TEXAS WINDSTORM
INSURANCE ASSOCIATION

Actuarial & Underwriting Committee

TWIA Actuarial Department – 2022 Rate Indications

July 18, 2022

Contents

- Actuarial Principles
- Statutory Language
- Recent Legislative Changes
- Overview of Rate Adequacy Analysis
- Rate Adequacy Analysis
- Reconciliation of Changes in Rate Indications
- Historical Rate Indications vs Rate Changes
- Impact of Alternative Rate Changes

Actuarial Principles

Casualty Actuarial Society Statement of Principles

1. A rate is an estimate of the expected value of future costs
2. A rate provides for all costs associated with the transfer of risk
3. A rate provides for the costs associated with an individual risk transfer
4. A rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer

Statutory Language

Sec. 2210.001

"The association shall function in such a manner as to not be a direct competitor in the private market;..."

Sec. 2210.355 (b) In adopting rates under this chapter, the following must be considered:

(1) the past and prospective loss experience within and outside this state of hazards for which insurance is made available through the plan of operation, if any;
(2) expenses of operation, including acquisition costs;
(3) a reasonable margin for profit and contingencies;
(4) payment of public security obligations issued under this chapter, including the additional amount of any debt service coverage determined by the association to be required for the issuance of marketable public securities; and
(5) all other relevant factors, within and outside this state.

Sec. 2210.355 (c) Rates must be reasonable, adequate, not unfairly discriminatory, and nonconfiscatory as to any class of insurer.

Recent Legislative Changes

HB 769

SECTION 1. Subchapter H, Chapter 2210, Insurance Code, is amended by adding Section 2210.3512 to read as follows:

Sec. 2210.3512. REQUIREMENT FOR VOTE ON RATE FILING. The board of directors may not vote on a proposed rate increase if:

(1) there is a vacancy on the board; and

(2) the vacancy has existed for at least 60 days at the time the vote is to be taken.

SECTION 2. The heading to Section 2210.453, Insurance Code, is amended to read as follows:

Sec. 2210.453. FUNDING LEVELS; REINSURANCE AND ALTERNATIVE RISK FINANCING MECHANISMS; REINSURANCE FROM CERTAIN INSURER OR BROKER PROHIBITED.

SECTION 3. Section 2210.453, Insurance Code, is amended by adding Subsection (f) to read as follows:

(f) The association may not purchase reinsurance under this section from an insurer or broker involved in the execution of a catastrophe model on which the association relies in:

(1) determining the probable maximum loss applicable for the period covered by the reinsurance; or

(2) adopting rates under Section 2210.355.

Recent Legislative Changes

SB 1448

SECTION 1. Section 2210.351, Insurance Code, is amended by amending Subsection (d) and adding Subsection (f) to read as follows:

(d) The association may use a rate filed by the association without prior commissioner approval if:

(1) the filing is made not later than the 30th day before the date of any use or delivery for use of the rate;

(2) the filed rate does not exceed [~~105 percent of~~] the rate in effect on the date on which the filing is made; and

(3) [~~the filed rate does not reflect a rate change for an individual rating class that is 10 percent higher than the rate in effect for that rating class on the date on which the filing is made; and~~]

[~~(4)~~] the commissioner has not disapproved the filing in writing, advising of the reasons for the disapproval and the criteria the association is required to meet to obtain approval.

(f) The association may not file a rate under this section that exceeds the rate in effect on the date on which the filing is made unless two-thirds of the board of directors votes to approve the rate.

Recent Legislative Changes

SB 1448

SECTION 2. Section 2210.352, Insurance Code, is amended by amending Subsection (a-1) and adding Subsection (a-3) to read as follows:

(a-1) The association may use a rate filed by the association under this section without prior commissioner approval if:

(1) the filing is made not later than the 30th day before the date of any use or delivery for use of the rate; and

(2) the filed rate does not exceed [~~105 percent of~~] the rate used by the association in effect on the date on which the filing is made[~~; and~~

[~~(3) the filed rate does not reflect a rate change for an individual rating class that is 10 percent higher than the rate in effect for that rating class on the date on which the filing is made~~].

