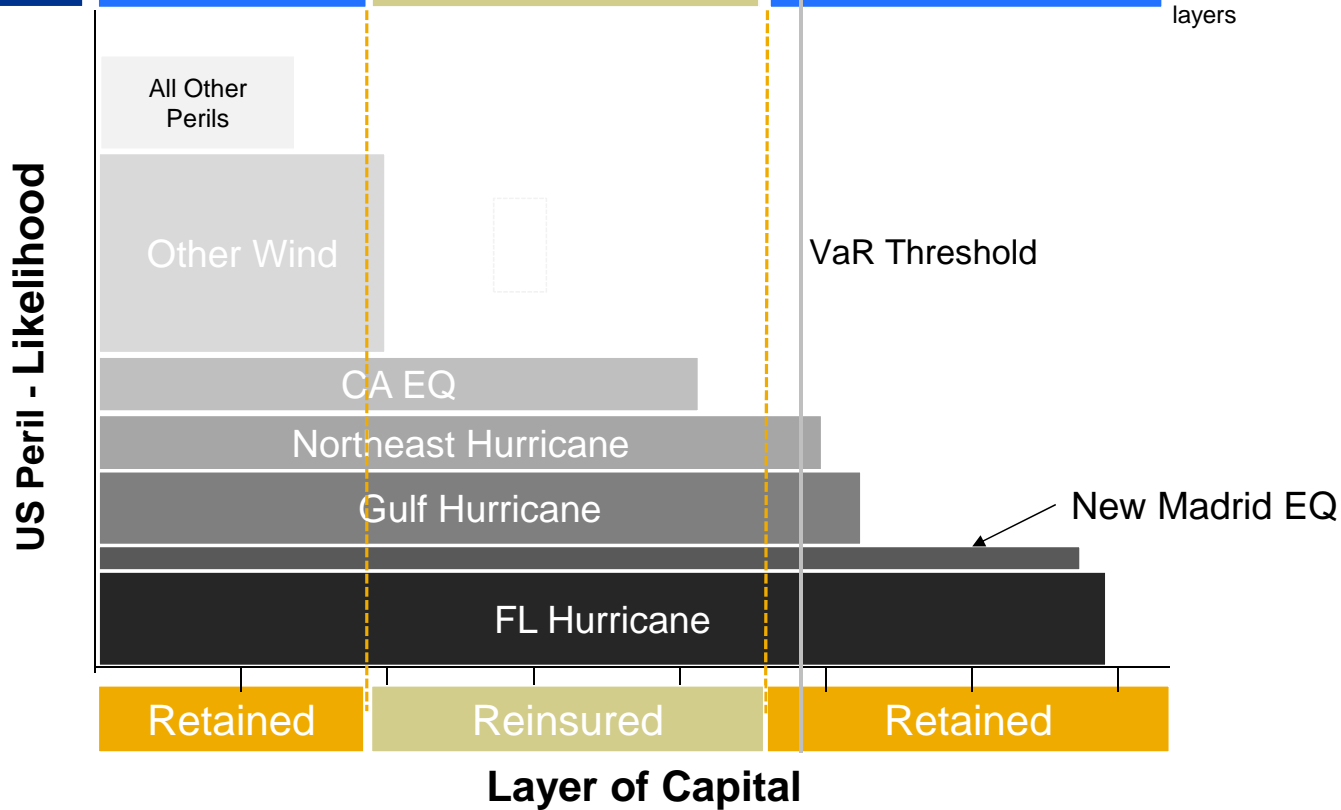
Best Practices

Implement as a fixed risk margin

Allocate geographically within state

- Promotes diversification

Avoid overlap with variable profit provision

- Or replace variable provision with a fixed non-cat risk margin

Avoid charging profit on profit

- If you keep a traditional profit provision, don't apply it to the risk margin

Phase in over time

- Attrition will reduce cost of peaks

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Does Catastrophe Reinsurance Increase or Decrease the Cost of Insurance for Policyholders?

Reinsurance Saves Money!

	Without Reinsurance	With Reinsurance
Required Cat Capital	$185M	$17M
Annual Cost	$32M	$3M
Net Cost of Reinsurance	-	$4M
Total Volatility Cost	**$32M**	**$7M**

- Reinsurers can diversify cat risk more efficiently than primary insurers
  - Renting often cheaper than owning

- Why do consumers, regulators, and even pricing actuaries believe that reinsurance purchases increase insurance premiums?

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Cat Score® Framework

Cat Score® Framework

Gross Expected Loss

- Expected loss (AAL) is a function of policy terms and conditions but is the same estimate for all carriers
- Determined using catastrophe models at the location and policy level

Net Cost of Reinsurance

- Determined specifically based on the **client reinsurance program**
- Allocation driven by **contribution to ceded volatility** and **correlation to industry loss**
- Calibrated using database of observed industry pricing

Cost of Capital

- Calibrated to the **client view** of capital required to support retained cat risk
- Allocation driven by **retained volatility** and correlation with **client portfolio**

Effective catastrophe risk management requires the measuring and recouping all catastrophe risk cost components

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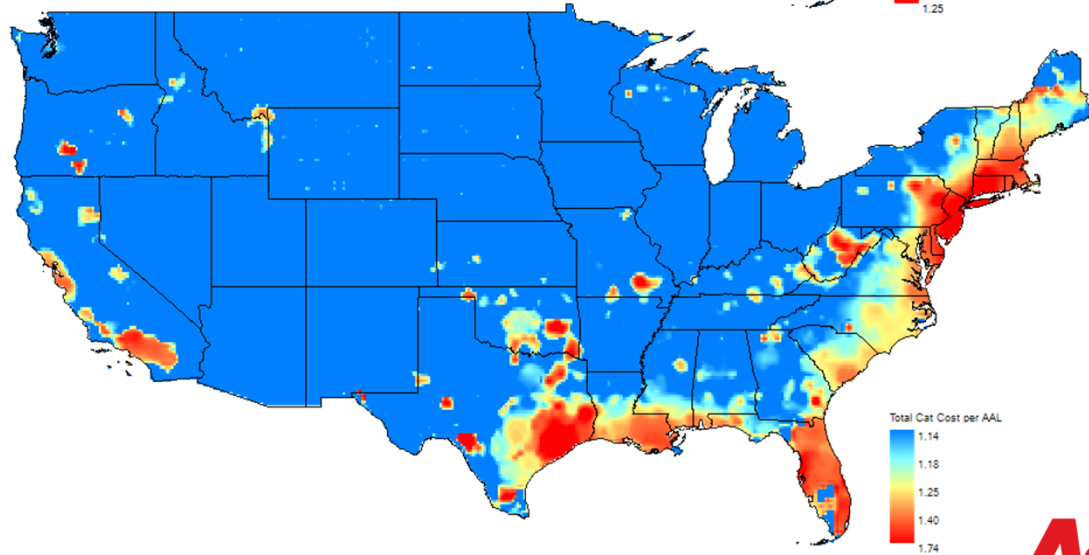
Cat Score as a Loss Cost (AAL) Multiplier

AAL

$$\frac{\text{Cat Score}}{\text{AAL}}$$

Cat Score as a Loss Cost (AAL) Multiplier

AAL

$$\frac{\text{Cat Score}}{\text{AAL}}$$

AAL per $1,000 TIV
1.20
1.49
1.75
2.12

Total Cat Cost/AAL
2.41
2.50
2.67
2.79

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Cat Score as a Loss Cost (AAL) Multiplier

AAL

$$\frac{\text{Cat Score}}{\text{AAL}}$$

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Cat Score as a Loss Cost (AAL) Multiplier

