CL-2: Catastrophe Modeling for Commercial Lines

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Casualty Actuarial Society, Ratemaking and Product Management Seminar

March 19-21, 2012

Philadelphia, PA

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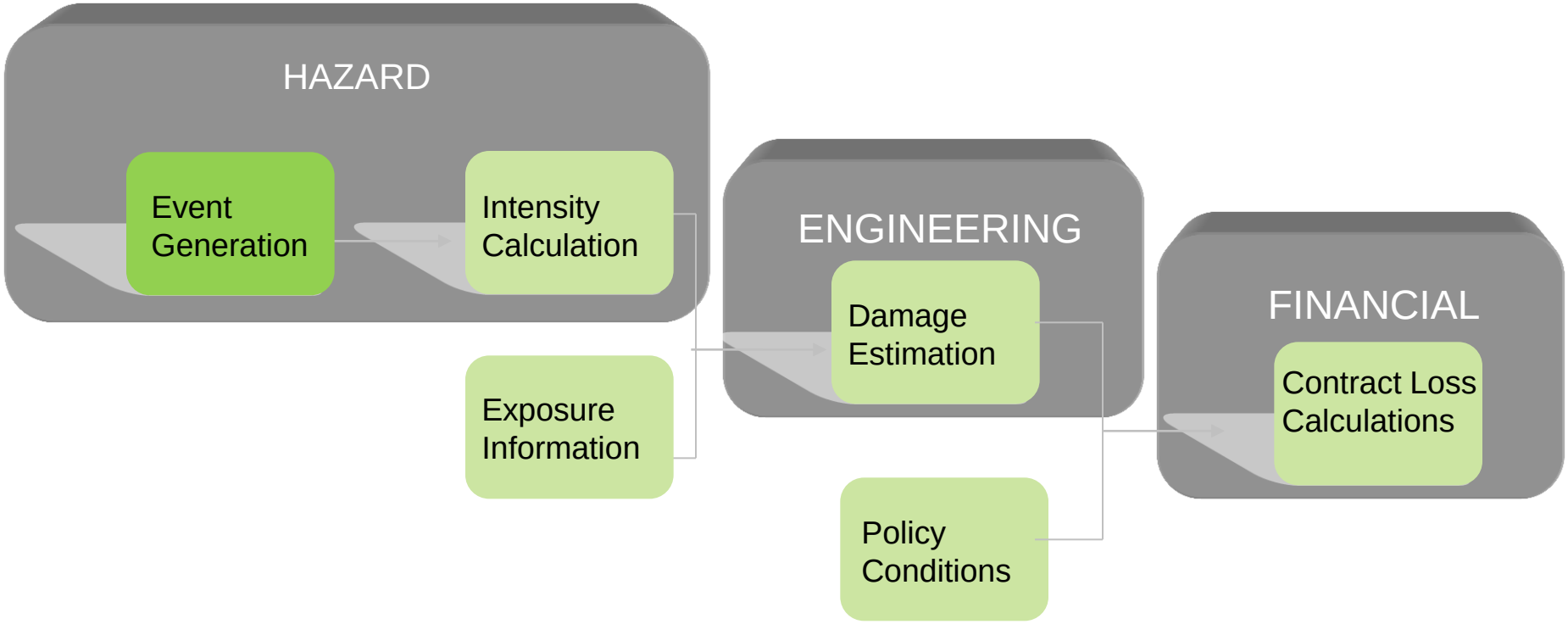
Agenda

- Increasing use of catastrophe models in the commercial property casualty industry
- Understanding the importance of exposure data quality and robust financial modeling
- Advances in modeling business interruption insurance
- Understanding industrial facilities
- Modeling severe thunderstorms for commercial exposures

Increasing Use of Catastrophe Models in the Commercial Property Casualty Industry

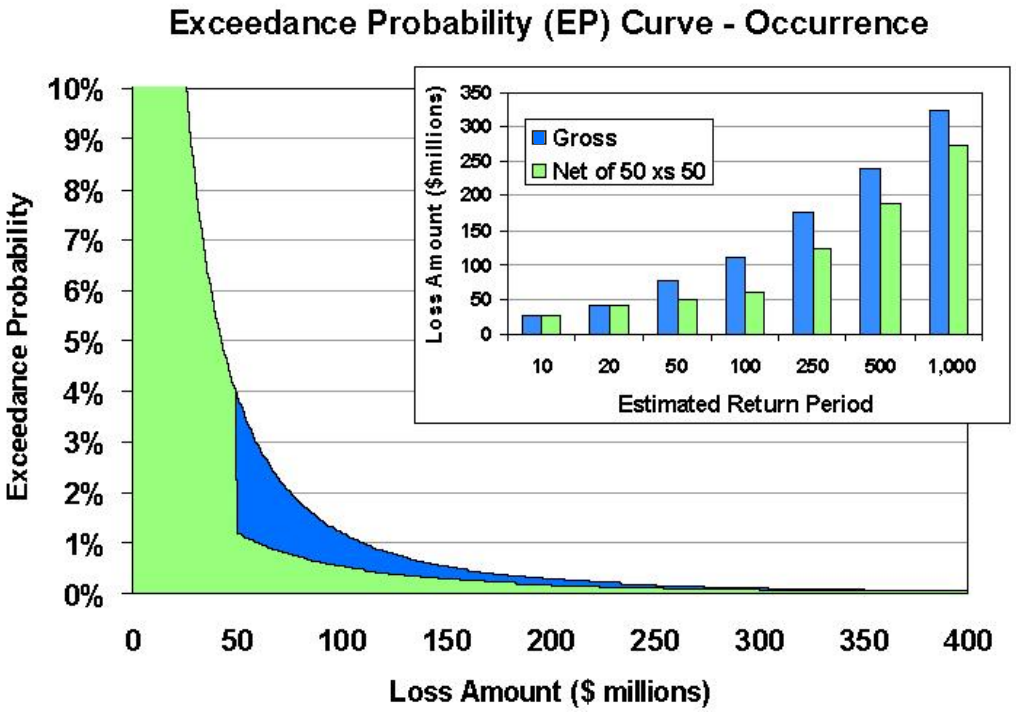
Catastrophe Modeling Framework



- Where are future events likely to occur?
- How intense are they likely to be?
- How frequently are they likely to occur?

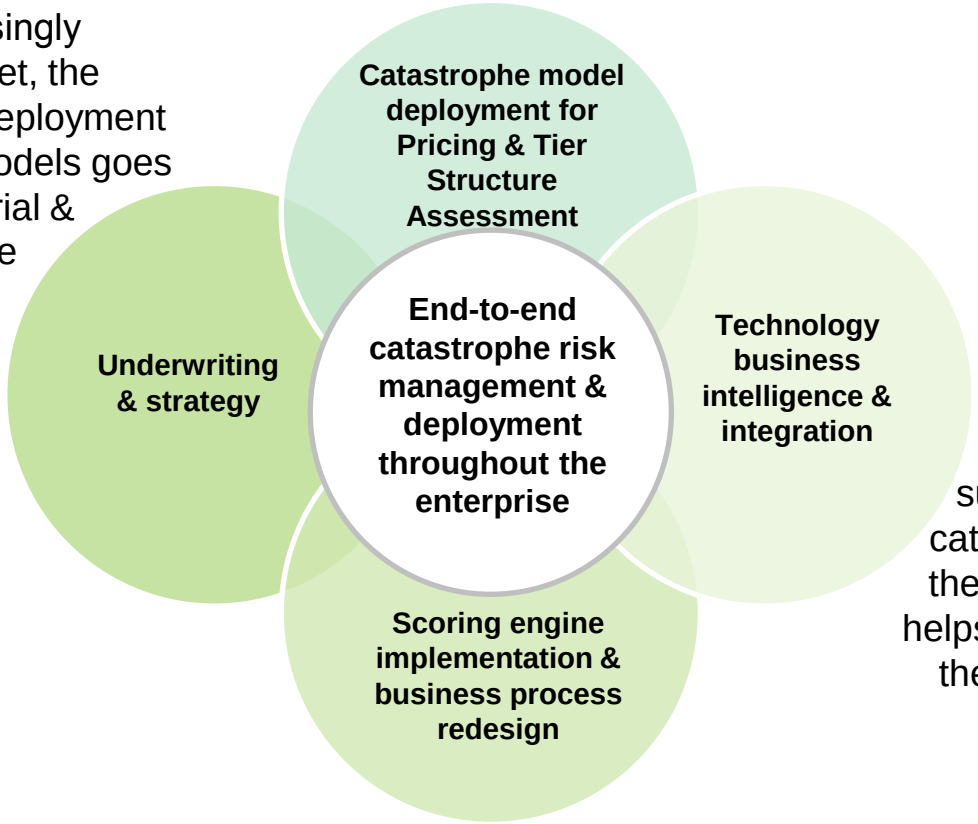
Catastrophe Model Output Provides a Tool for Probabilistically Assessing and Managing Risk

- Models provide estimates of loss by event, location and coverage
- This allows determination of the full probability distribution of losses (EP curves)
- Ability to classify losses by:
  - Annual aggregate & occurrence losses
  - Direct, ceded and net retained loss
  - Location, policy, zone, territory and portfolio levels
  - Line of business, construction type, etc.
- Determination of robust risk measures such as TVar