(a-3) The association may not file a rate under this section that exceeds the rate in effect on the date on which the filing is made unless two-thirds of the board of directors votes to approve the rate.

Overview of Rate Adequacy Analysis

TWIA employs the "Loss Ratio Method" to determine rate level indications.

- This approach compares the estimated percentage of each premium dollar needed to cover future losses, loss adjustment expense and other fixed expenses for a prospective accident year to the amount of each premium dollar that is available to pay for such costs (referred to as the permissible loss ratio).
- This relationship is defined as:

$$\text{Indicated Rate Change Factor} = \frac{(\text{Loss \& LAE Ratio} + \text{Fixed Expense Ratio})}{(1 - \text{Variable Expense Ratio})}$$

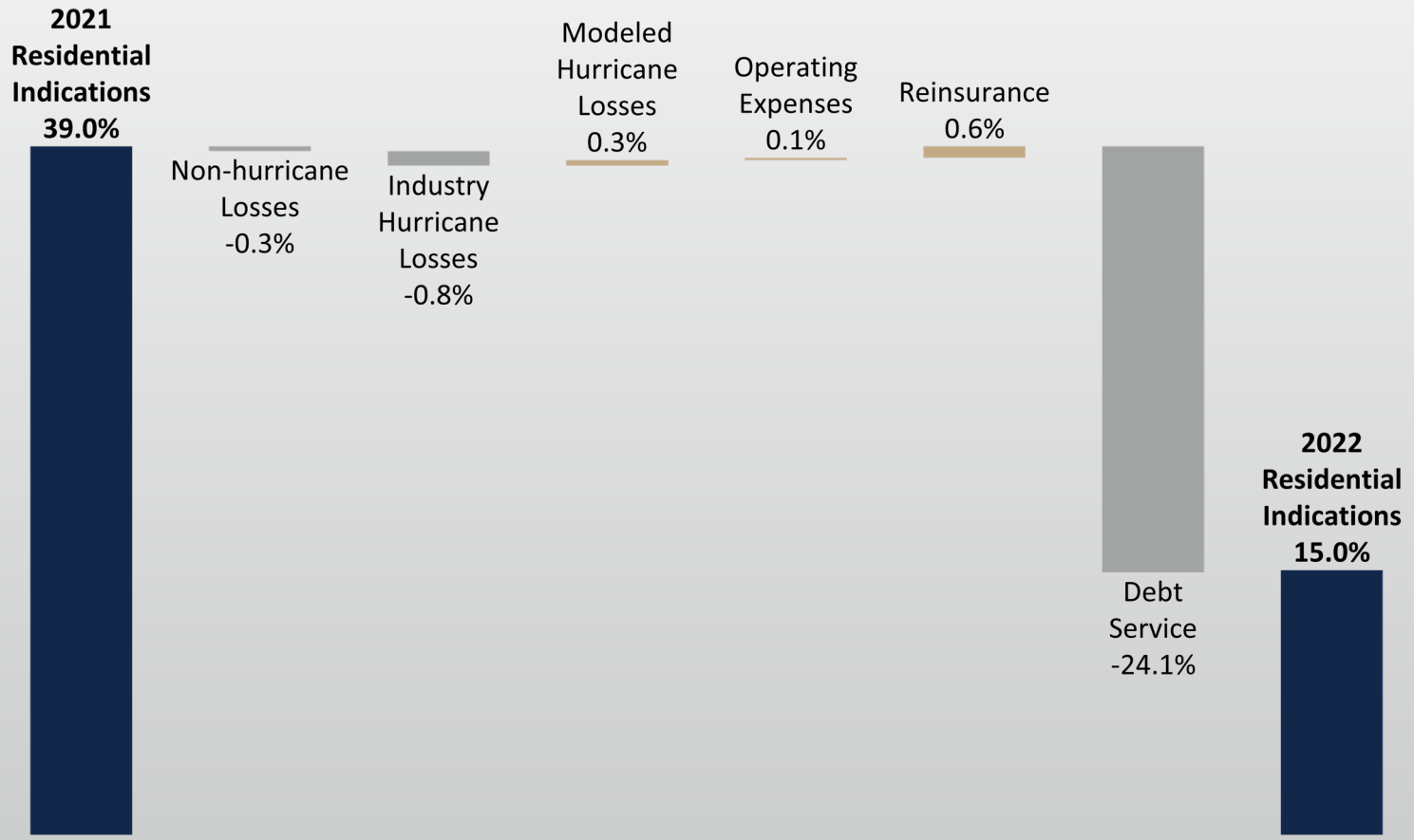
Overview of Rate Adequacy Analysis

- The Loss and LAE Ratio includes provisions for:
  - Hurricane losses and loss adjustment expenses
  - Non-hurricane losses and loss adjustment expenses
- The Fixed Expense Ratio includes:
  - General operating expenses
  - Net cost of reinsurance
    (total premiums less expected average annual recoveries)
  - Any debt service outstanding on public securities
    (no debt service is included in the 2022 indications)
- The Variable Expense Ratio includes:
  - Commissions, taxes, licenses and fees
  - Provisions for CRTF and contingencies