AAL

Cat Score
―――――
AAL

Empower Results®
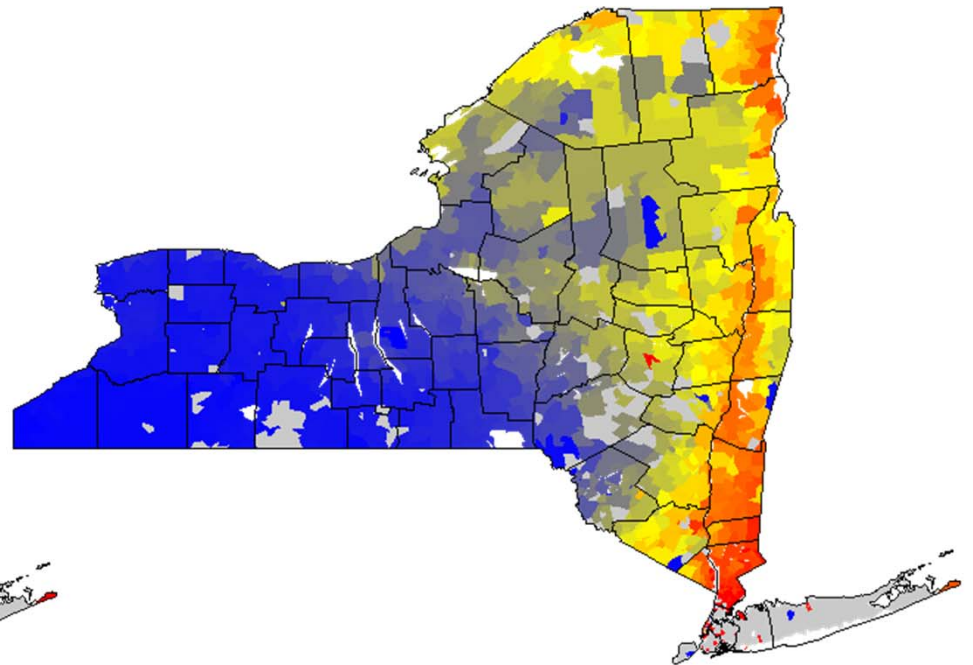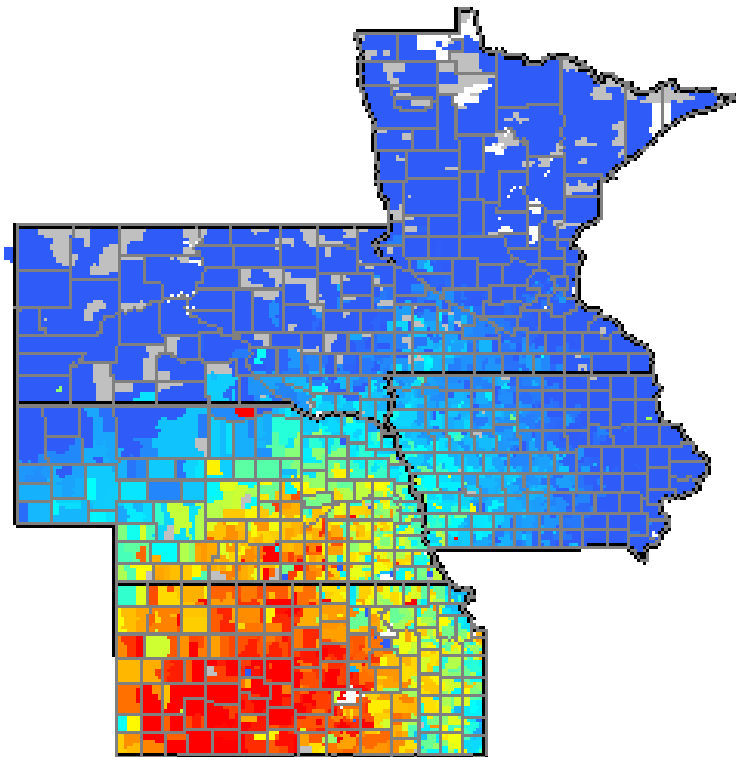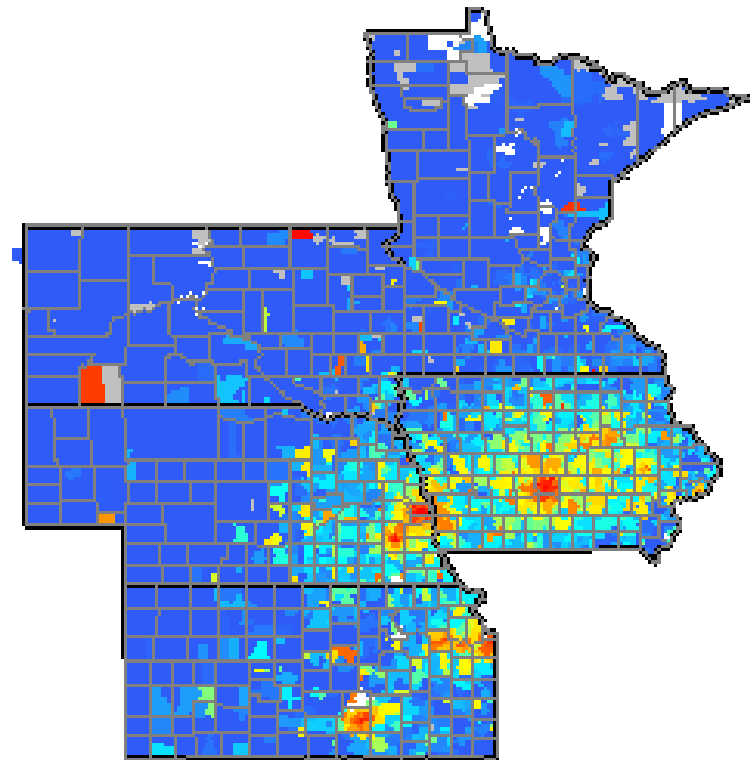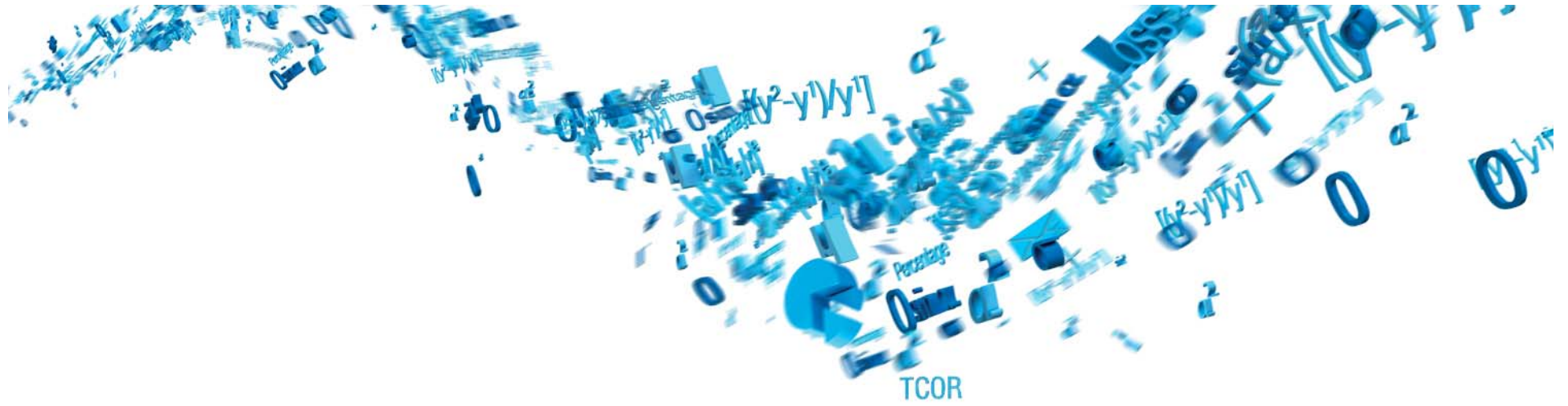
Section 2: Applications

Catastrophe Risk Management

Identify and track exposure concentrations

Model Exposures

Structure Reinsurance

Allocate catastrophe costs to determine pricing risk loads
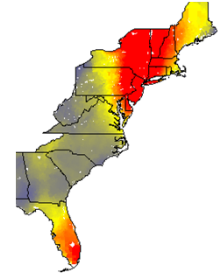
Monitor cat event tracts & exposed locations
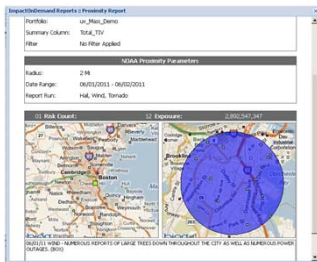
Monitor new business for rate adequacy and PML impact

Allocate Production Capacity
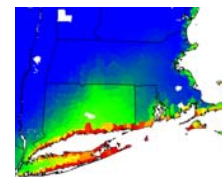
Evaluate Profitability & set growth capacity
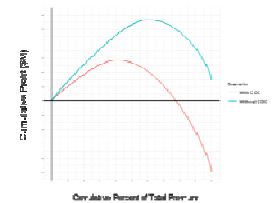
Profitability Analysis by Policy
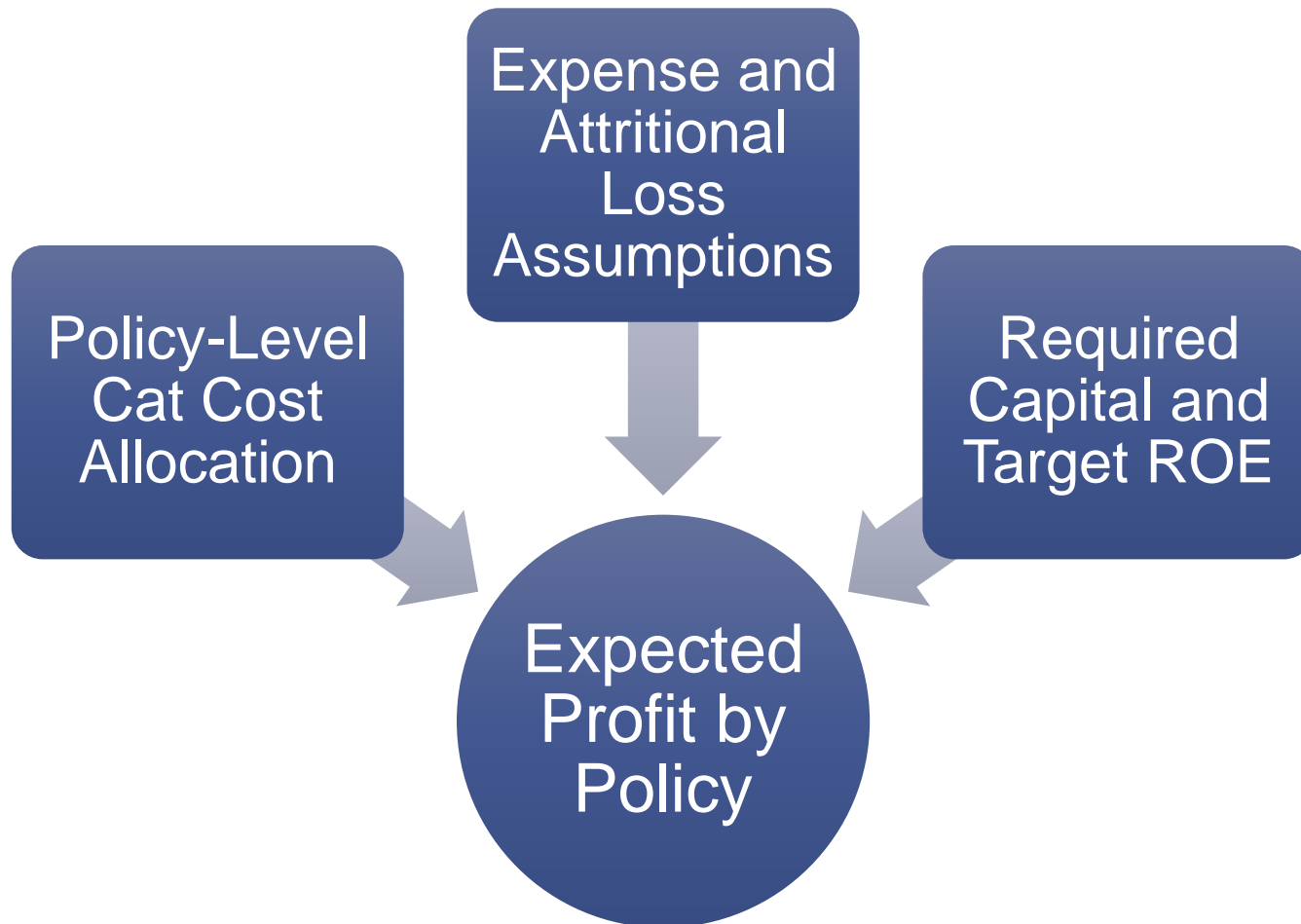
Cumulative Profit Curves