Industry Trends in Adopting Catastrophe Modeling

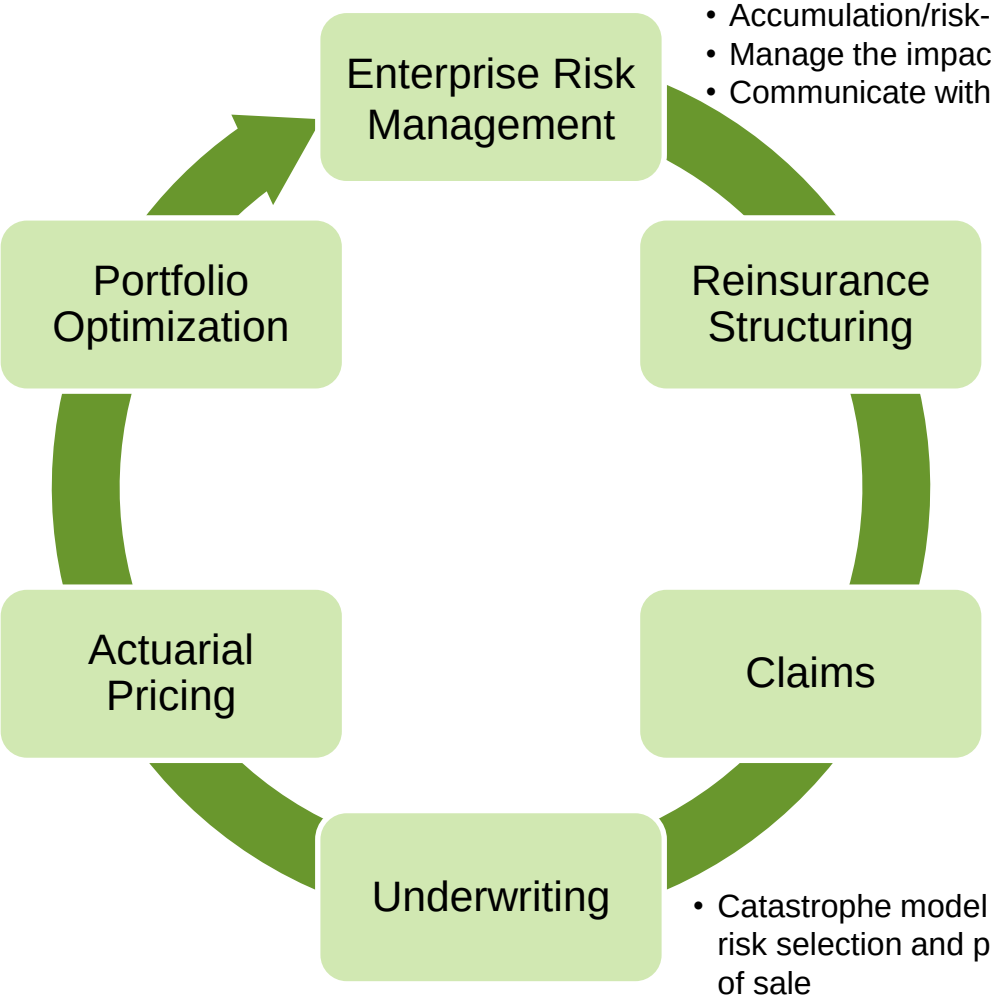
In today's increasingly competitive market, the development & deployment of catastrophe models goes beyond an actuarial & statistical exercise



Market leaders are those organizations that take a holistic approach to catastrophe risk management. A fully integrated solution that supports the application of catastrophe model output at the point of decision making helps bridge the gap between the slow adopters & market leaders

- **Models continue to provide an increasingly more accurate view of catastrophe risk and offer continually expanding functionality.**
- **Insurers that have successfully integrated catastrophe model output into their risk management practices are best positioned to leverage the advanced accuracy and expanded functionality of the models.**

Integration of Catastrophe Models Across the Organization Support Risk Management Best Practices



- Accumulation/risk-aggregation management
- Manage the impact of catastrophe risk on surplus
- Communicate with ratings agencies

- Use models to structure reinsurance treaties
- Use models to evaluate reinsurance purchases

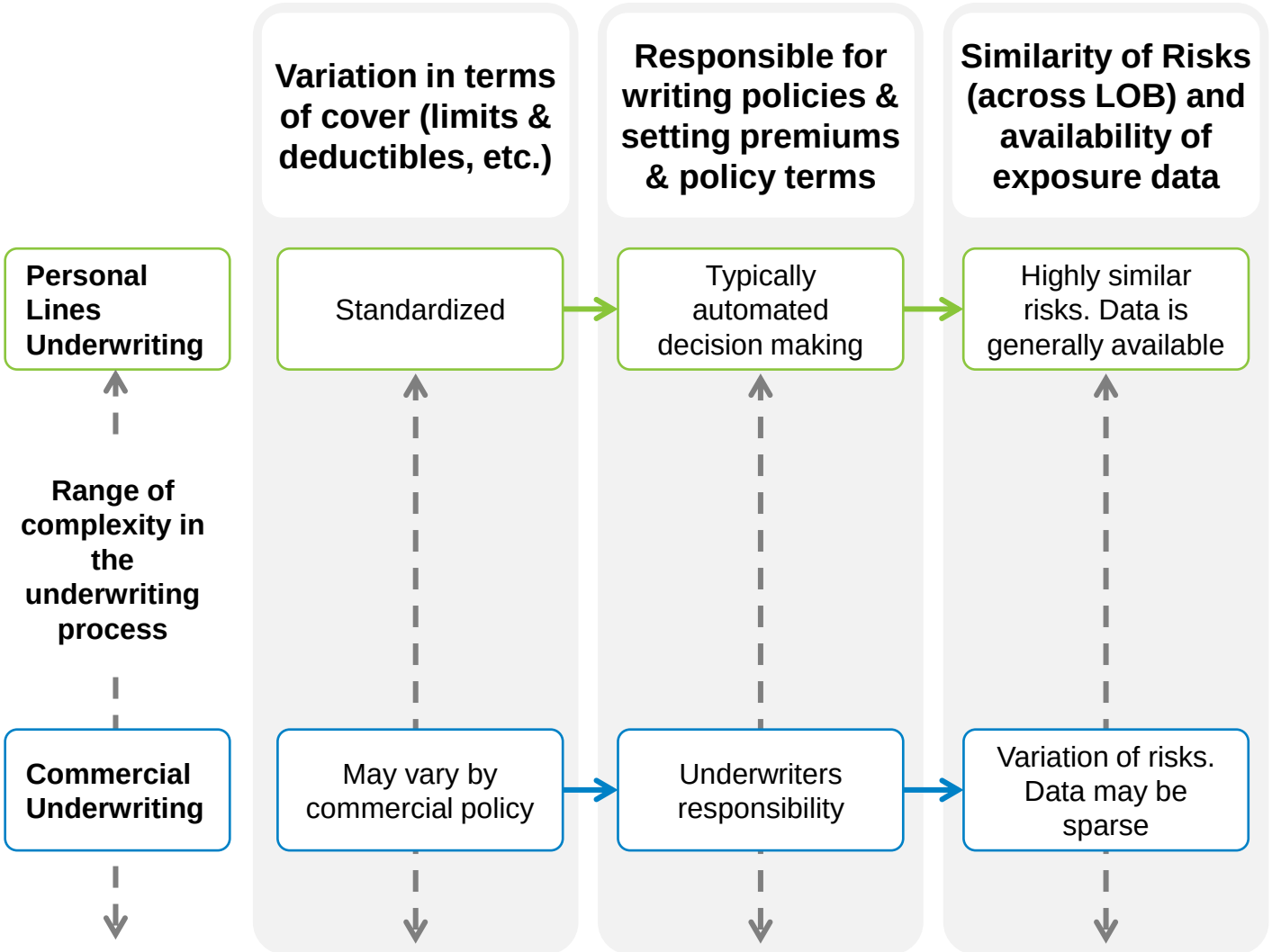
- Advance planning, resource deployment, post-event communications

- Catastrophe model output used for risk selection and pricing at the point of sale

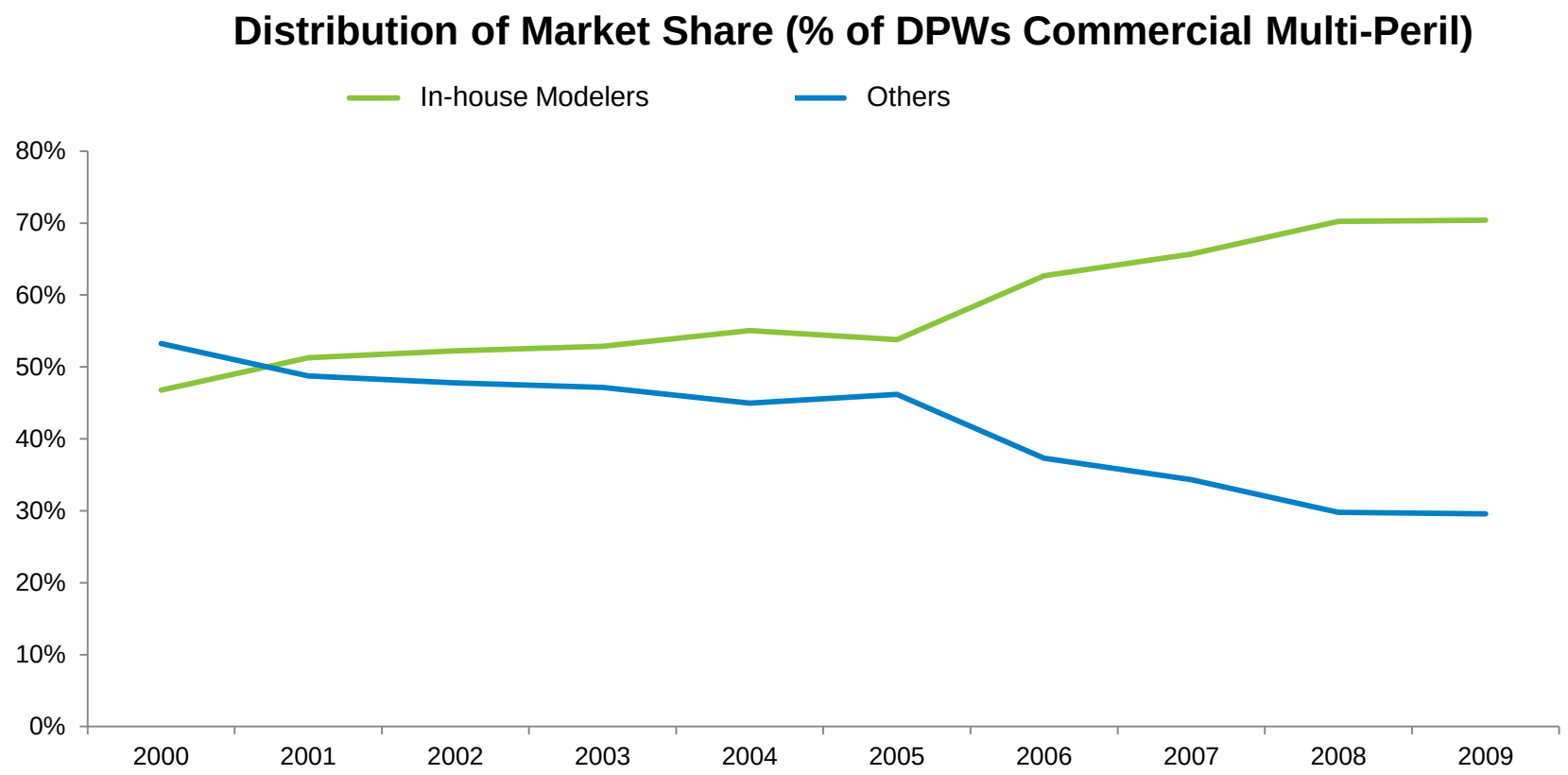
- Use model outputs in rate filings and in pricing of individual policies or programs

- Identify areas to grow based on model-based risk metrics
- Perform model-based analyses to understand and manage the drivers of catastrophe risk

Catastrophe Models Provide Increased Value to the Risk Assessment of More Complex Policy Types



Increasing Number of Commercial Lines Writers Are Using Catastrophe Models In-House