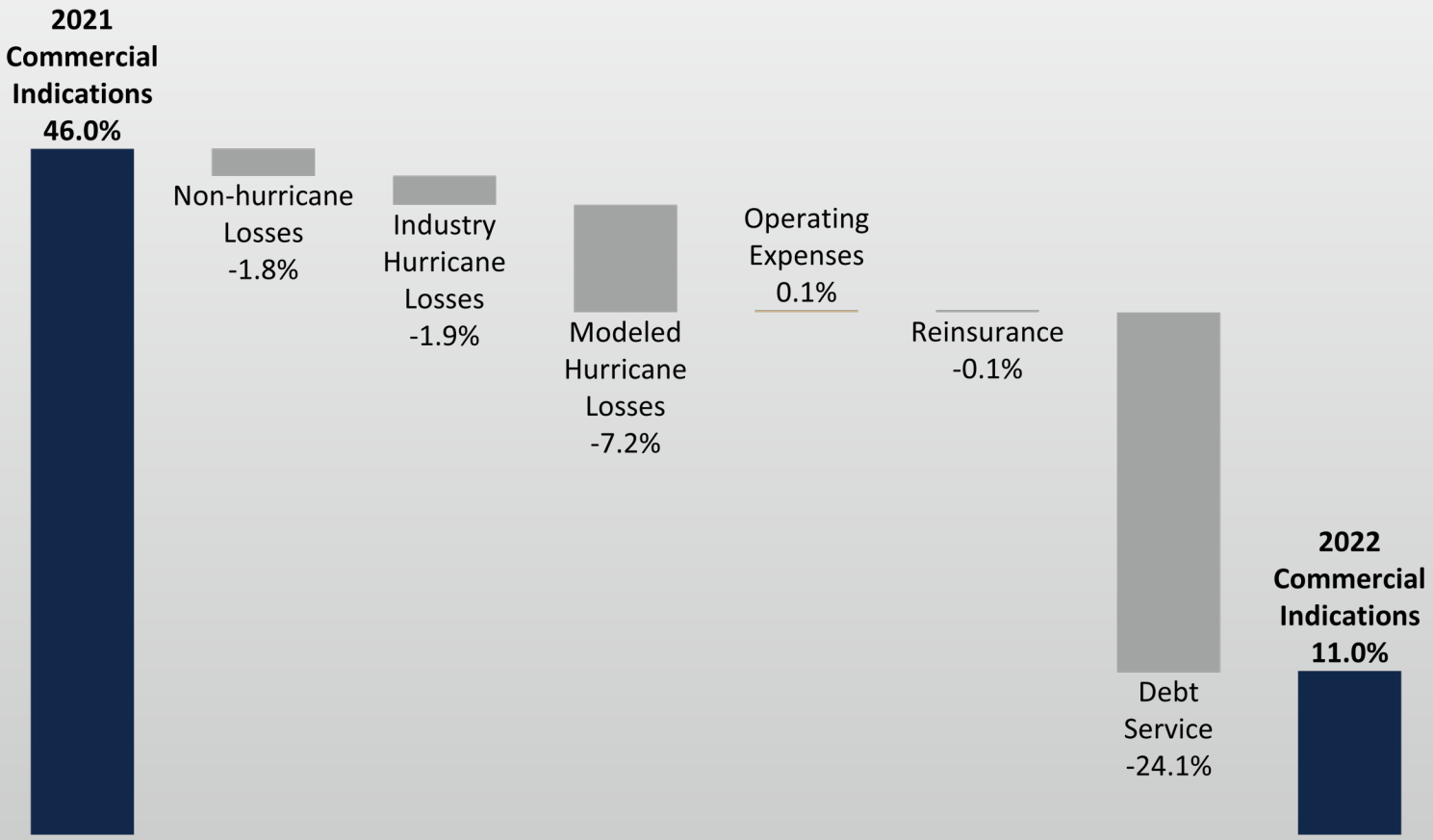
2022 Rate Adequacy Analysis

Rate Element	Residential 2019 Review	Residential 2020 Review	Residential 2021 Review	Residential **2022 Review**	Residential 2022 vs. 2021	Commercial 2019 Review	Commercial 2020 Review	Commercial 2021 Review	Commercial **2022 Review**	Commercial 2022 vs. 2021
Non-Hurricane Loss Provision	14.2%	14.6%	14.9%	**14.7%**	-0.2%	9.3%	9.0%	8.1%	**6.7%**	-1.4%
Hurricane Loss Provision										
Experience	42.7%	42.5%	41.5%	**40.2%**	-1.3%	56.9%	54.3%	51.7%	**48.7%**	-3.0%
Modeled	51.9%	55.1%	52.2%	**52.7%**	0.5%	59.7%	62.1%	64.4%	**53.3%**	-11.1%
Combined	47.3%	48.8%	46.8%	**46.5%**	-0.3%	58.3%	58.2%	58.1%	**51.0%**	-7.1%
Fixed Expenses										
Operating	6.2%	8.5%	8.1%	**8.2%**	0.1%	6.2%	8.5%	8.1%	**8.2%**	0.1%
Reinsurance	16.6%	19.5%	18.6%	**19.1%**	0.5%	16.6%	19.5%	19.7%	**19.6%**	-0.1%