New Jersey Homeowners Profit Curve
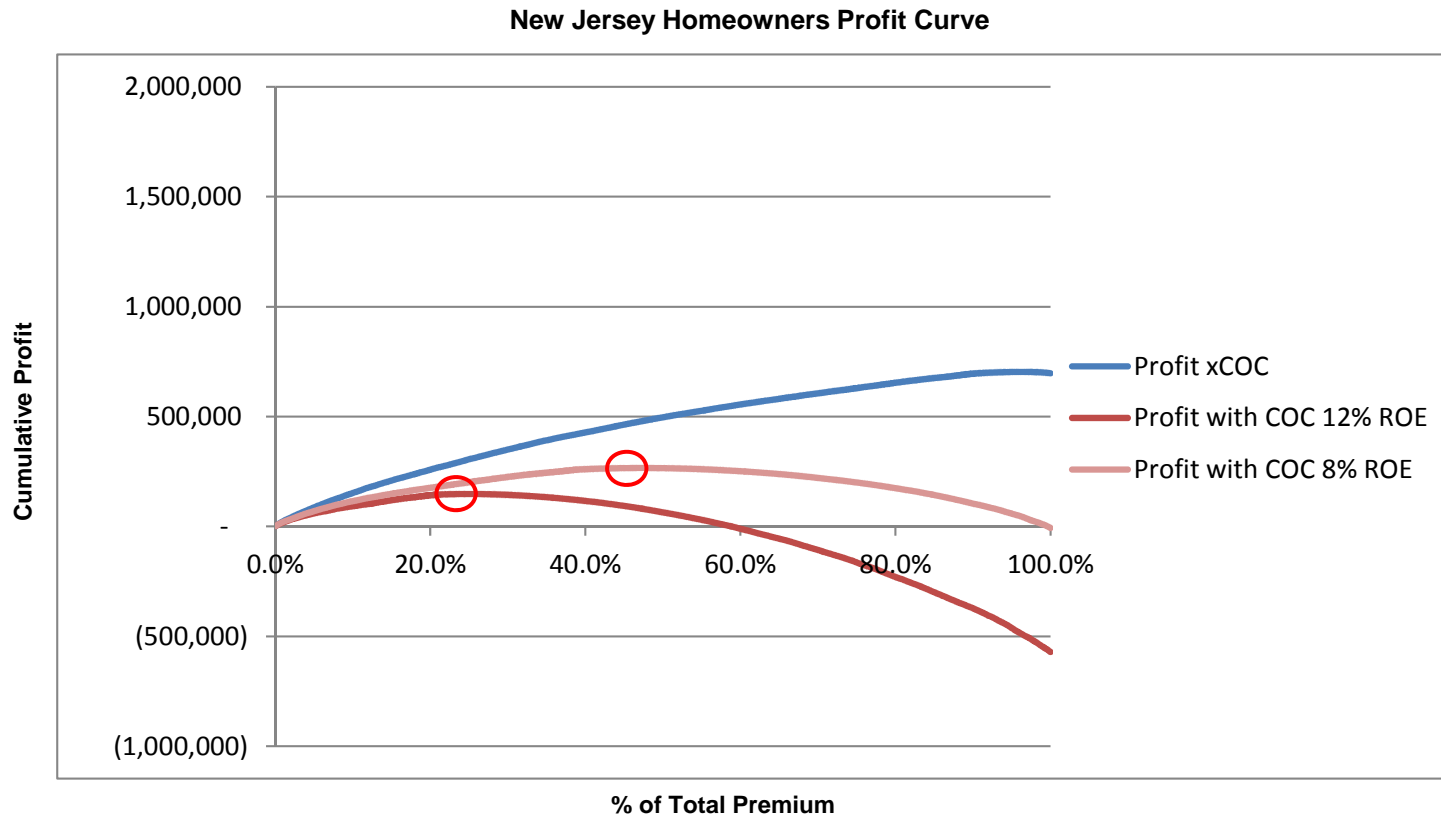

- The blue line shows that almost all policies are expected to earn a positive profit

- The pink line shows that 47% of policies are expected to earn an 8% risk-adjusted ROE

- The red line shows that 25% of policies are expected to earn a 12% risk-adjusted ROE
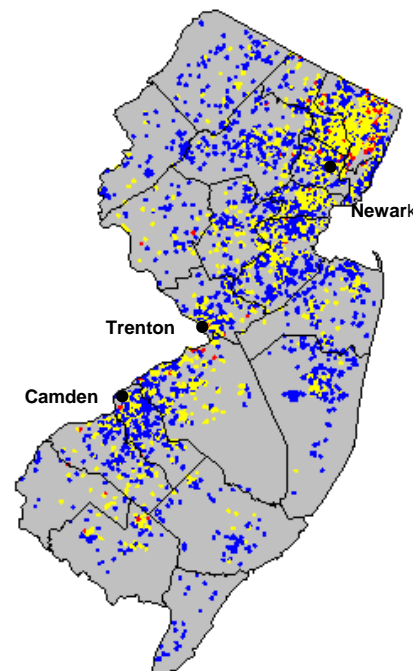
Expected Profitability by Policy

Profitability – 12% ROE

Profitability – 8% ROE

Legend:
- Blue: Rate Adequate
- Yellow: Inadequate Return
- Red: Unprofitable
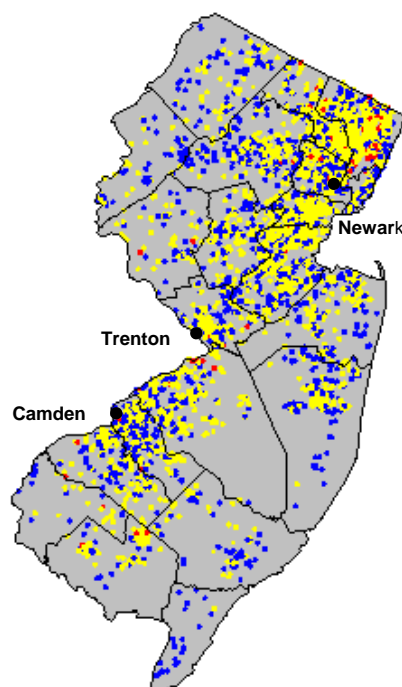
Risk is acceptable as long as
- A solvency concern is not being created, *and*
- Adequate compensation is being secured

Key Observations

- Very few policies priced at an expected negative profit

- There may be opportunities to write profitably on the coast

- Target combined ratios vary by geography

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A Comparison of Target Combined Ratios in New York

Company A

Target CR at Varying ROE

ROE	Target CR
5%	93.2%
8%	88.3%
10%	84.9%
12%	81.6%
15%	76.7%

Company B

Target CR at Varying ROE

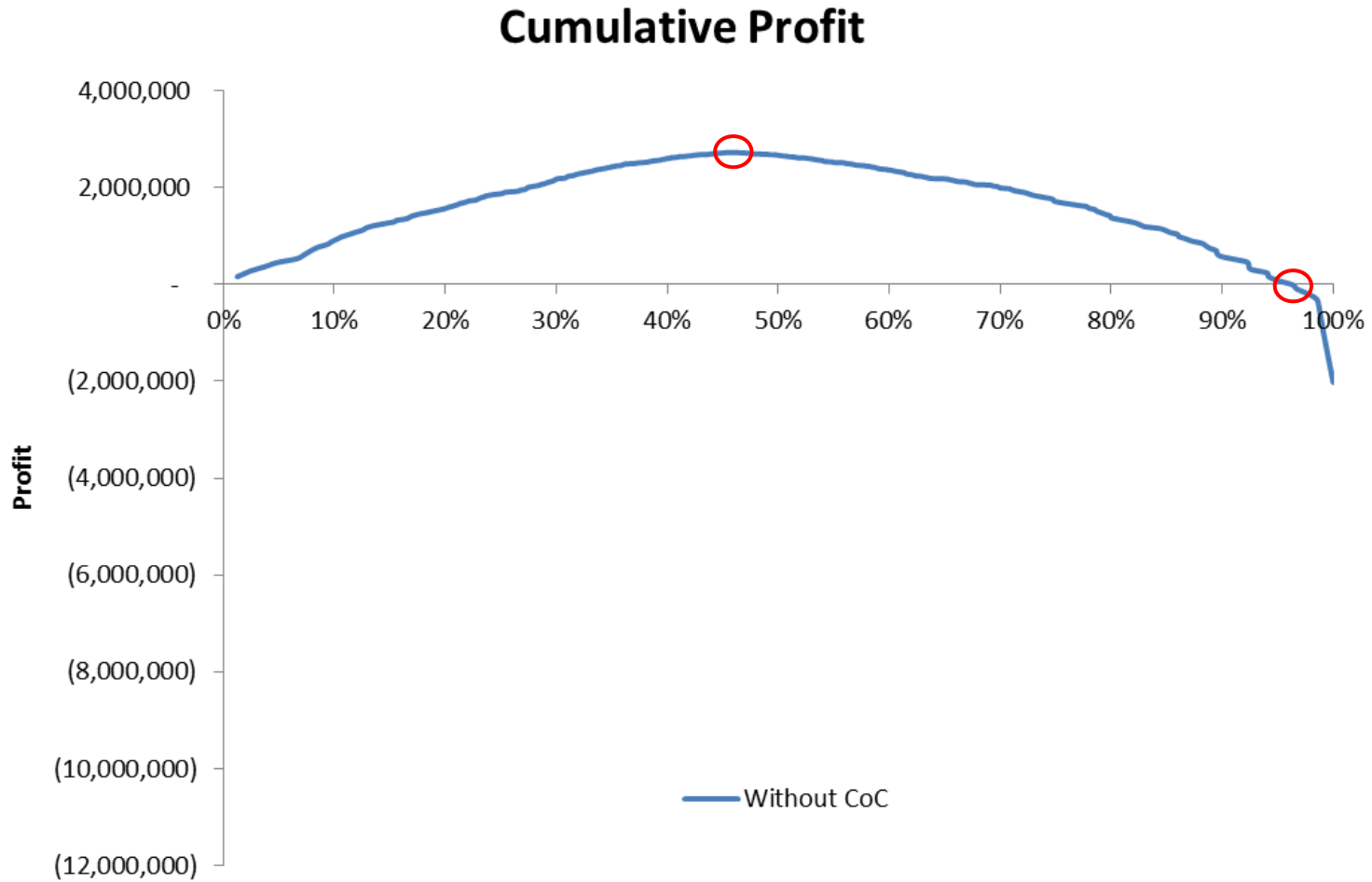| ROE	Target CR
5%	87.6%
8%	75.2%
10%	67.0%
12%	58.7%
15%	46.3%
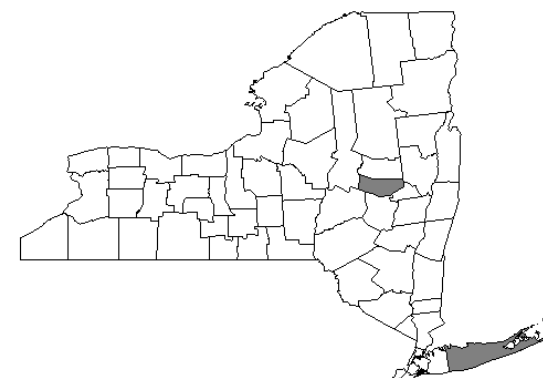
County	Target CR
Montgomery County	91.2%
Suffolk County	55.9%