SOURCE: AM Best, AIR Worldwide

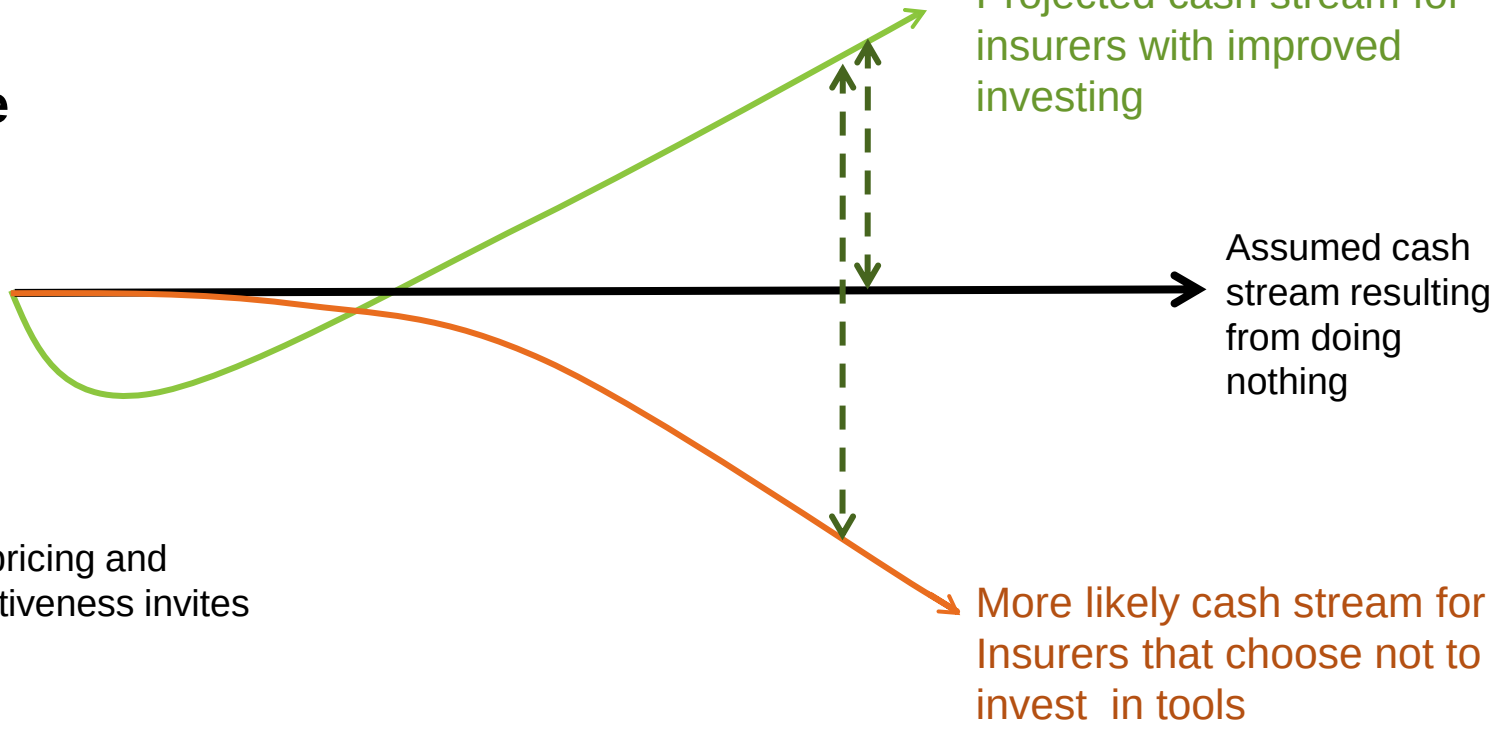
Companies that Don't Invest in Analytics, Won't Be Able to Maintain the Status Quo

Competitive Advantage

Vs.

Adverse Selection

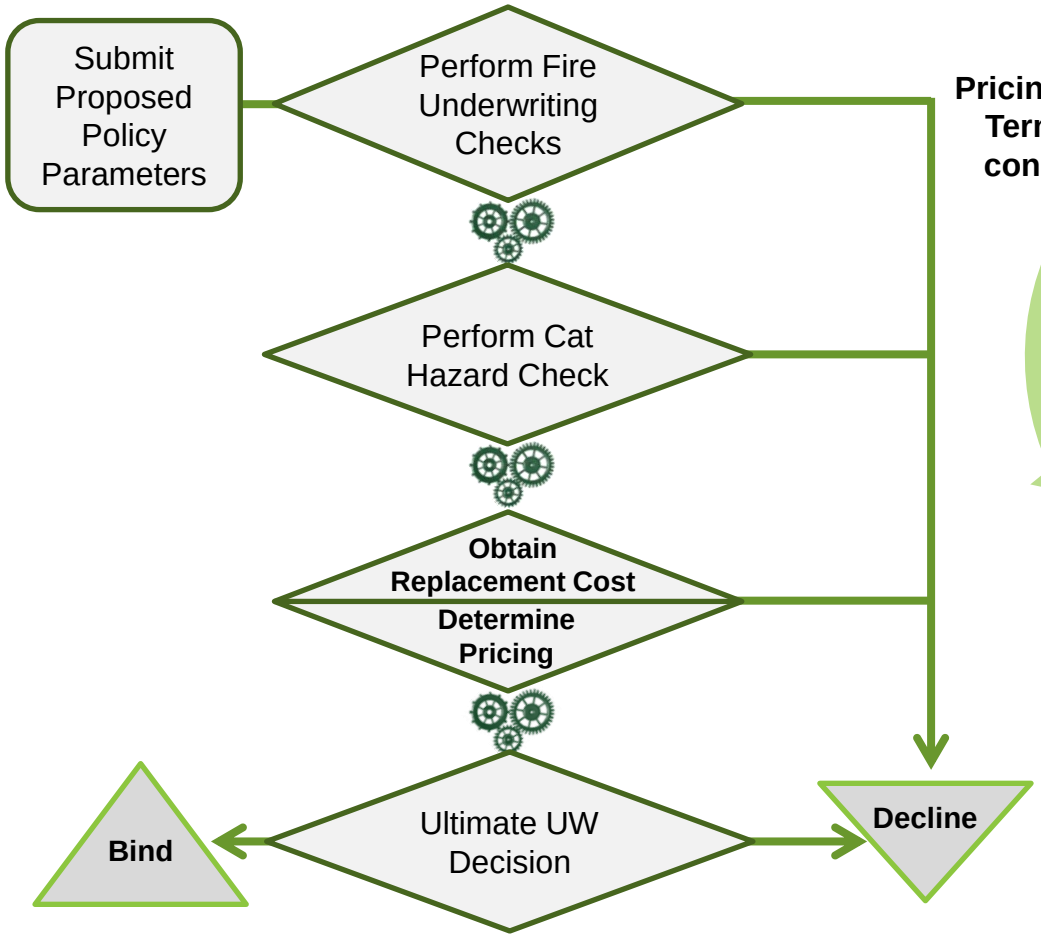
Falling behind in pricing and underwriting effectiveness invites adverse selection

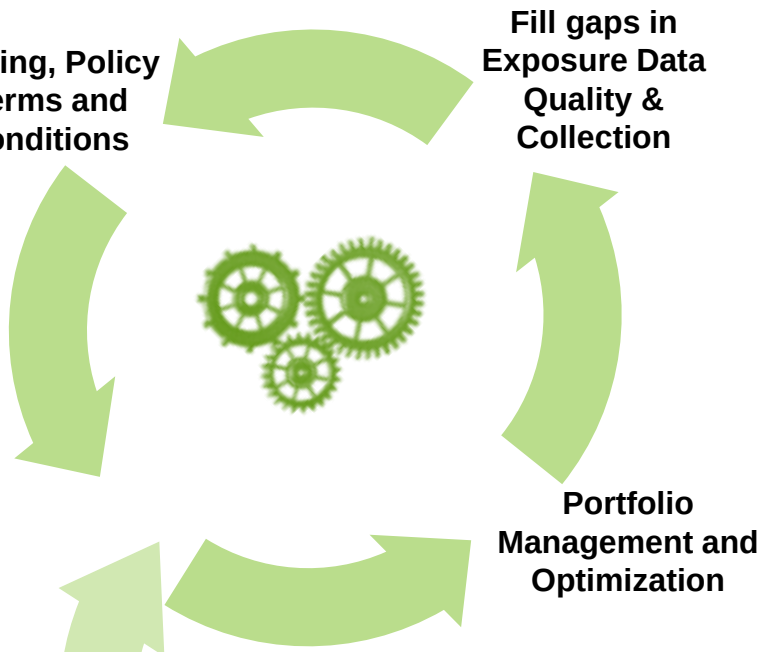


Source: Christensen, Kaufmann, Shih, "Innovation Killers: How Financial Tools Destroy Your Capacity to Do New Things," Harvard Business Review, Jan. 2008.

Understanding the Importance of Exposure Data Quality and Robust Financial Modeling