Outstanding Debt Service	25.1%	19.7%	18.6%	**0.0%**	-18.6%	25.1%	19.7%	18.6%	**0.0%**	-18.6%
Total	47.9%	47.7%	45.3%	**27.3%**	-18.0%	40.3%	47.9%	46.4%	**27.8%**	-18.6%
(A) Total Loss Provision plus Fixed Expenses	109.4%	111.1%	107.1%	**88.4%**	-18.7%	115.5%	114.9%	112.5%	**85.5%**	-27.0%
Variable Expenses										
Commissions	16.0%	16.0%	16.0%	**16.0%**	0.0%	16.0%	16.0%	16.0%	**16.0%**	0.0%
Taxes and Fees	2.0%	1.9%	1.9%	**1.9%**	0.0%	2.0%	1.9%	1.9%	**1.9%**	0.0%
CRTF Funding & Contingencies	5.0%	5.0%	5.0%	**5.0%**	0.0%	5.0%	5.0%	5.0%	**5.0%**	0.0%
(B) Total Variable Expenses	23.0%	22.9%	22.9%	**22.9%**	0.0%	23.0%	22.9%	22.9%	**22.9%**	0.0%
(C) Permissible Loss Ratio (1 - B)	77.0%	77.1%	77.1%	**77.1%**	0.0%	77.0%	77.1%	77.1%	**77.1%**	0.0%
(D) Rate Indication (A / C - 1)	42.1%	44.0%	39.0%	**15.0%**	-24.0%	50.0%	49.0%	46.0%	**11.0%**	-35.0%