- Company B writes significantly more on Long Island

- Company A buys significantly more reinsurance

Aon Benfield | Analytics
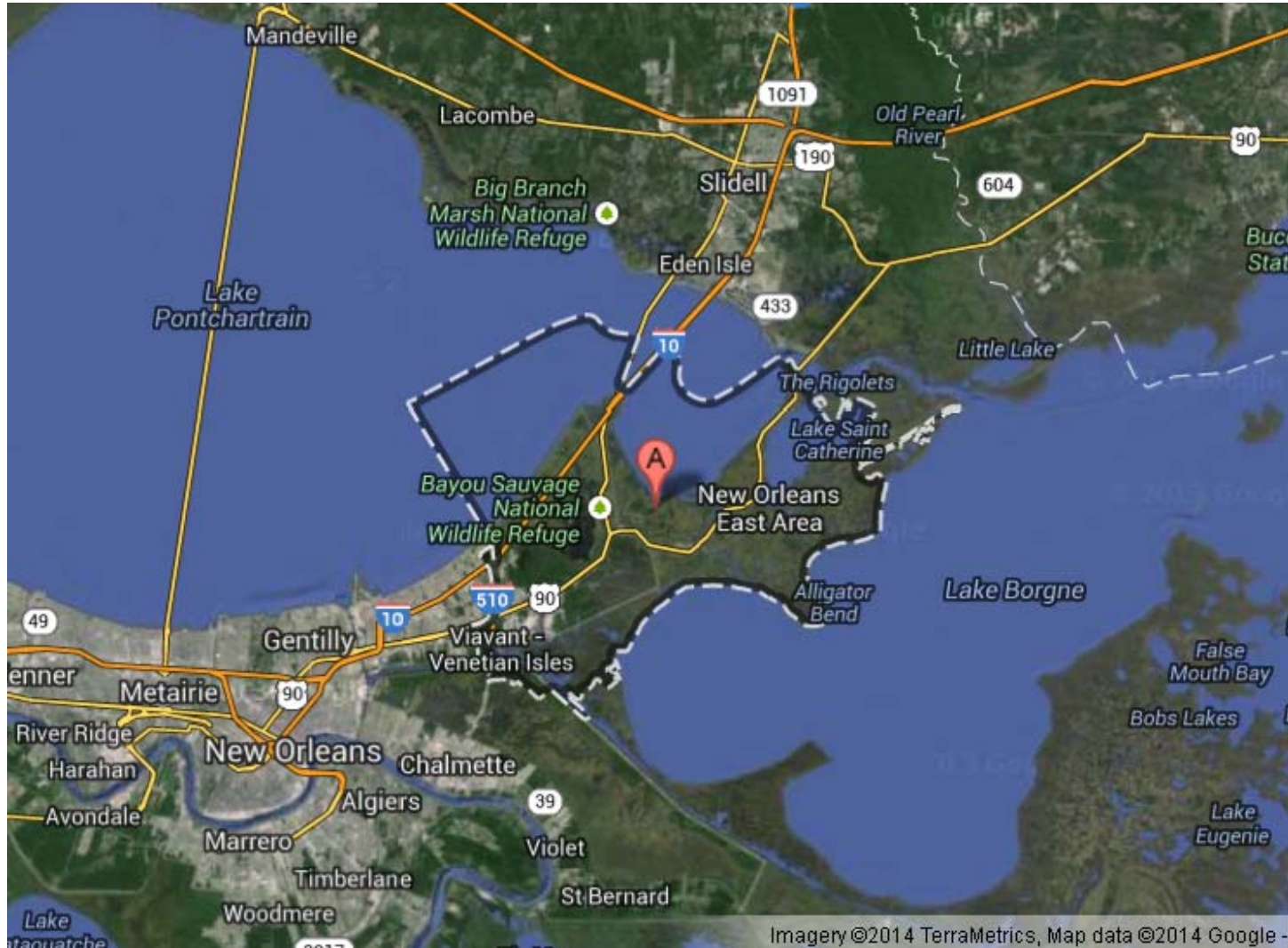Risk & Capital Strategy

Strategic Planning

Cumulative Expected Profit per Policy

Cumulative Expected Profit per Policy
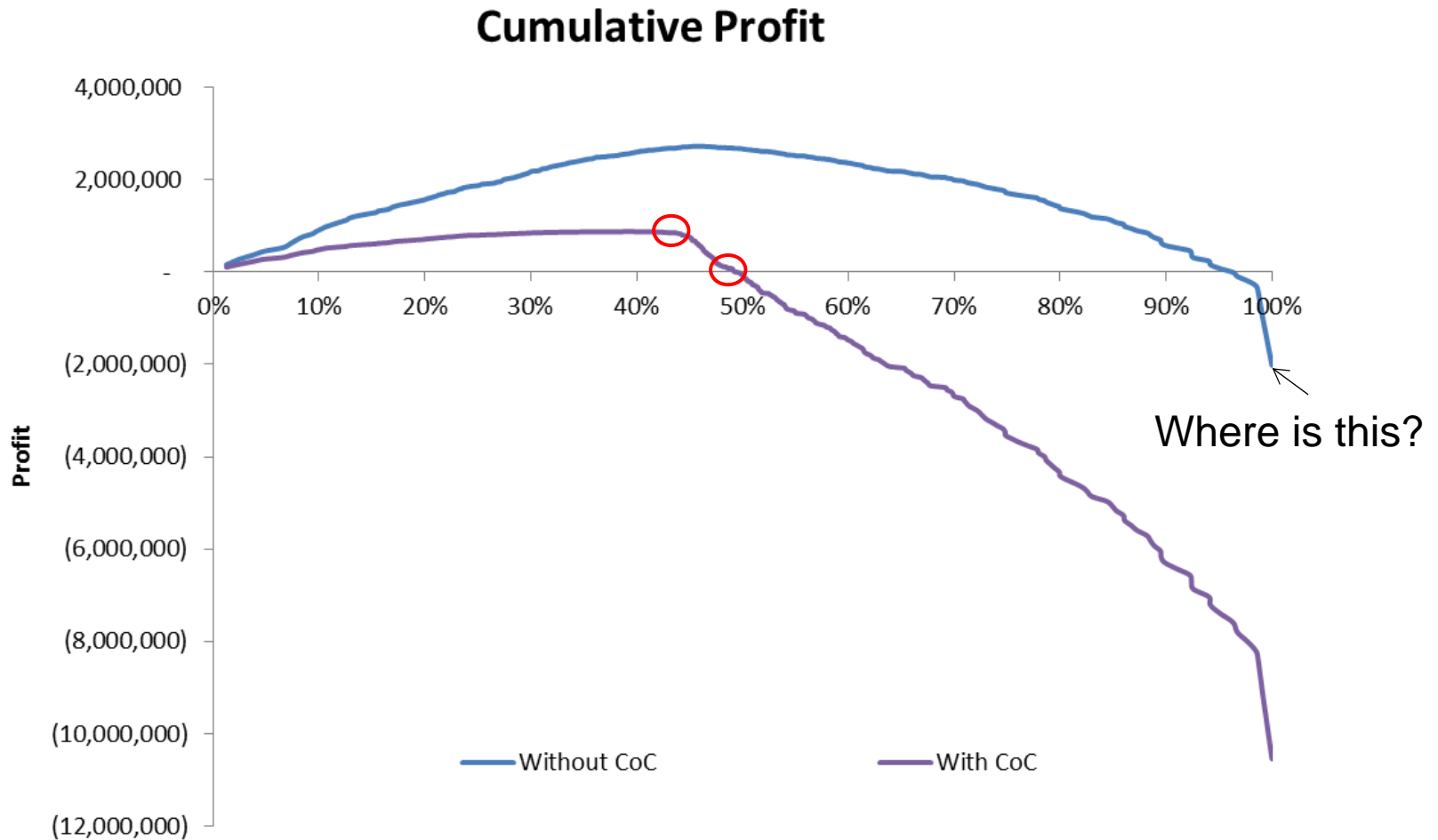
Zip Code 70129