Integration of Catastrophe Model Output into Commercial Underwriting Workflows



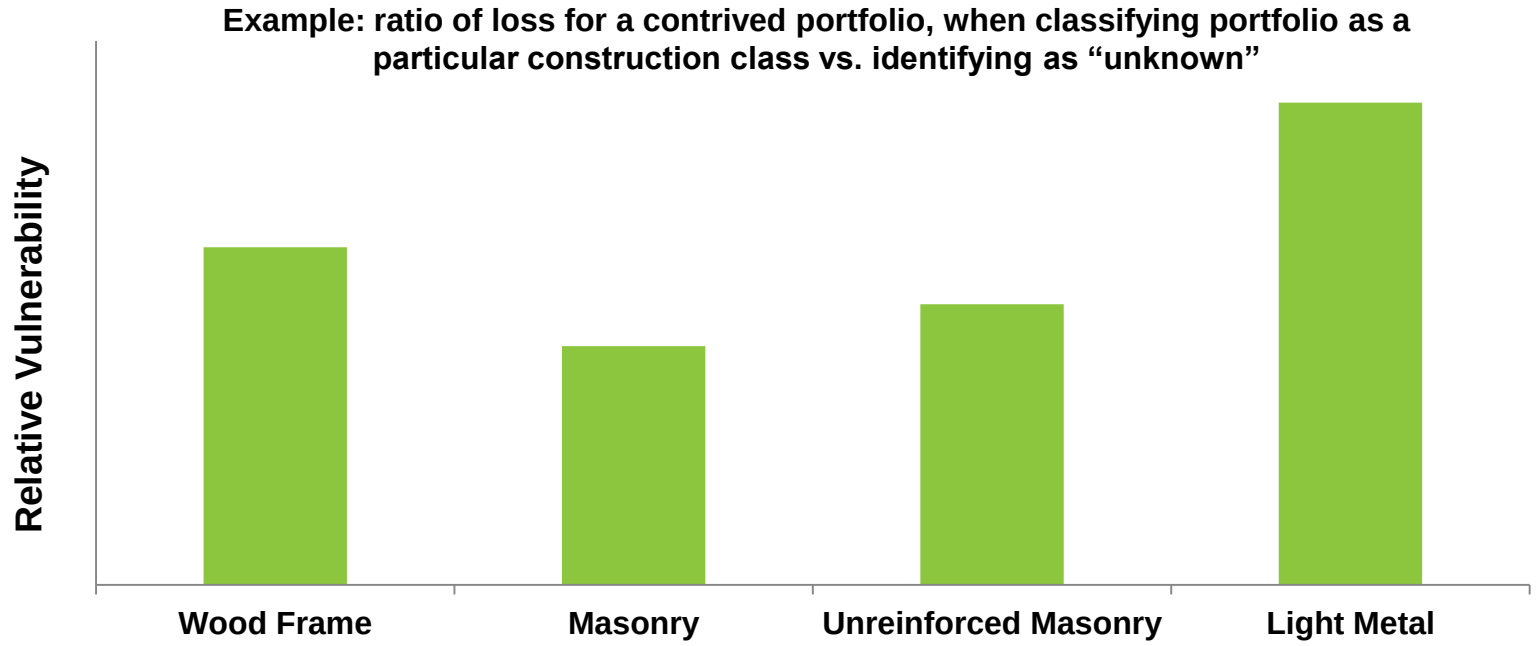


Integration of Catastrophe Model allows risk analyses to be performed iteratively at all stages of the underwriting process

Identifying the Appropriate Construction and Occupancy Class Can Impact Loss Analyses

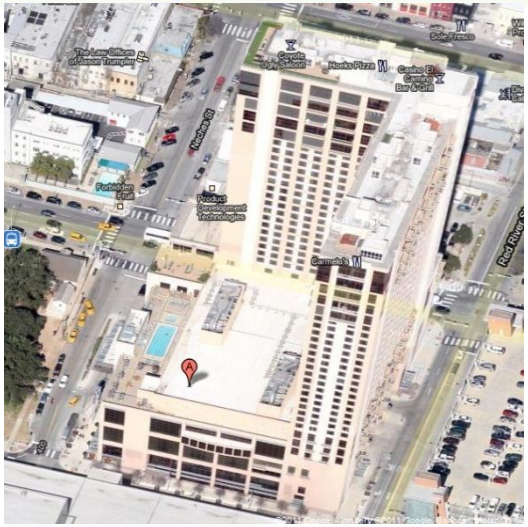
Underwriter receives submission with limited information:

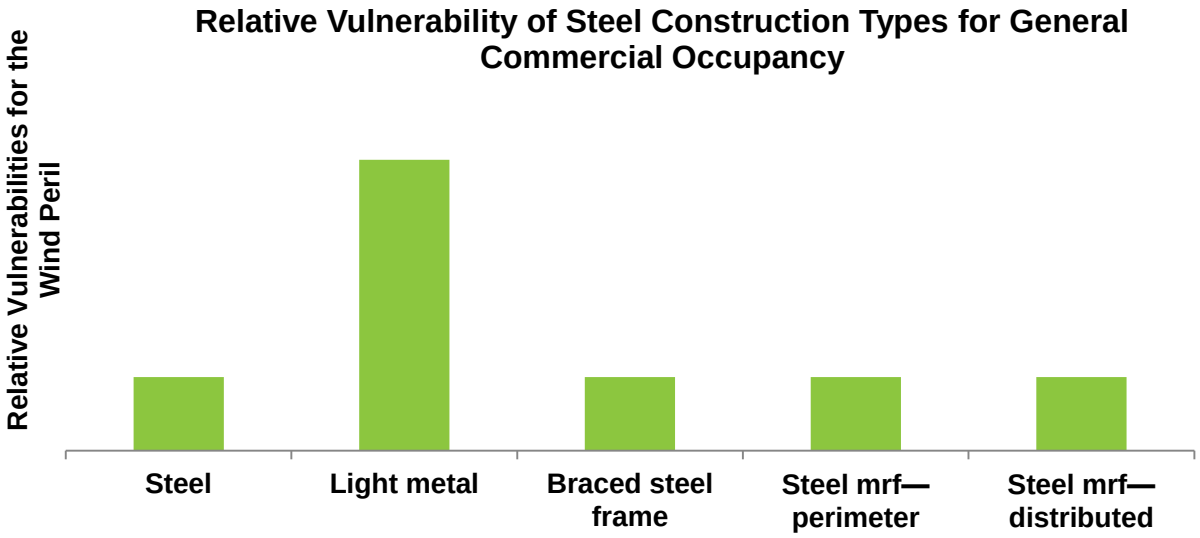
- General commercial occupancy
- Unknown construction
- Replacement Cost: $100 million



Lack of Detailed Data Can Lead to an Incomplete View of Risk

- Underwriter might collect additional information through available resources:
  - Commercial occupancy: Hotel (Temporary lodging)
  - Construction type: Steel

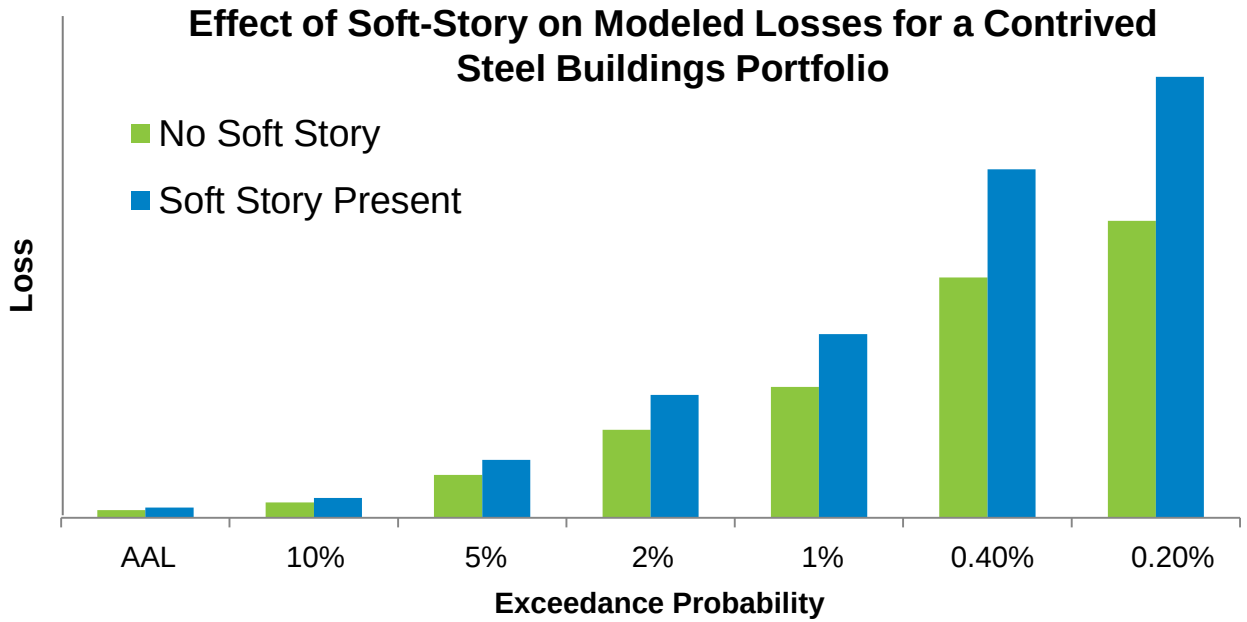




Variation within sub-classes of construction types highlights the need to accurately capturing detailed data

Robust Exposure Data Tools Provide the Underwriter with the Most Complete View of Risk

- AIR's TruExposure ™ enables the underwriter to validate and fill gaps in exposure data:
  - Validate replacement value and collect data on other primary risk characteristics such as year built, building height, etc.
  - Determine appropriate construction and occupancy classes
  - Identify secondary risk characteristics such as presence of a soft story



Commercial Policies can Have Complex Terms & Conditions

Deductibles

- At location level
  - By site: $, %, % of loss
  - By coverage: $ and %
  - Combined (Building, Other Structures, Contents): $ and %
  - CEA Mini Policy: $ and %
  - Franchise
- At policy level
  - Attachment point
  - Blanket, Minimum, Maximum
  - % of loss
  - Franchise

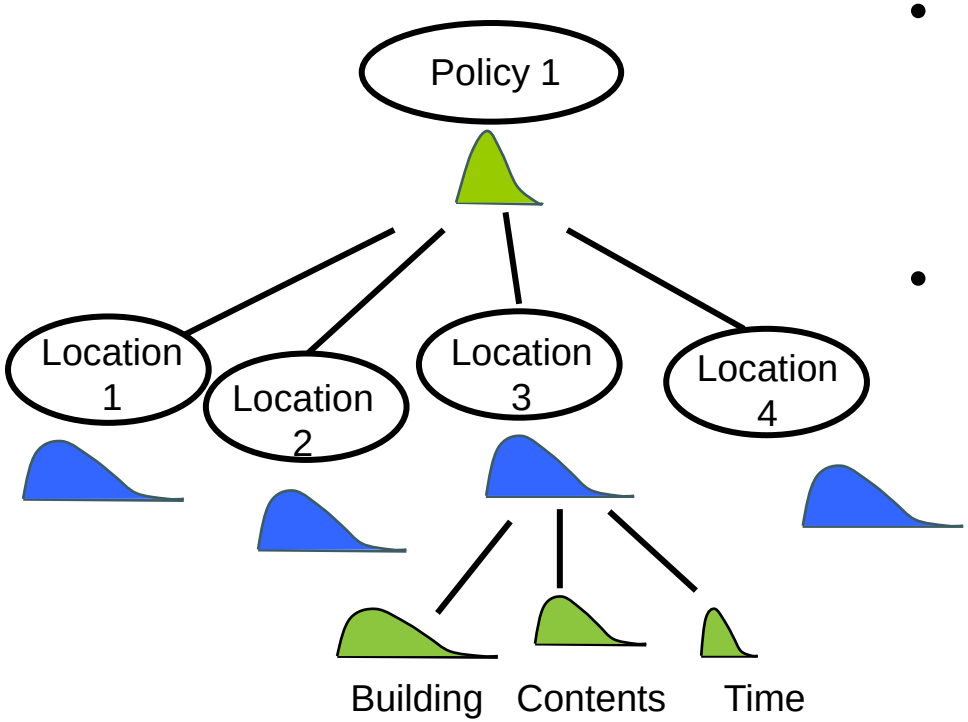
Limits

- At location level
  - By site or by coverage
- At policy level
  - Blanket, Excess, By coverage, Sublimits, First loss