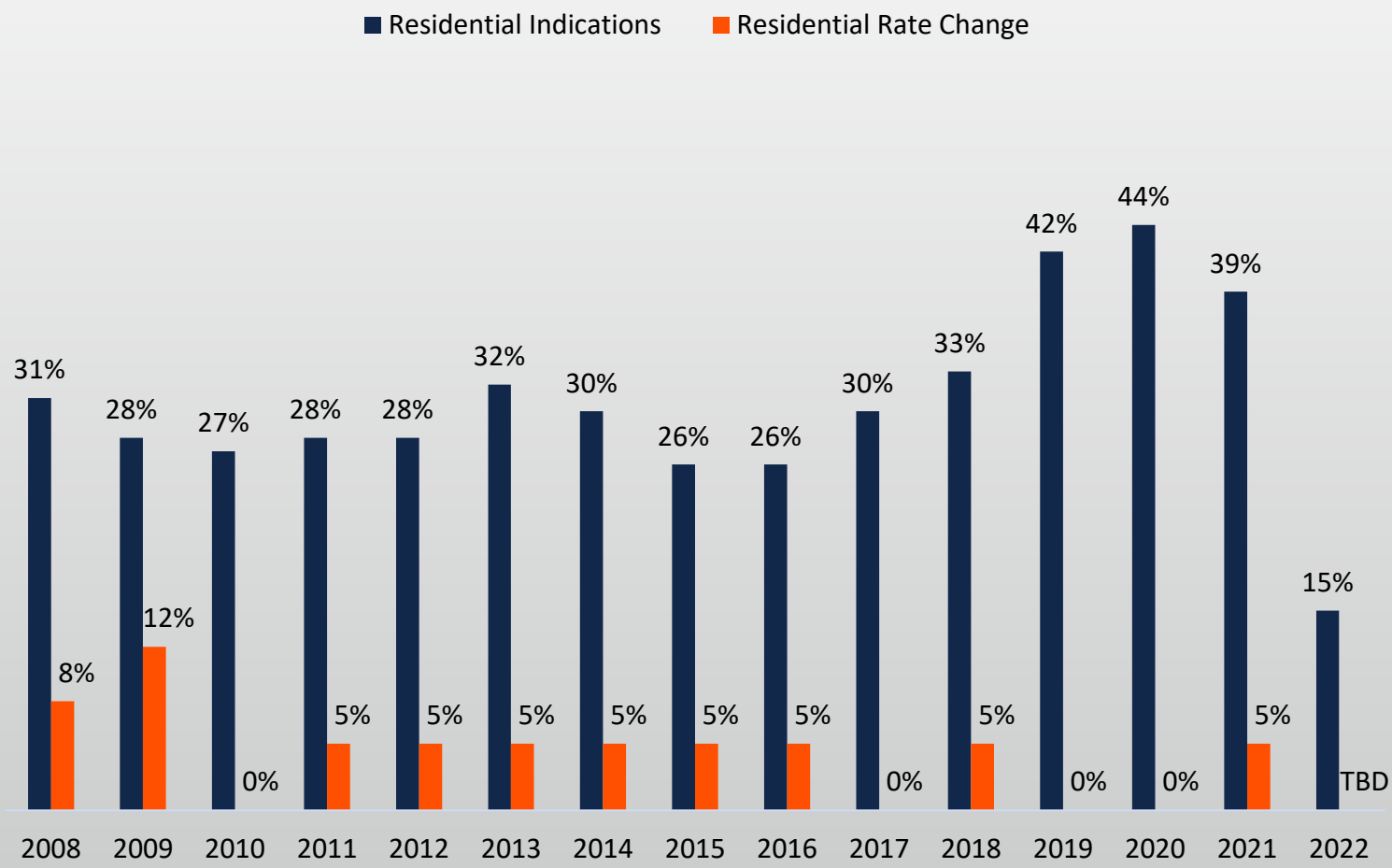
Reconciliation of Change in Rate Indications Residential 2022 vs 2021