Cumulative Expected Profit per Policy

Cumulative ROE

-5.4%

ROE
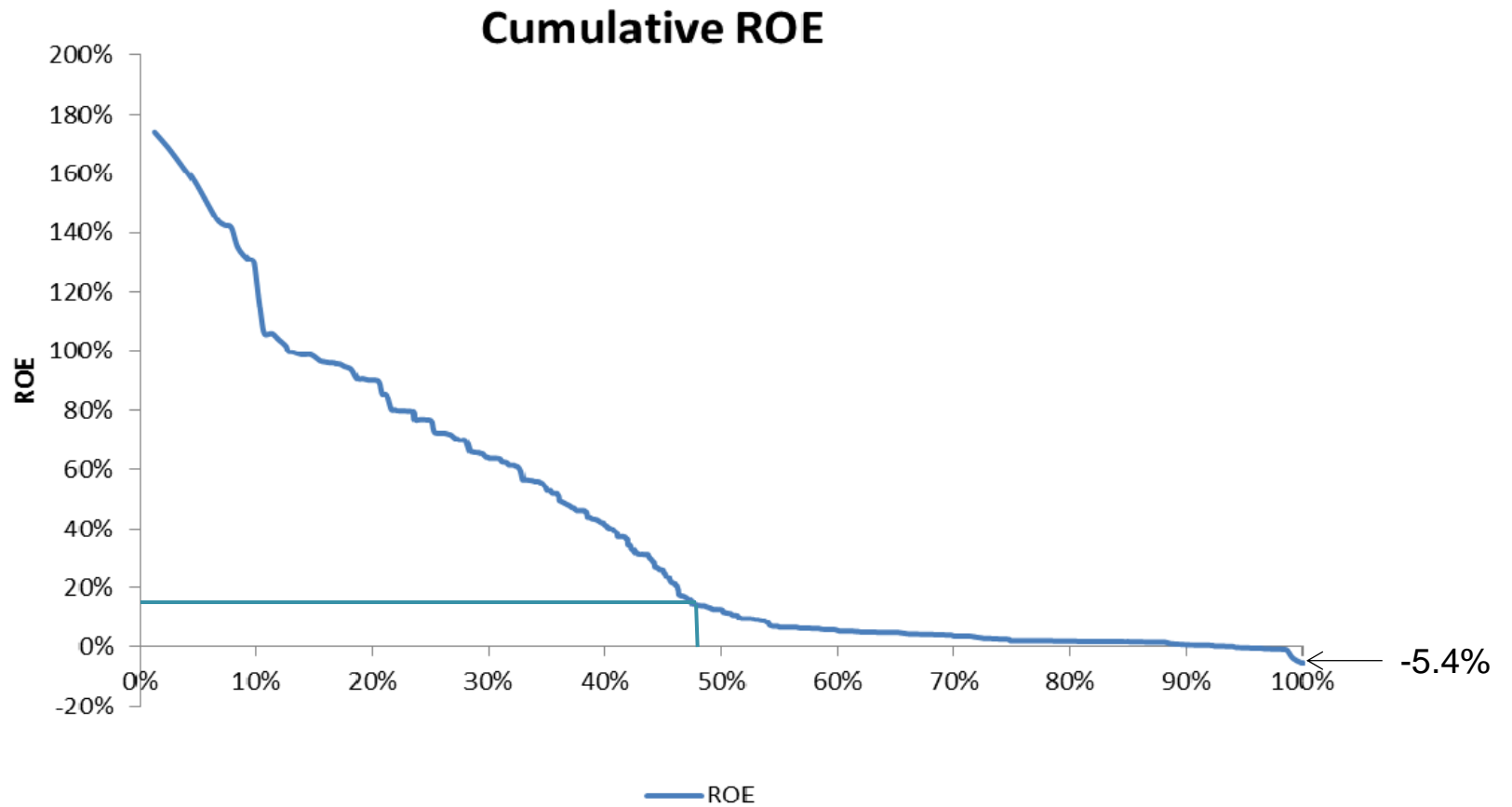
Indicated Rate Need per Policy

Indicated Rate Need

|	
-0.15	
-0.05	
0	
0.15	
0.25	
0.4	
0.55	
1.0	
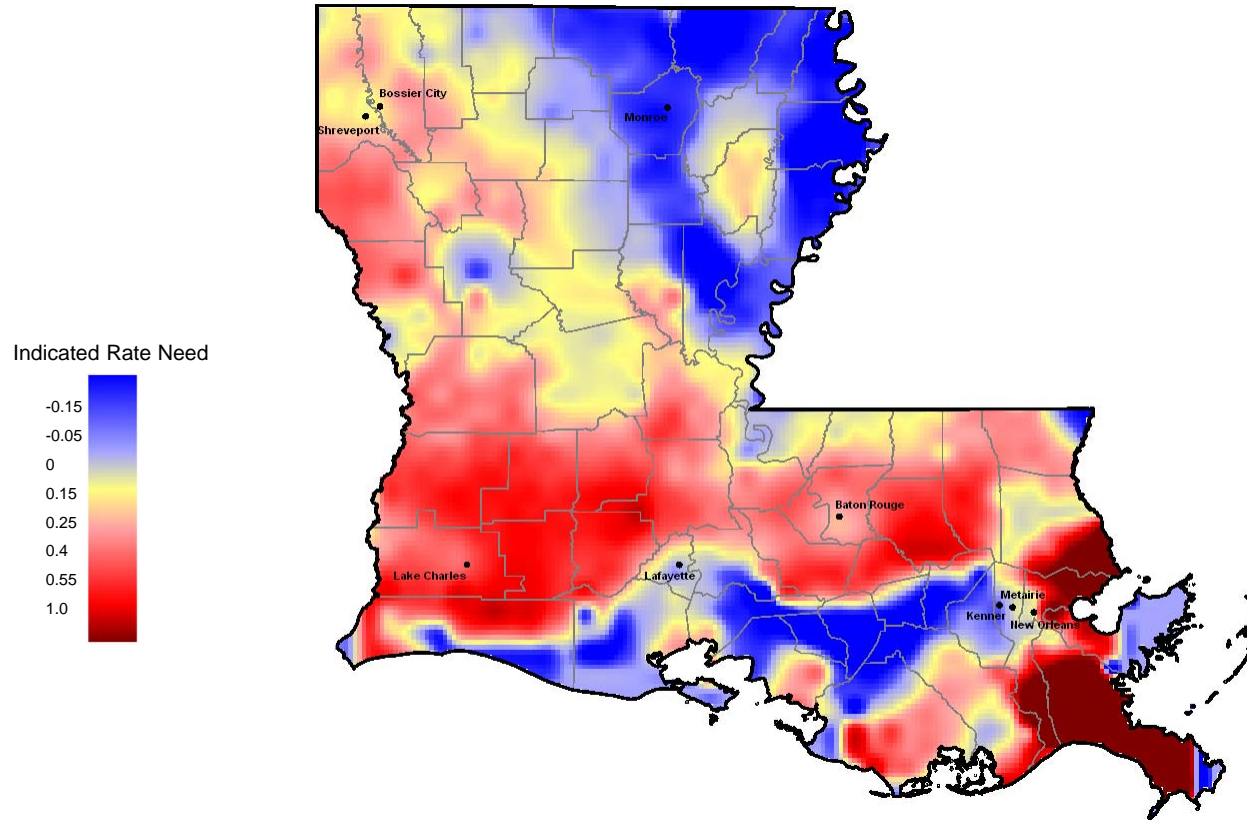
Plan for Rate Activity

- +32.1% indicated rate need

- +10% achievable statewide rate increase based on recent approvals

- Group policies by zip to approximate rating territories
  - Or potential rating territories

- Raise rates by 40% of indicated
  - Tempered due to expected attrition and impact on volatility costs
  - 20% cap to avoid regulatory push-back

- Assumed incremental attrition based on selected rate changes

Attrition Rates

Rate Increase	Attrition
5-10%	1%
10-15%	2%
Over 15%	4%

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Potential Growth Targets

Indicated Rate Need

-0.15
-0.05
0
0.15
0.25
0.4
0.55
1.0
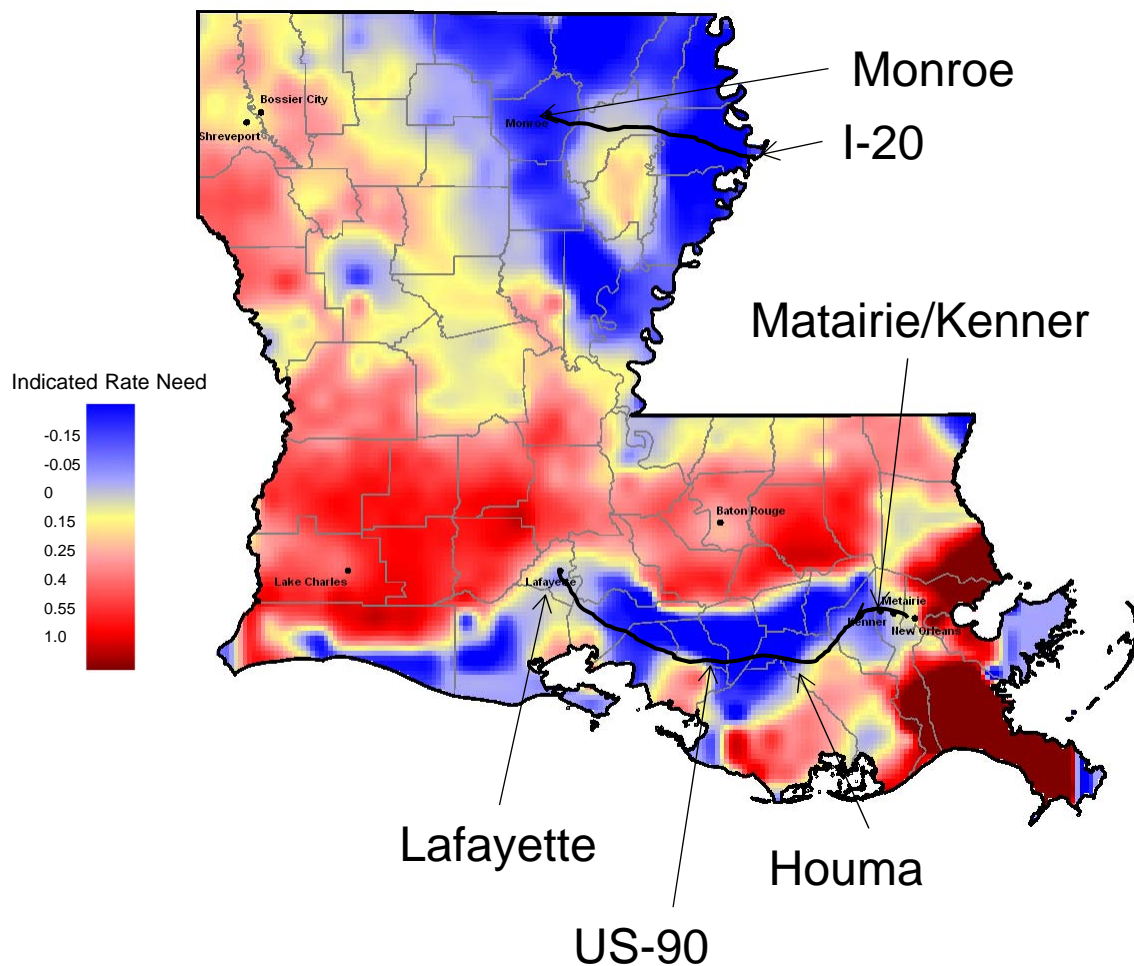
Metro Area	Population
New Orleans-Metairie-Kenner	1.2
Baton Rouge	0.8
Shreveport-Bossier City	0.4
Lafayette	0.3
Houma-Bayou Cane-Thibodaux	0.2
Lake Charles	0.2
Monroe	0.2

Growth Rates

Profit Margin	Growth
5-10%	1%
10-15%	2%
Over 15%	4%

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Expected Impact on Exposures

Current

After Implementation

TIV (in 000s)