Reinsurance

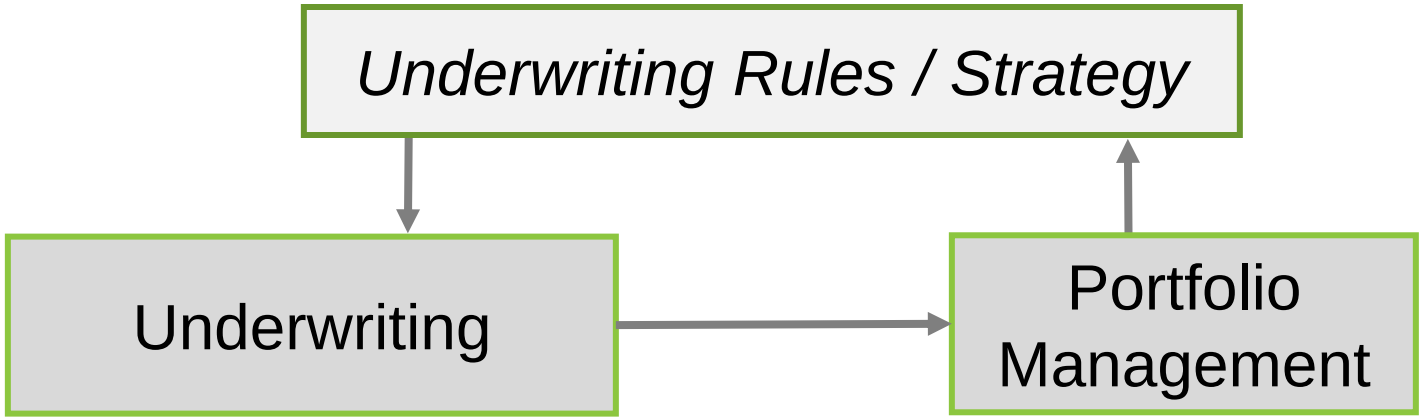
- Facultative reinsurance
  - Proportional
  - Non-proportional
  - Available at policy or individual locations
- Risk-based treaty reinsurance
  - Quota share
  - Surplus share
  - Per risk excess of loss
  - Includes special conditions
    - Line of business and region specific
    - Occurrence limits
    - Aggregate limits
- Portfolio (CAT) treaty reinsurance
  - Occurrence
  - Aggregate (stop loss)

A Probabilistic Approach is Required to Accurately Capture Policy Terms



- Commercial policy terms can be complex
- Defining and incorporating policy terms into catastrophe risk analyses improves the accuracy of modeled losses
- For instance, policy terms covering multiple coverages and location
  - Individual distributions need to be combined to arrive at the joint probability distribution of loss across
    - Coverages
    - Locations

Quality Exposure Data Captured at the Point of Underwriting Improves the Portfolio-level View of Exposure and Informs Underwriting Rules & Strategy



- Simple issue/decline decisions
- Pricing
- Policy terms
- Feed into rate-scoring models
- Impact on loss ratios
- Exposure concentration limits

- Exposure concentration
- Growth planning
- Reporting (statutory)
- Ratemaking
- Reinsurance

Advances in Modeling Business Interruption Insurance

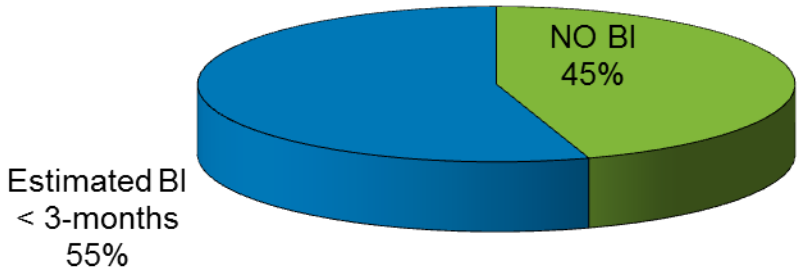
Discussion on Business Interruption (BI)

- BI from an underwriting perspective
  - Estimation of an insured's business income requirement
  - Complexity and variation in policy forms and coverages
  - Challenges in BI claims settlement
- BI exposure data
  - Data requirements
  - Exposure data analysis
- Modeling
  - Model variables
  - Model framework

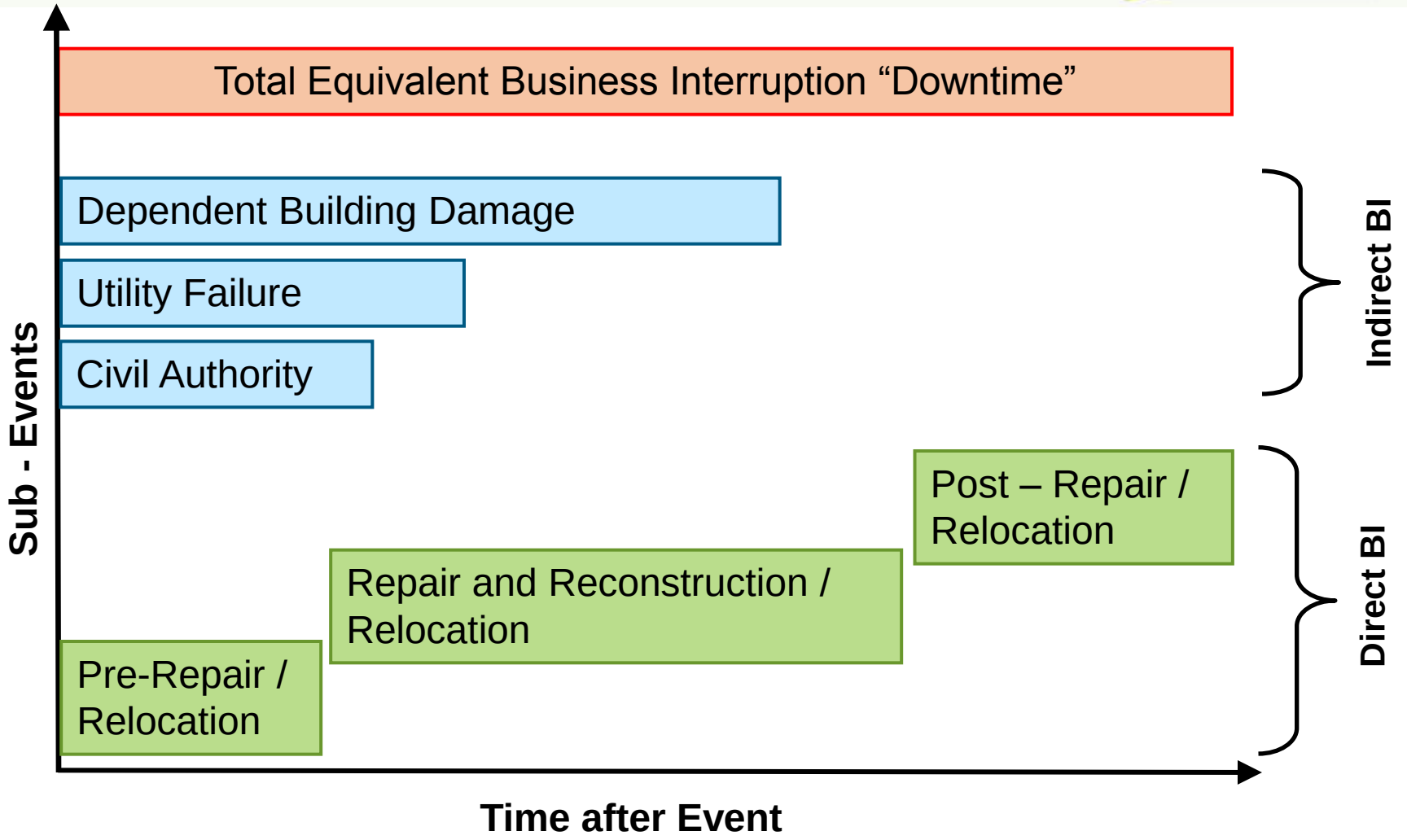
Income and Expenses	Estimated 12 Month Policy Period Beginning: _____
A. Gross Sales **See Note (A)**	$
B. DEDUCT:	
Prepaid Freight – Outgoing	- $
Discounts, Returns & Allowances	- $
Bad Debts & Collection Expenses	- $
C. EQUALS: Net Sales	= $
D. ADD: Other Earnings from your business operations (not royalties or investment income): **See Note (D)**	
Commissions or Rents	+ $
Cash Discounts Received	+ $
Other _____	+ $
E. EQUALS: TOTAL REVENUES	**= $**
F. DEDUCT: Total Cost of Goods Sold. This is NOT the GAAP figure. **Calculate using worksheet below.**	- $
G. DEDUCT: Cost of services you purchase from outsiders to separately resell (e.g. service contracts), that do NOT continue under contract. Costs that continue are NOT deducted.	- $
H. Are you Excluding OR Limiting "Ordinary Payroll" Expenses? **If YES,** DEDUCT: All "Ordinary Payroll" Expenses **See Note (H)** If NO, leave blank.	- $
I. BUSINESS INCOME EXPOSURE FOR 12 MONTHS	**= $**

Factors Contributing to Underinsurance in Business Interruption

- Use of business interruption limits for annual BI exposure
- Use of rules of thumb to determine BI limit rather than using BI worksheet for each location
- Underestimation of number of locations that can get damaged in a catastrophe
- Business interruption findings from Independent Insurance studies
  - Businesses either do not have BI coverage or do not have the information to estimate BI exposure
  - Significant underestimation of business downtime (<3 months) to determine BI Limits