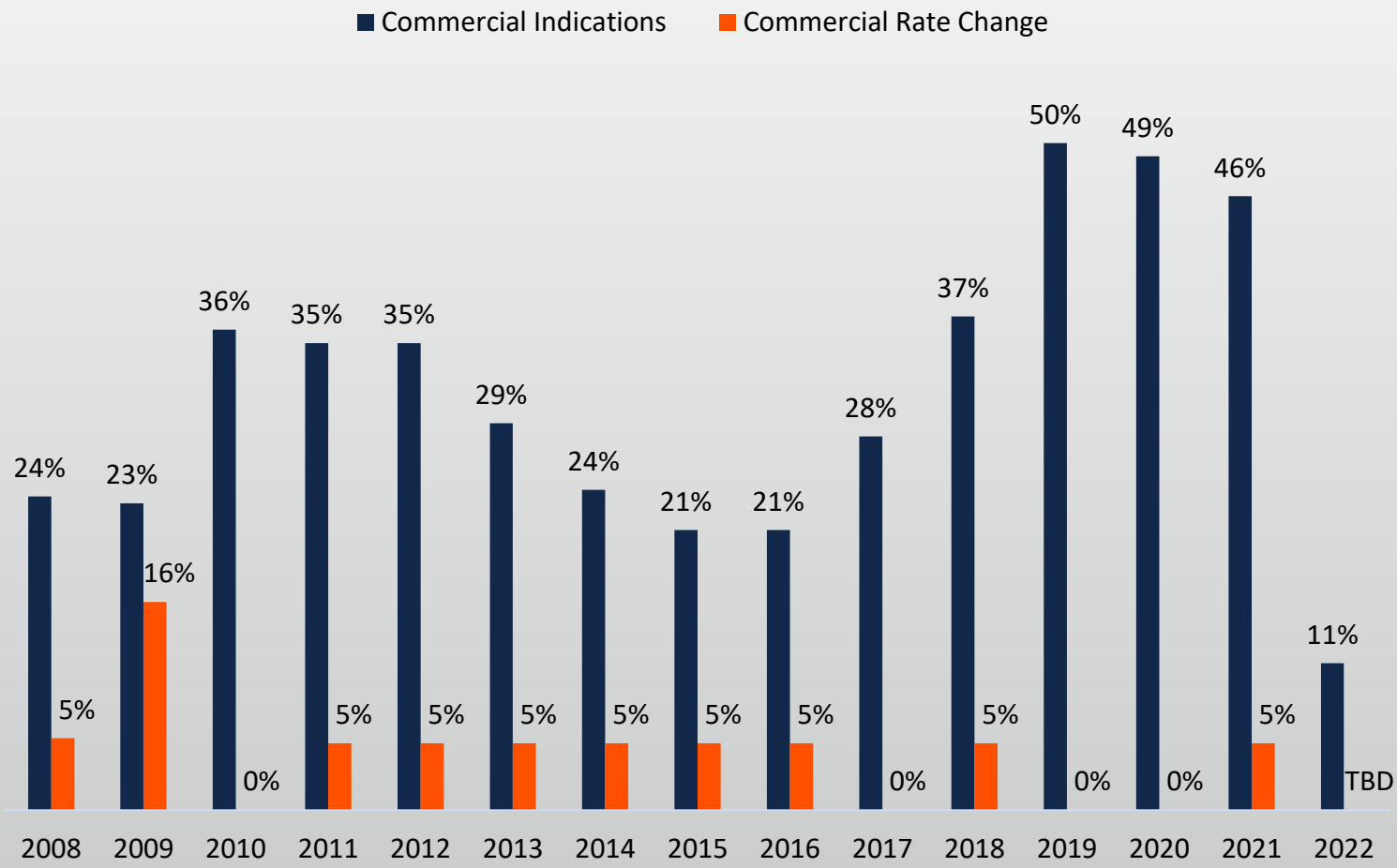
Reconciliation of Change in Rate Indications Commercial 2022 vs 2021