15
30
45
60
80
100
150
250
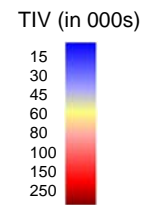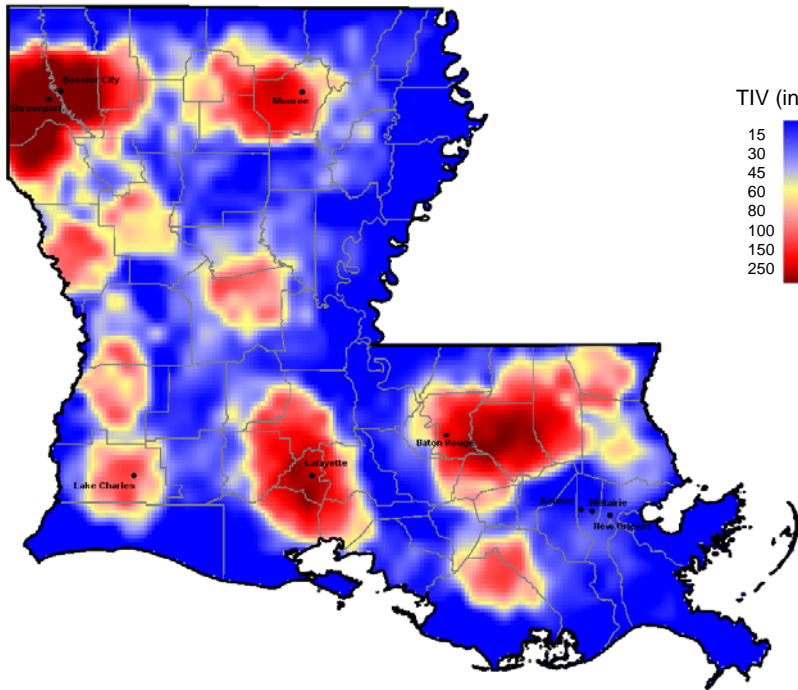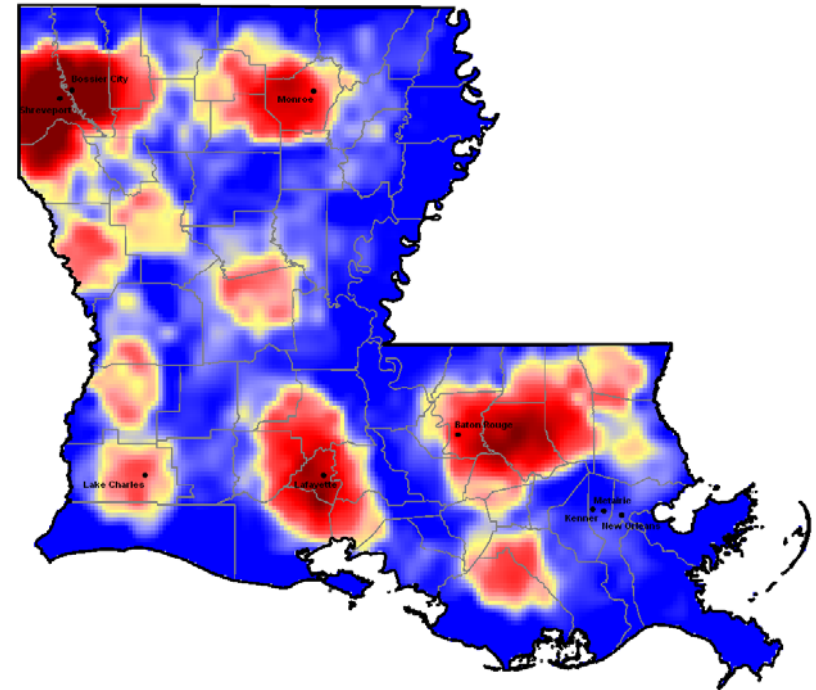
Expected Impact on Premium

Current

After Implementation

Premium per $1k TIV

8
9.5
11
12.5
14
18
28
35
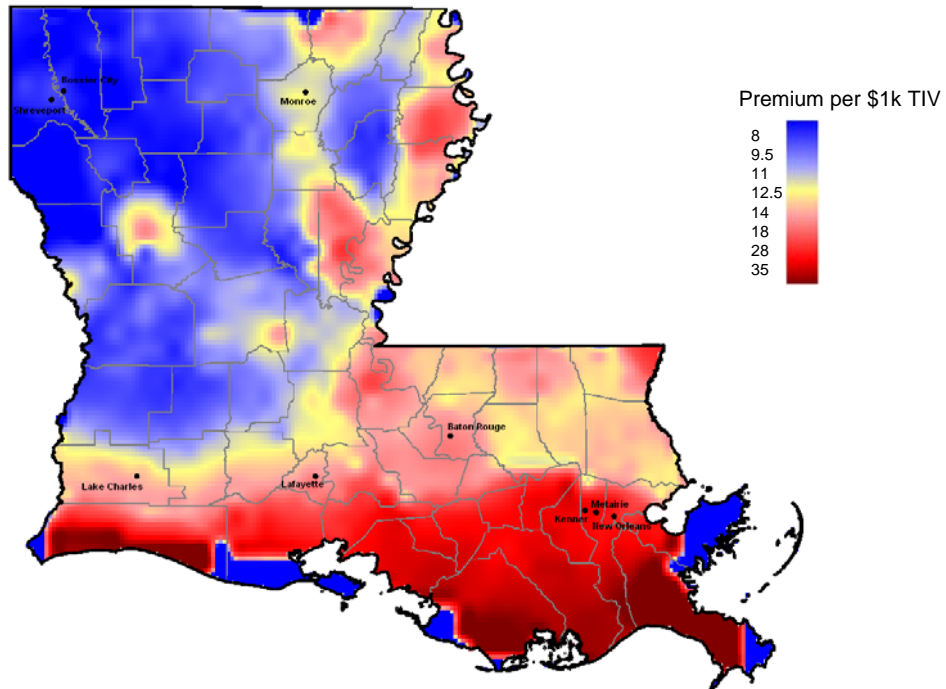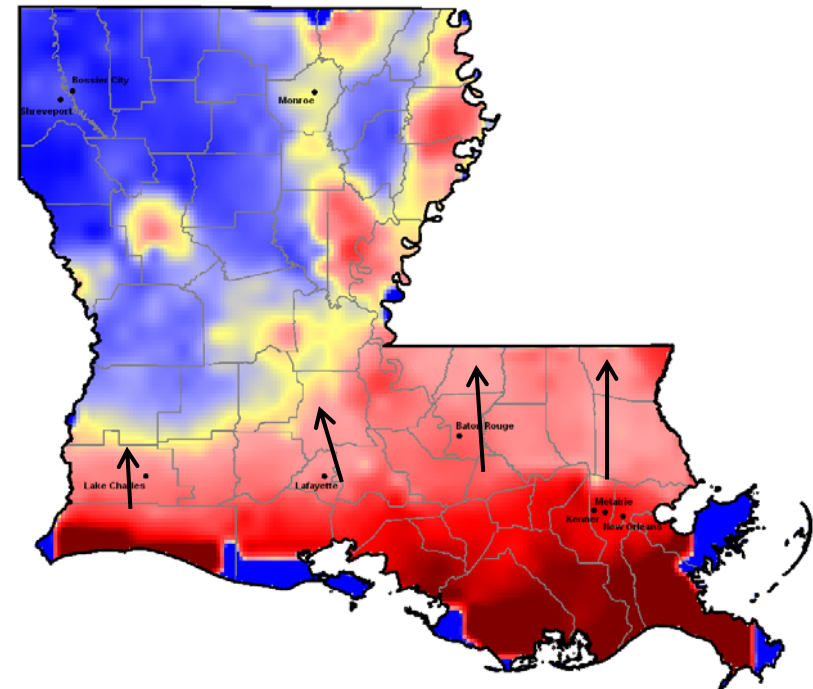
Expected Impact on Reinsurance

Current

After Implementation

Margin/AAL

0.1
0.2
0.3
0.4
0.5
0.55
0.6
0.7
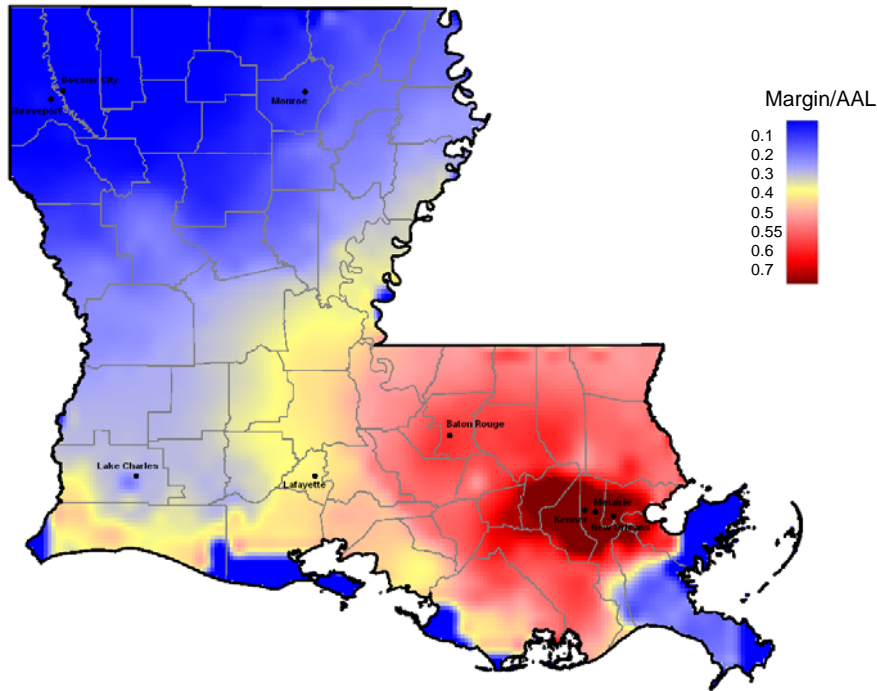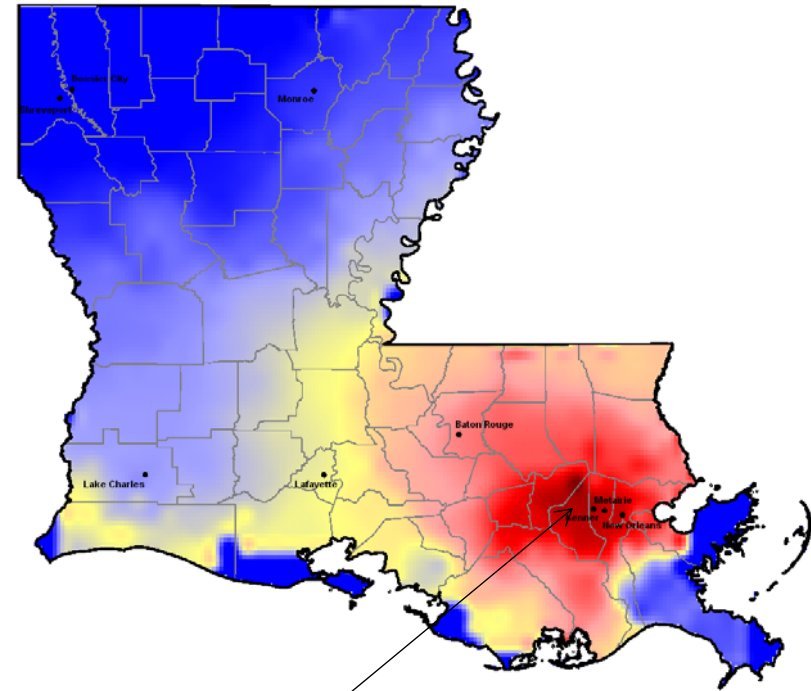
Flattened Peak