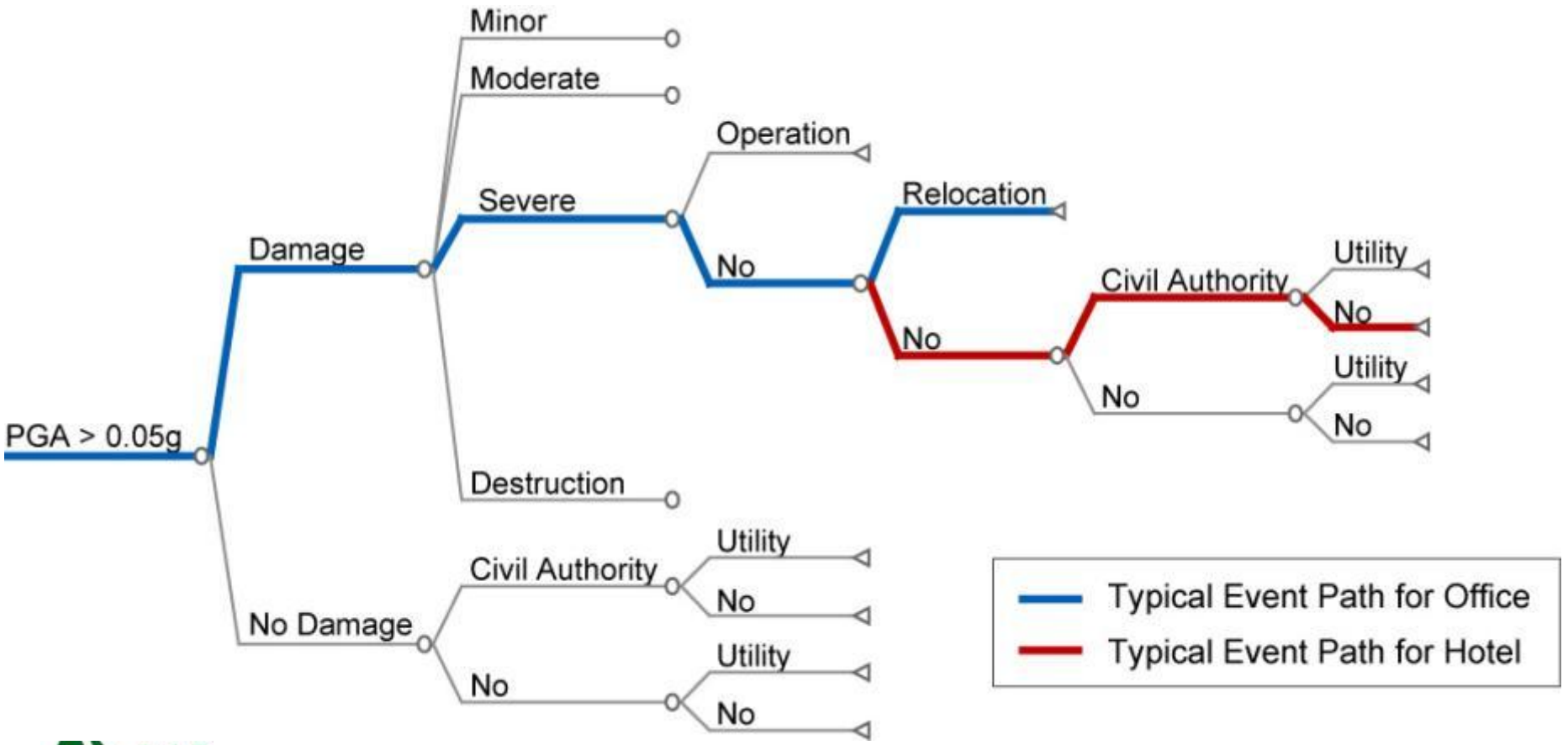


Robust Approach to Modeling Business Interruption Captures Insured Downtime Following a Loss



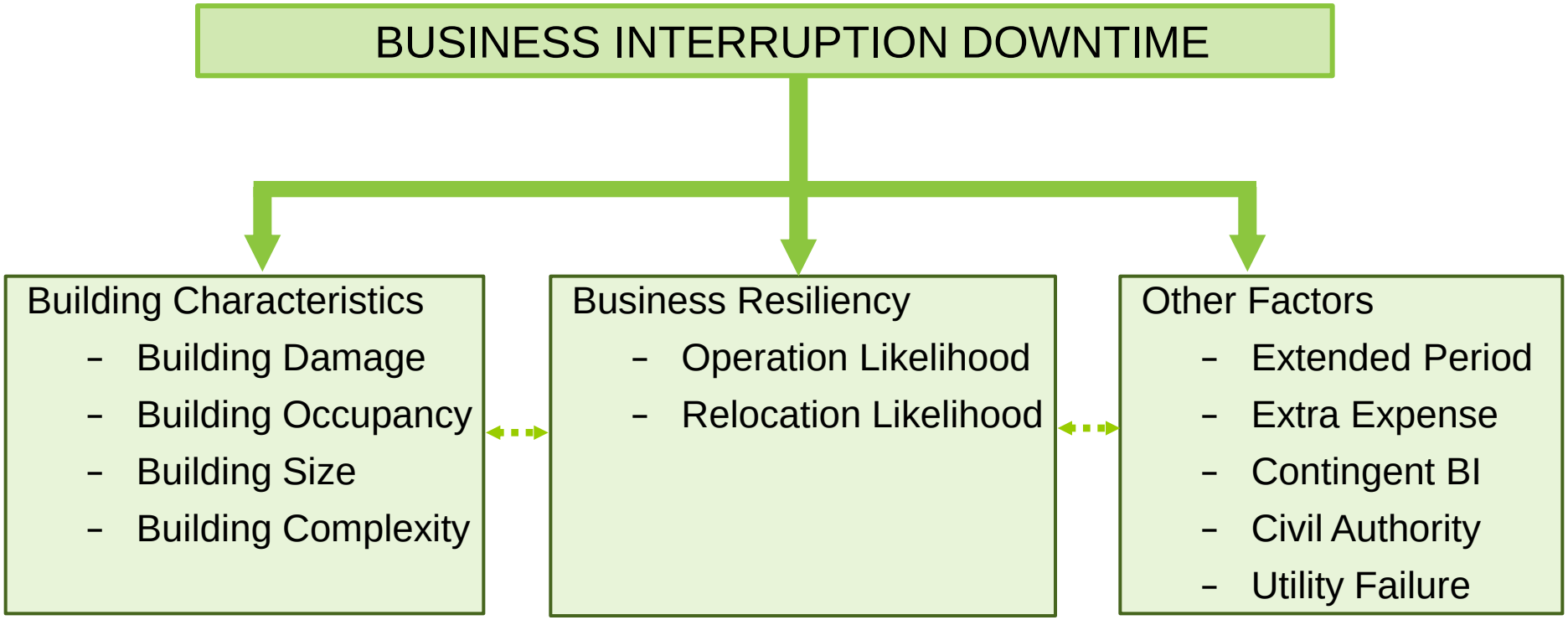
AIR's Models Use an Event Tree Approach to Handle Business Interruption

- Event Tree approach
- Function of building damage and occupancy class

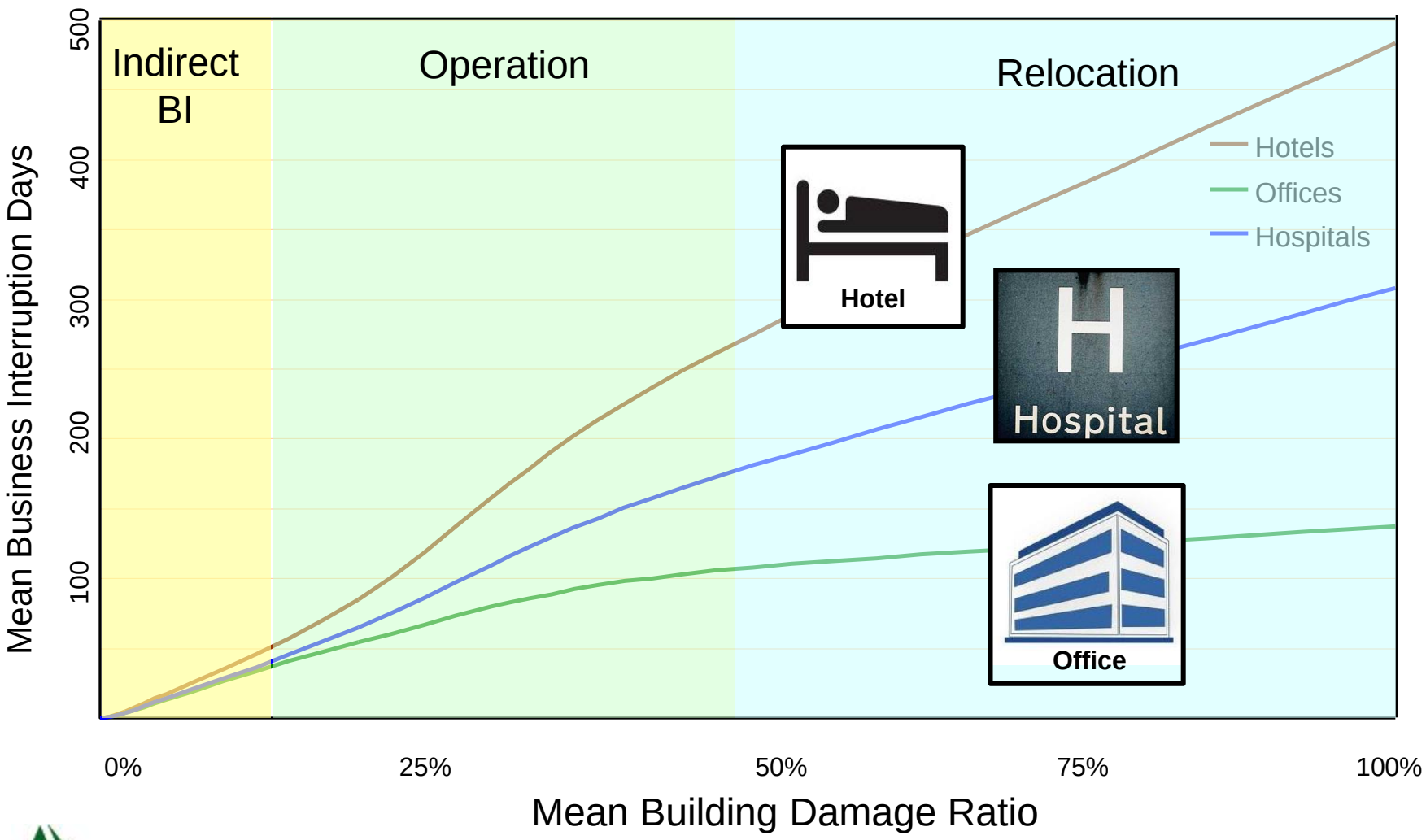


Key Factors Used in Determining Business Interruption Downtime

Downtime is Influenced by Both Building Complexity and Content Types



A Robust Business Interruption Model Should Incorporate the Impact of Various Factors by Occupancy



Advances in Modeling Business Interruption Insurance

- Business interruption accounts of downtime
- Modeling can capture both direct & contingent BI
- AIR's modeling framework allows for the development of separate downtime functions for different types of businesses (occupancies)
- Quality of exposure data varies significantly across the industry: detailed business interruption policy conditions and property conditions are often not available
  - AIR's methodology to modeling business interruption losses employs logical assumptions about the occupancy and building characteristics of "typical" BI policy

Understanding Industrial Facilities

Identifying Major Component Classes Within Industrial Facilities (Example: Chemical Plant)