Residential Rate Indications vs Rate Changes 2008-2022



Commercial Rate Indications vs Rate Changes 2008-2022



Questions

TEXAS WINDSTORM
INSURANCE ASSOCIATION

Actuarial & Underwriting Committee

TWIA Actuarial Department – Wind Mitigation Analysis

July 18, 2022

Contents

- **Catastrophe Modeling Overview**
- **Opening Protection Analysis**
- **Roof Characteristics Analysis**

Catastrophe Modeling Overview

- HB 769 prohibits TWIA from purchasing reinsurance from a broker involved in the execution of catastrophe models on which the association relies in adopting rates
- The TWIA Board of Directors selected Aon on February 2, 2022 to serve as its designated catastrophe modeler for reinsurance and ratemaking
- TWIA staff has worked with Aon to produce all of the modeling results contained in this analysis
- TWIA's reinsurance broker, Gallagher Re, has not been involved in the execution of any of the relied upon models

Opening Protection Analysis

- Currently, TWIA offers a 10% retrofit credit for residential properties that have upgraded all exterior openings to current building codes, including windows, doors, and any other openings
- TWIA staff and Aon created a representative portfolio of risks to examine the specific impact of glazed opening (window) protections on modeled hurricane losses

Opening Protection Analysis

- Results of the analysis indicate an 8.8% credit for upgrading all windows on a structure
- Given how close this is to the existing 10% retrofit credit, staff proposes expanding the eligibility on the existing credit to include properties that have upgraded all windows without also requiring replacement of other openings
- As a new credit, this change would not have an overall impact on rate and would not impact existing policyholders who do not apply for the new credit

Roof Characteristics Analysis

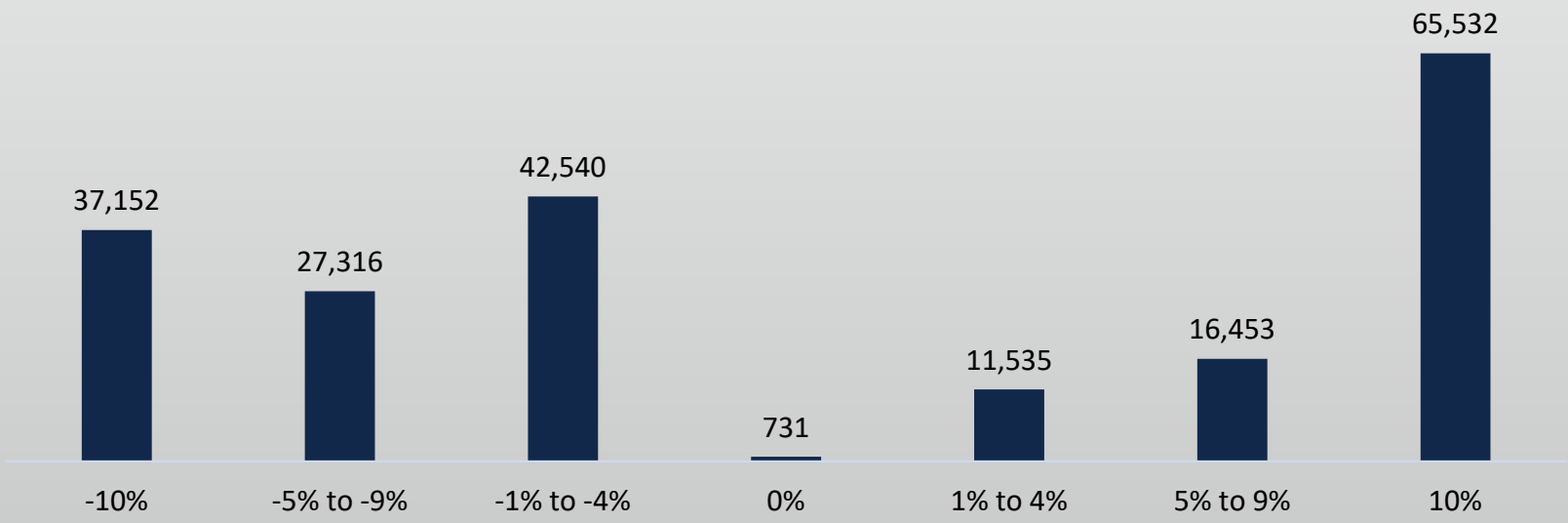
- TWIA does not currently have rating factors for roof age, material, or shape
- We have recently begun incorporating this information in reinsurance modeling, and Aon and staff have completed a preliminary analysis of potentially introducing a new rating factor based on roof characteristics