Expected Impact on Capital Costs

Current

After Implementation

Capital/AAL

0.1
0.16
0.2
0.3
0.34
0.36
0.38
0.4
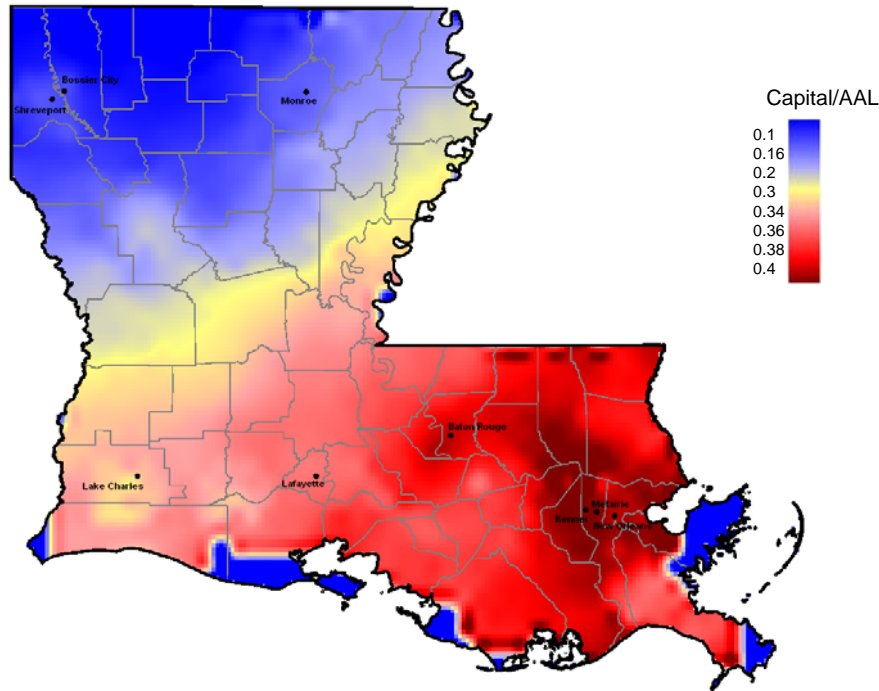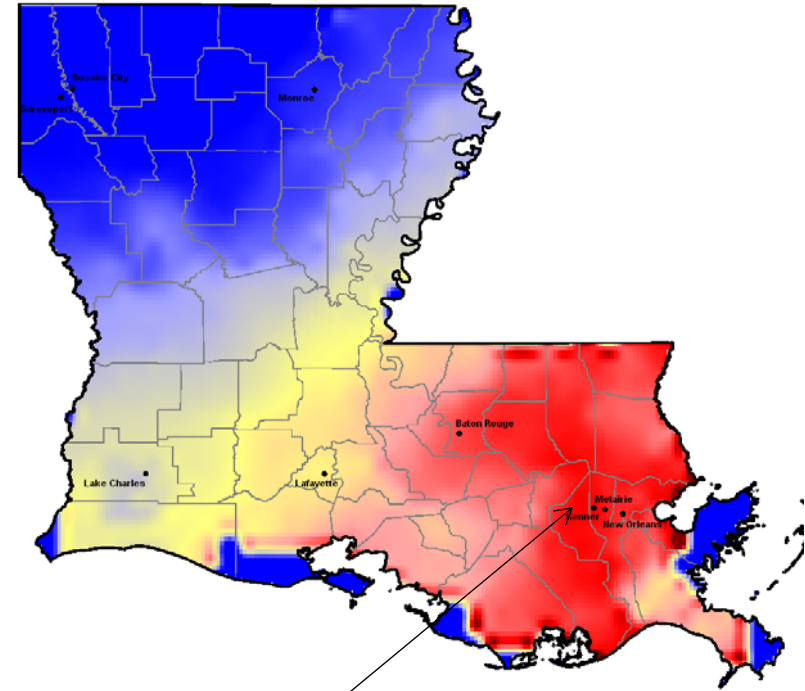
Flattened Peak

Expected Impact on Profitability

Current

After Implementation

Indicated Rate Need

-0.15	
-0.05	
0.0	
0.15	
0.25	
0.4	
0.55	
1.0	

More Policies

Less Unprofitable

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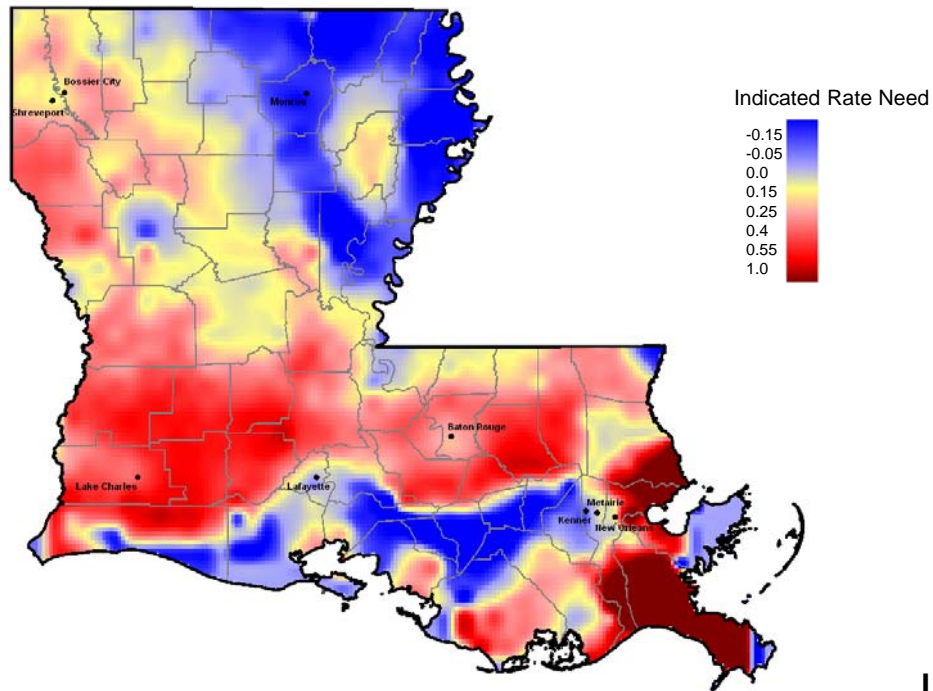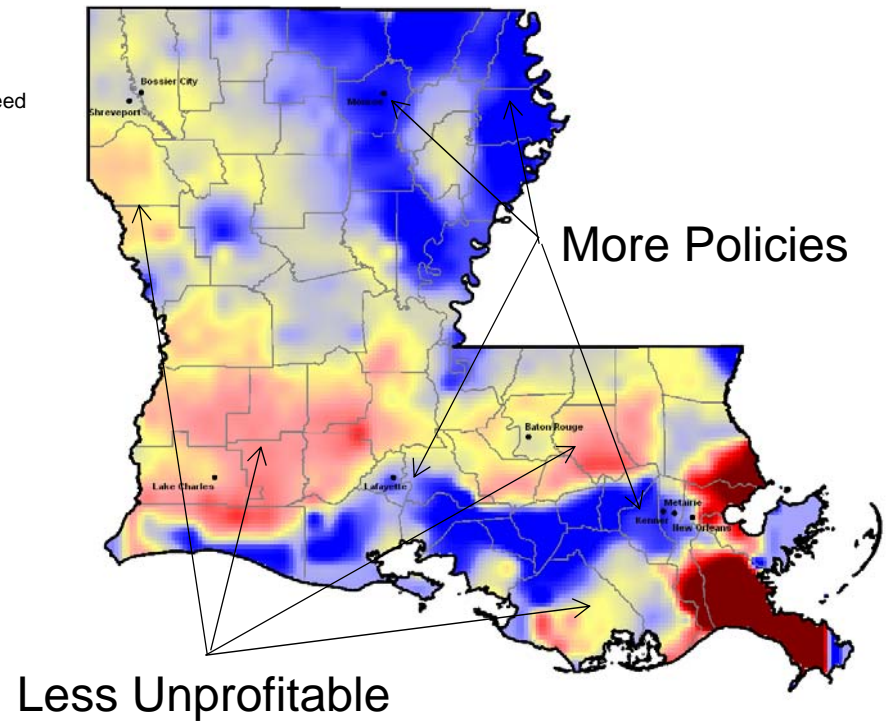
Comparison to Flat Rate Increase

Cumulative ROE

What happened here?

+5.4%
-0.9%
-5.4%

Legend: ROE (Current) — — ROE (Projected) — — ROE (10% Flat Increase)
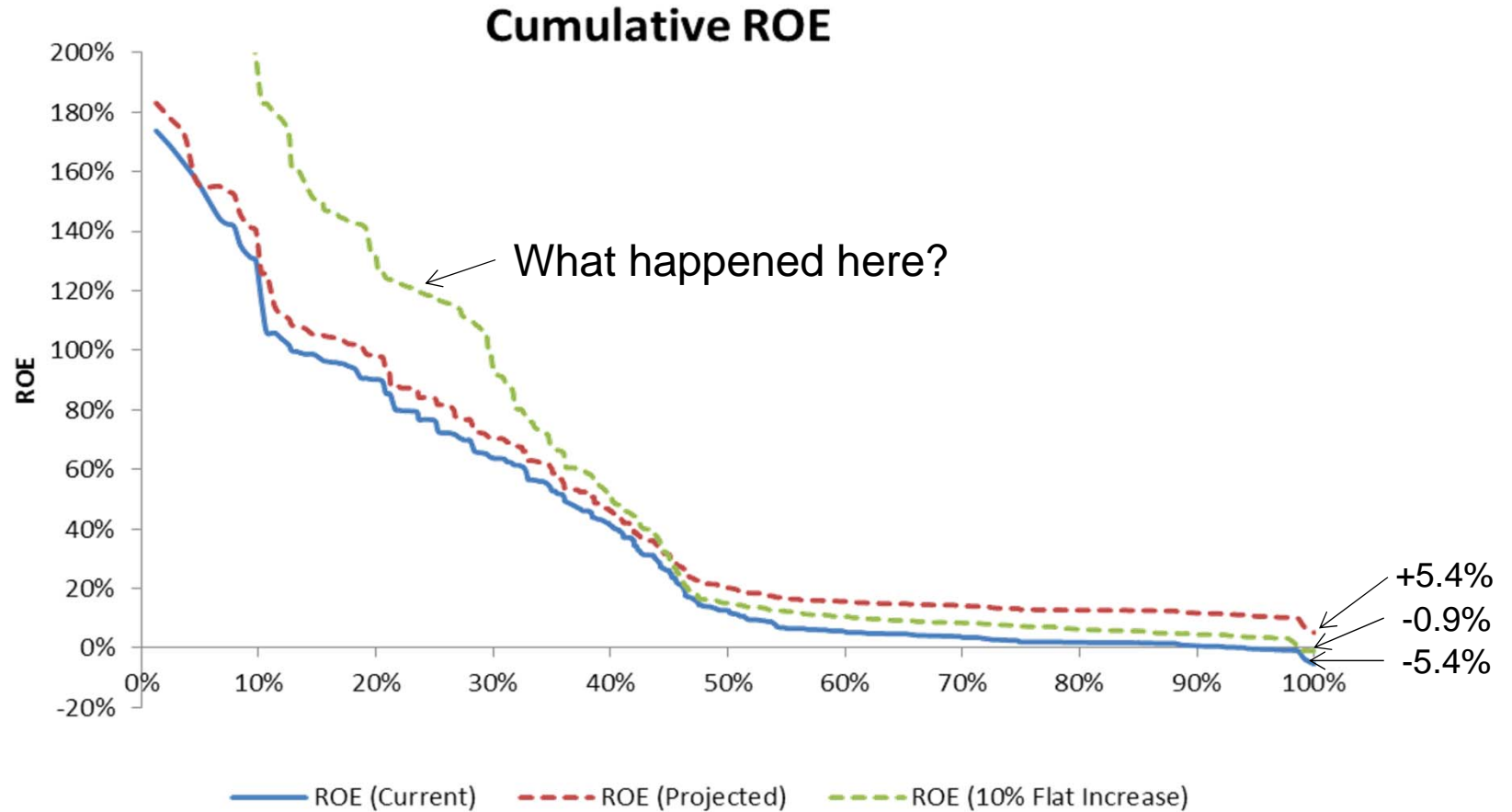
- The green line demonstrates the benefit of a flat 10% rate increase