Component Class	Subclass
1. Transportation Assets	1 = Docks
	2 = Loading Structure
	3 = Freight Cars
	4 = Rails
	5 = Pavement
2. Plant Equipment	1 = Pumps
	2 = Air Condensors
	3 = Generators
	4 = Transformers
	5 = Rectifiers
	6 = Chlorine Cells
	7 = Compressor
	8 = Furnace
	9 = Motors
	10 = Gas Turbines
	11 = Process Control Equipment
	12 = Analyzer
	13 = Elect HV Circuit Brk
	14 = substations
	15 = switching stations
3. Buildings	1=MCC Building/CMU Construction
	2=Control/office Building/Concrete Construction
	3=Warehouse Building/ Metal Building
	4=Maintenance Building/Metal Building

Transformer

Cooling Towers

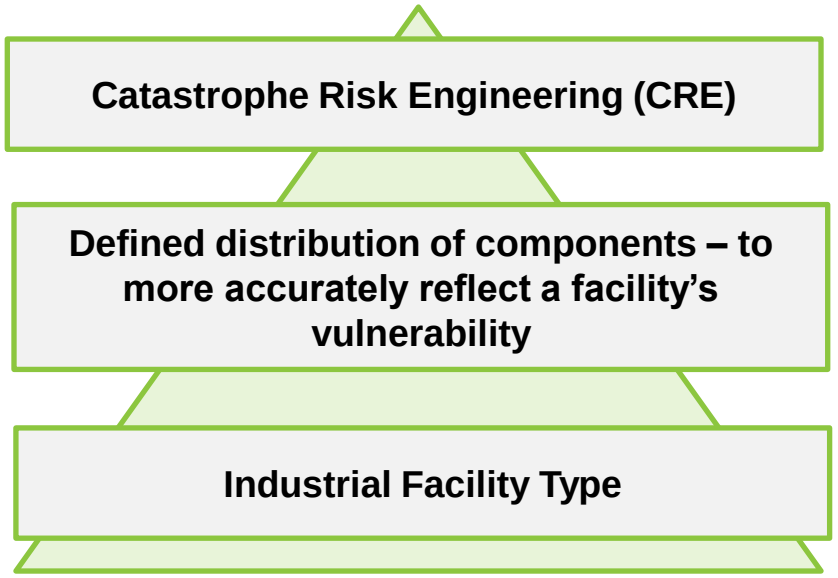
Vertical Vessels

Component Class	Subclass
4. Pipe Racks	1 = Old Structures
	2 = New Structures
5. Open Frame Structures	1 = Braced
	2 = Unbraced
6. Flares	1 = Free standing
	2 = Guyed
	3 = Derrick
7. Process Towers	1 = All
8. Cooling Towers	1 = Wood frame
	2 = Concrete
	3 = Composite Fiber
9. Tanks	1 = Unanchored
	2 = Anchored
	3=H/D Range
	4=Fill ratio
10. Utility Structures	1 = Single Wood Pole
	2 = Two-pole wood
	3 = Three-pole wood
	4 = Lattice Pole (transmission tower)
	5 = Tubular Steel Pole
	6 = Steel Dead-end Pole

Complexity and Diversity of Industrial Facilities Creates Additional Challenges to the Underwriting Process

- A site can be very large with very different industrial plants in its interior
- Examples of Industrial facility classes
  - Chemical plants
  - Petrochemical plants
  - Power generation and distribution systems
  - Manufacturing plants
- In addition, plants may be comprised of many different components - each of very different vulnerability

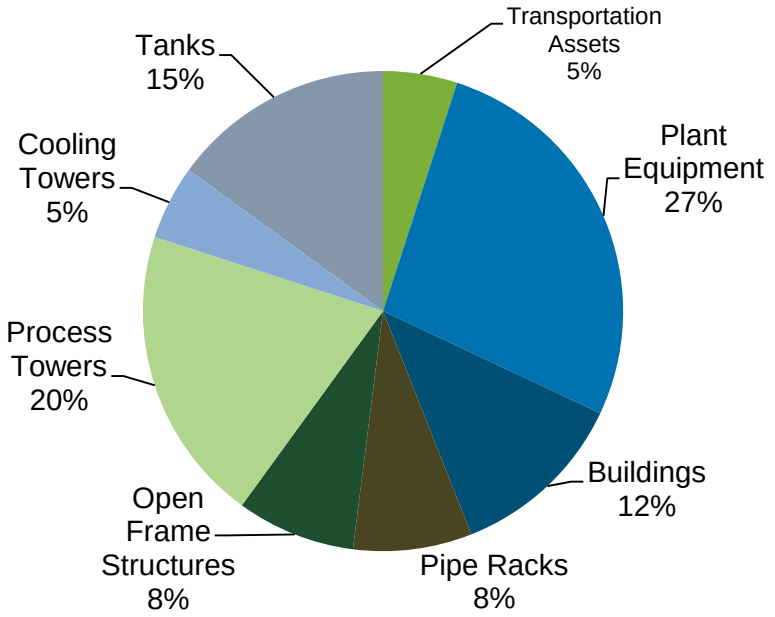
Analysis of a facility's catastrophe risk exposure can depend on the carrier's sophistication & experience in underwriting industrial facilities



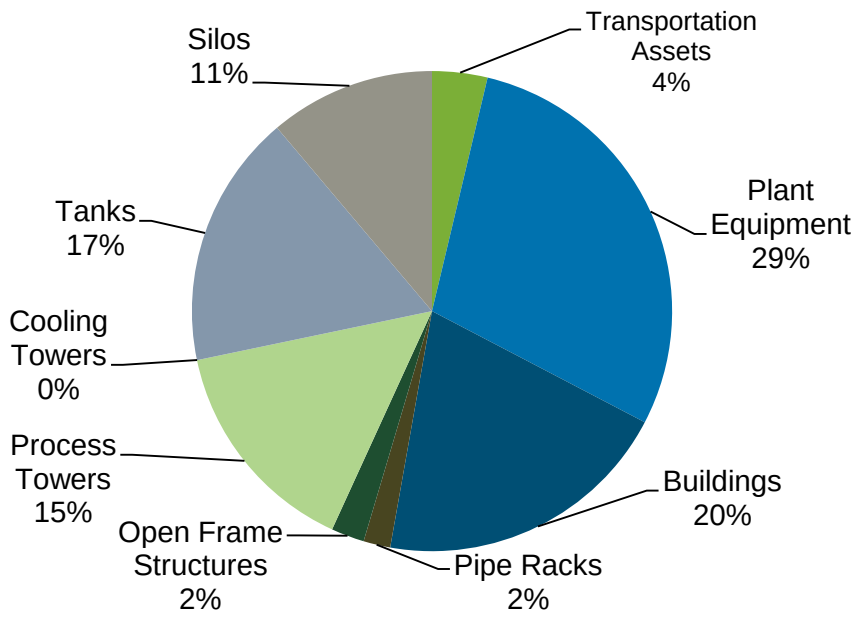
Defining the Component-Mix of a Facility Helps to Ensure the Most Accurate Assessment of the Vulnerability

- A Component-based approach to modeling a facility's damageability should consider the vulnerability of assets comprising the facility
- Underwriters can input the facility's distribution of components to accurately assess vulnerability or select standard industrial facility type

Chemical Plant

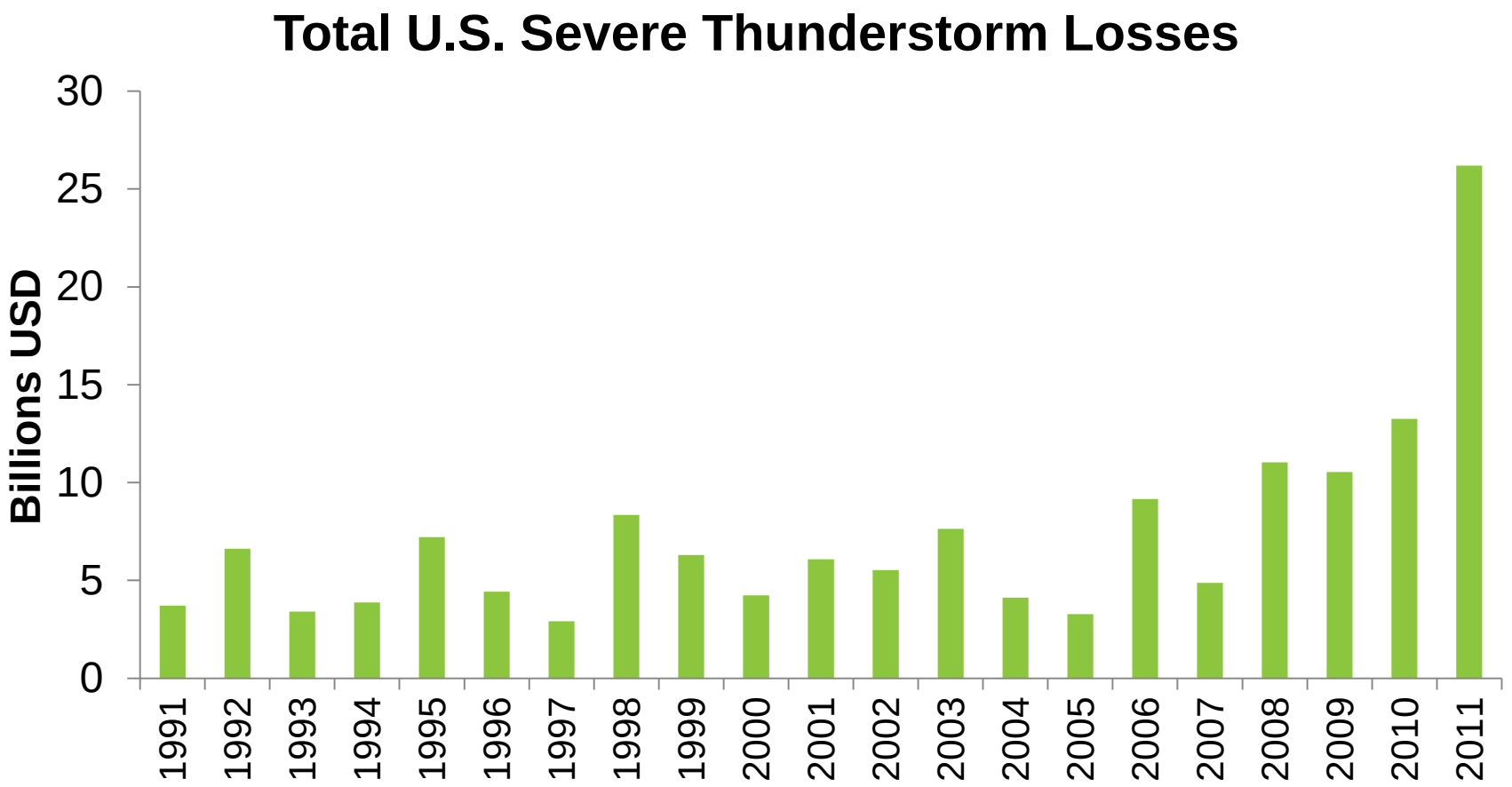


Ethanol Plant



Modeling Severe Thunderstorms for Commercial Exposures

Insured Losses from Severe Thunderstorms, 1991-2011



Source: PCS, trended to 2012

Severe Thunderstorms Can Generate Hail, Tornadoes, and Extreme Straight-line Winds