- The red line demonstrates the benefit of a targeted 10% rate increase combined with targeted growth

Collaborative Steps for Successful Execution

Profitability Study
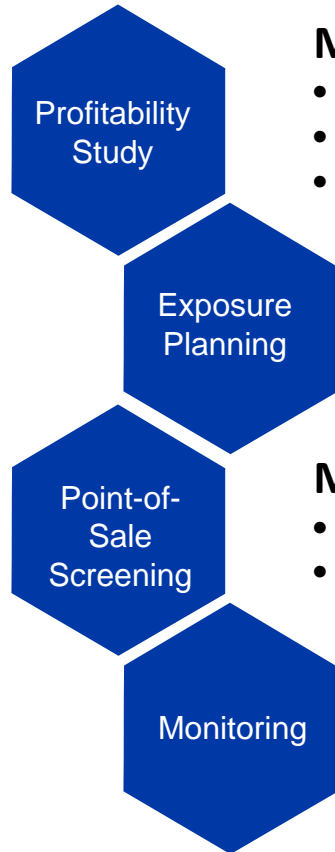
Make sure the Price Is Right
- Evaluate cost of catastrophe differentials across the portfolio
- Combine with client view of attritional and expense differences
- Balance rate change and growth targets by territory and segment

Exposure Planning

Plan for Exposure Accumulation
- Plan to grow where profitable, hold elsewhere
- Use Cat Score **Portfolio Manager** to quantify impact and test plan alternatives

Point-of-Sale Screening

Maintain Margin Discipline at Point of Sale
- **Cat Score Location Analyzer** provides total cost of catastrophe by location
- Used to filter new business applications for Accept/Reject decision
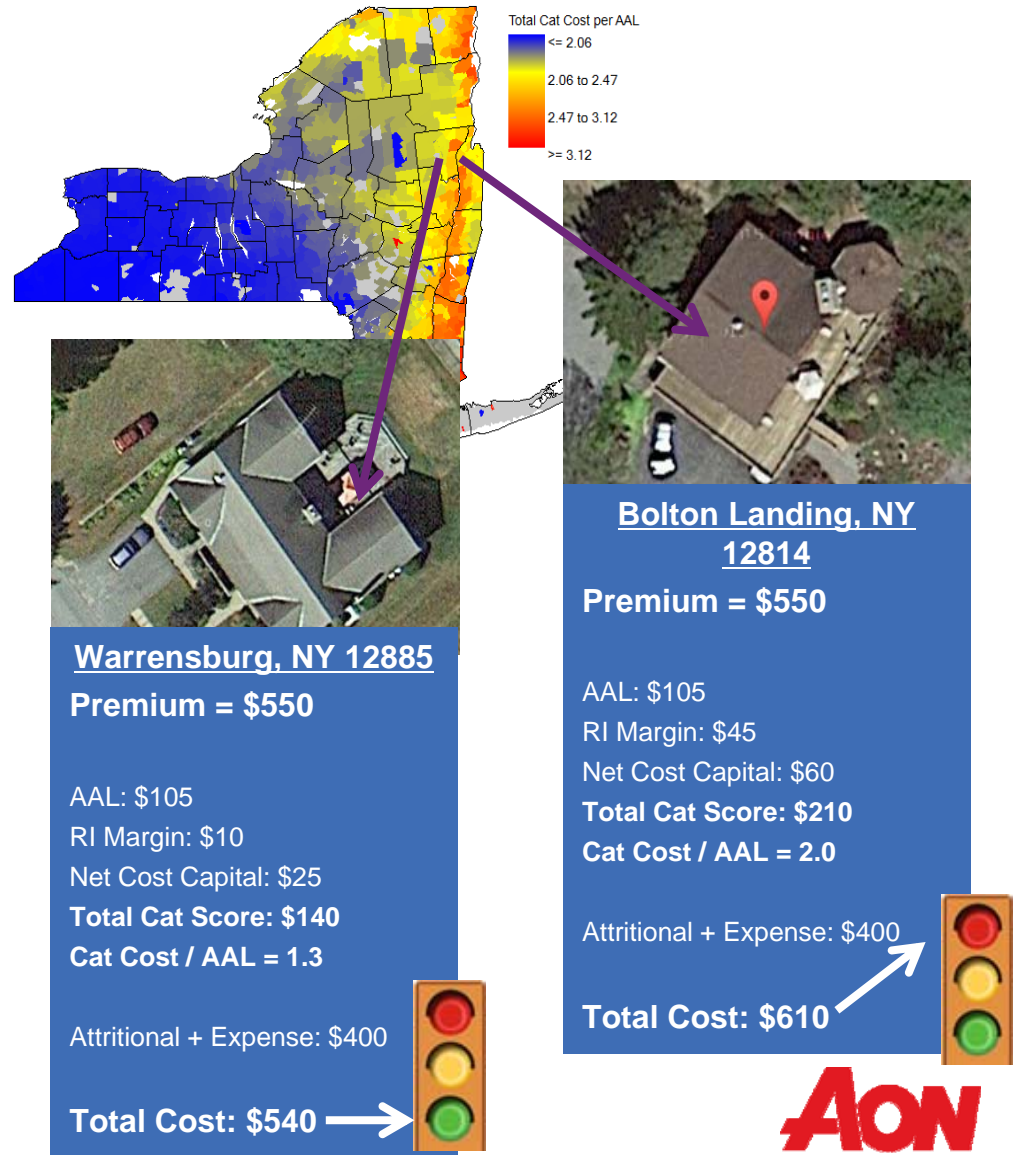
Monitoring

Track Exposure Change Impact to PML
- **Cat Score Portfolio Manager** used to track PML in between model runs
- Evaluate book roll opportunities
- Re-allocate capacity if actual exposure deviates from plan

Benefits include improved profitability while facilitating growth in profitable areas, better diversification, and continued improvement over time

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Cat Score® Location Analyzer

Quantifying total cat costs for individual prospective risks at point of sale

- **Cost components**
  - Gross Expected Loss
  - Reinsurance Margin
  - Cost of Net Capital
- **WebServices technology delivery**
  - Link to your own pricing system
  - Also available by website
  - Accessible through ImpactOnDemand
- **Application by clients:**
  - Strategically grow into new geographic regions with adequate price
  - Identify inadequately priced risks
  - Provide key cost component for combined cat, non-cat price adequacy evaluation

Total Cat Cost per AAL
- <= 2.06
- 2.06 to 2.47
- 2.47 to 3.12
- >= 3.12

Warrensburg, NY 12885

Premium = $550

AAL: $105
RI Margin: $10
Net Cost Capital: $25
Total Cat Score: $140
Cat Cost / AAL = 1.3

Attritional + Expense: $400

Total Cost: $540

Bolton Landing, NY 12814

Premium = $550

AAL: $105
RI Margin: $45
Net Cost Capital: $60
Total Cat Score: $210
Cat Cost / AAL = 2.0

Attritional + Expense: $400

Total Cost: $610

AON
Empower Results®

Use Portfolio Manager to Monitor Planned Growth

<u>Current Portfolio Metrics</u>

Economic Costs

Metric	ALL	EQ	HU	OW
Gross AAL	15,970	153	7,245	8,572
Ceded AAL	0	0	0	0
Reins Margin	0	0	0	0
Reins Premium	**0**	**0**	**0**	**0**
Capital Cost	0	0	0	0
Total Cat Cost	**15,970**	**153**	**7,245**	**8,572**

US $ in Thousands

Accumulation Metrics

Metric	ALL	EQ	HU	OW
PML-100	131,975	407	130,626	28,705
PML-250	232,161	3,838	232,161	42,385
TVaR-100	266,036	10,734	265,872	48,030
TVaR-250	401,559	24,695	401,559	68,297
SD	35,454	2,469	34,505	7,767

US $ in Thousands

<u>Portfolio Metrics after Growth</u>

Economic Costs

Metric	ALL	EQ	HU	OW
Gross AAL	16,337	161	7,348	8,829
Ceded AAL	0	0	0	0
Reins Margin	0	0	0	0
Reins Premium	**0**	**0**	**0**	**0**
Capital Cost	0	0	0	0
Total Cat Cost	**16,337**	**161**	**7,348**	**8,829**

US $ in Thousands

Accumulation Metrics

Metric	ALL	EQ	HU	OW
PML-100	133,184	490	132,984	29,609
PML-250	235,394	4,386	235,394	44,601
TVaR-100	269,658	11,497	269,386	49,119
TVaR-250	406,802	26,156	406,802	69,297
SD	35,944	2,534	34,964	7,945

US $ in Thousands

- The two tables above are examples of information that can be obtained from portfolio manager

- The table on the left represents the current book of business

- This can be updated at any desired interval (quarterly, monthly, weekly) by company staff trained by Aon Benfield