The Frequency, Severity, and Location of Thunderstorms in 2011 Led to Significant Losses

Severe Storms April 22-28, 2011

Winds in excess of 100 mph

St Louis, MO

Tuscaloosa, AL

Hail > 4.5” in size

409 damaging tornadoes

Vulnerability Functions Vary by Peril and Exposure Type

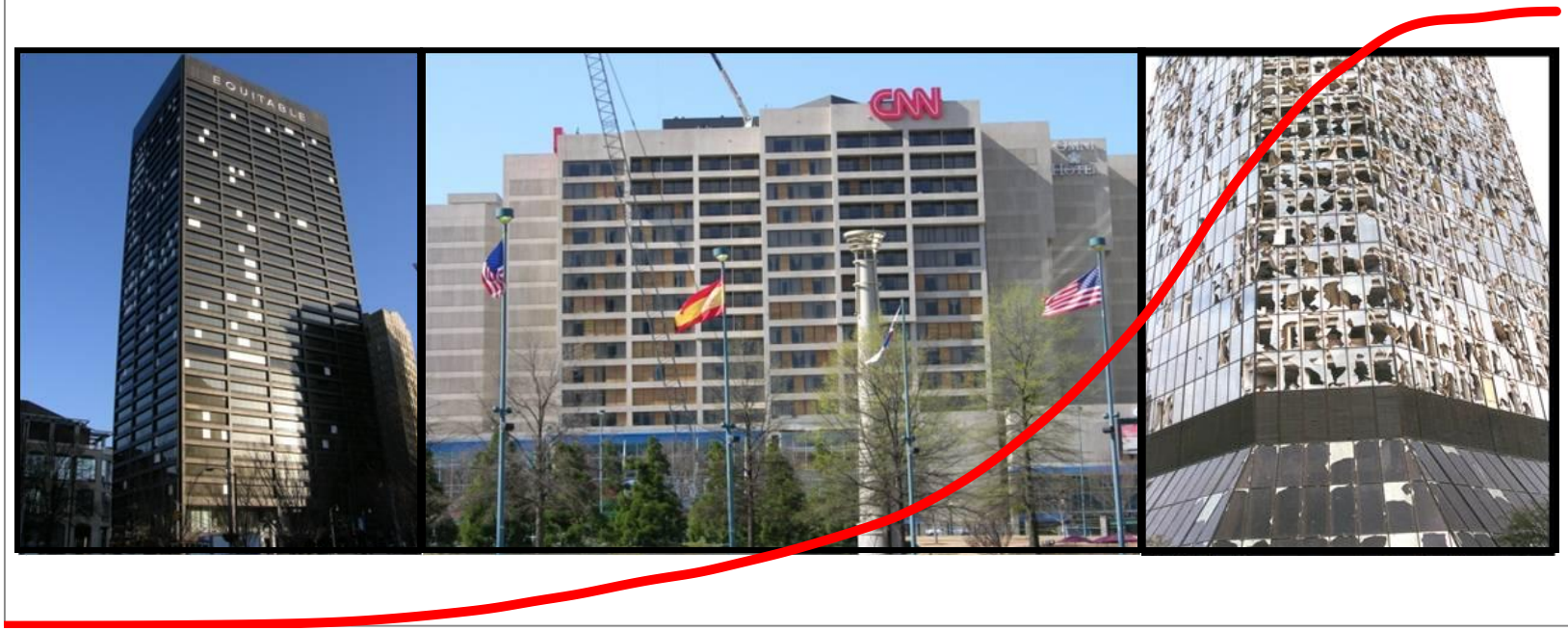
- Vulnerability functions based on
  - Published research
  - Engineering principles
    - Tornado, straight-line winds and hail damage mechanisms
  - Company claims data and loss information from Property Claims Services (PCS)
  - Post-disaster field surveys by AIR engineers
- Developed by peril and Construction/Occupancy/Height type

2008 Atlanta Tornado

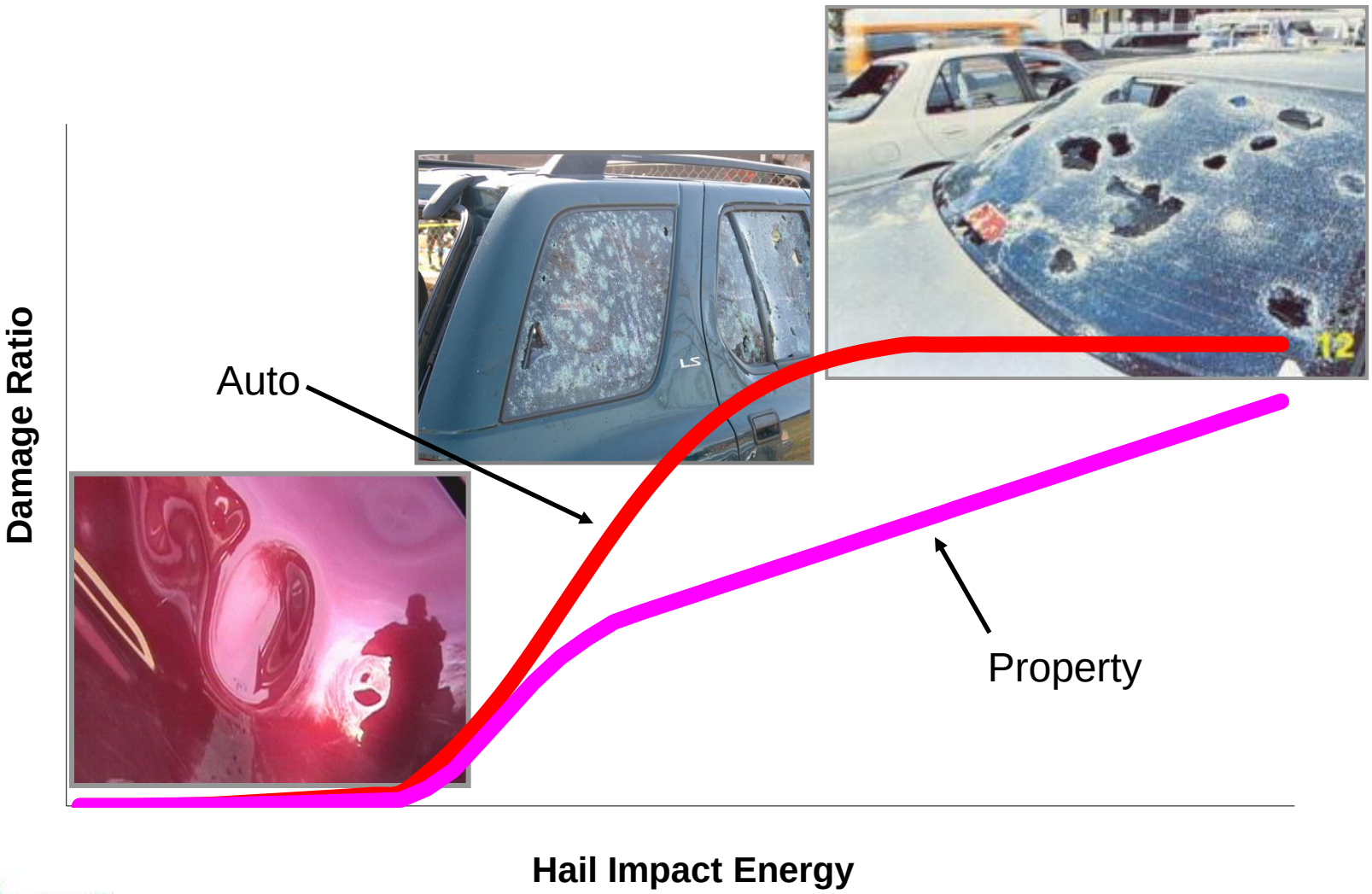
- PCS estimates that insured losses will exceed $695M
- Atlanta downtown suffered major damage from tornadoes, hailstorms and straight-line winds
- Assessed damage at hundreds of locations, including commercial buildings

Tornado Damage Function for Commercial Steel Frame Structure

40-112 mph	113-206 mph	>207 mph
Minimal to Moderate Damage (Minor damage to roofs & cladding)	Considerable to Severe Damage (Significant damage to roofs & cladding)	Catastrophic Damage (Major damage to engineered structures)

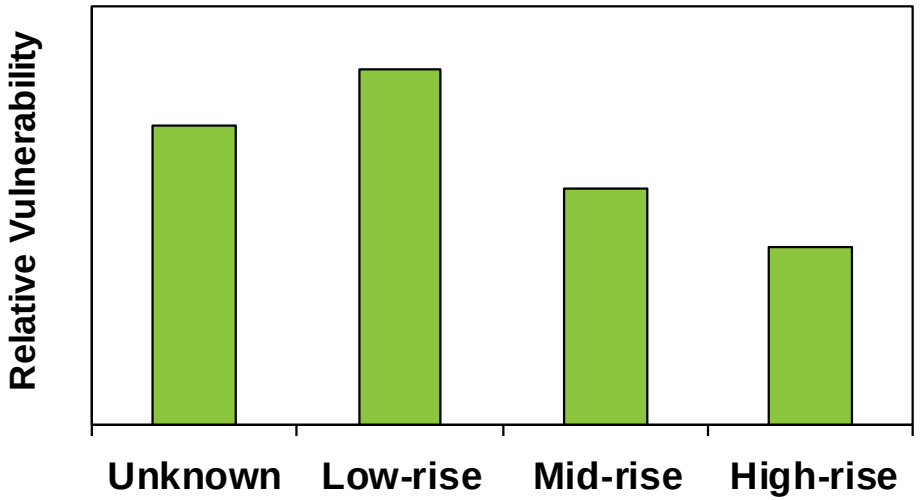


Autos are More Vulnerable to Hail than Property



Vulnerability Functions Vary by Building Characteristics

- High rise buildings are typically well-engineered and adhere to strict code guidelines
- Percentage of roof and glass is important for assessing the vulnerability to hail
- Wood frame (low – 1, mid and high > 1)
- Masonry (low – 1, mid – 2 & 3, high > 3)
- Concrete/Steel (low – 1-3, mid – 4-7, high > 7)



Summary

- Leading companies are integrating catastrophe modeling into their underwriting process for better decisions
- A range of data and techniques are available to provide increasing precision in risk differentiation
- Catastrophe risk is influenced by factors other than simple hazard metrics
- Proper capture of building characteristics and business interruption risk can significantly impact loss estimates
- Component approach improves modeling of Industrial Facilities