Roof Characteristics Analysis

- Using the same representative portfolio, modeling results were produced quantifying the difference in expected hurricane losses based on roof age, material, and shape
- Staff also analyzed non-hurricane loss experience using a generalized linear model
- Analysis results indicate decreased risk associated with newer, metal, and hip roofs and increased risk associated with older, unrated shingle, and gable roofs

Roof Characteristics Analysis

- Rating factors vary widely based on specific characteristics
- Following is the potential impact of implementing indicated factors capped at ±10%:



Roof Characteristics Analysis

- Factors have been selected to be rate-neutral, i.e., projected credits equal surcharges
- TWIA does not currently collect all required information on its application
- The potential implementation timeframe for this factor would therefore be significant
- Additional work may also be warranted to identify other secondary modifiers that may be impacted by roof age, specifically as it pertains to changes in required building codes over time

Questions and Next Steps

Texas Windstorm Insurance Association Exhibit I
Residential Property - Wind & Hail Sheet 1
Wind Mitigation Analysis
Opening Protection
Indicated Window Retrofit Credit

	Protection Status	
	Unprotected	Protected
(1) Combined Modeled Hurricane Relativities	0.707	0.588
(2) Rescaled Modeled Hurricane Relativities	1.000	0.832
Standard Rate Components:		
(3) Hurricane Loss and Loss Adjustment Expense Ratio		40.5%
(4) Non-Hurricane Loss and Loss Adjustment Expense Ratio		12.8%
(5) Fixed Expense Ratio		23.8%
(6) Permissible Loss and Loss Adjustment Expense Ratio		77.1%
(7) Indicated Credit		-8.8%
Selected Credit		-10%

(1) Modeled relativities from Exhibit I, Sheet 2 combined using weights from Exhibit III, Sheet 2
(2) Rescaled relative to unprotected status
(3) - (6) from 2022 Residential Rate Adequacy Analysis, rescaled to no overall change
(7) = [(3) * (2) + (4) + (5)] / (6) - 1

Texas Windstorm Insurance Association Exhibit I
Residential Property - Wind & Hail Sheet 2
Wind Mitigation Analysis
Opening Protection
Notional Model Relativities

Model	Construction	Opening Protection	Model Relativities by Year Built 1985	2005	2015
AIR	Wood Frame	Unknown	1.000	0.384	0.326
		No protection	1.000	0.455	0.388
		Non-engineered shutters	0.899	0.377	0.320
		Engineered shutters	0.793	0.329	0.278
	Brick Veneer	Unknown	1.000	0.384	0.326
		No protection	1.000	0.455	0.388
		Non-engineered shutters	0.899	0.377	0.320
		Engineered shutters	0.793	0.329	0.278
RMS	Wood Frame	Unknown	1.000	0.501	0.455
		No protection	1.059	0.538	0.491
		All glazed openings designed for pressure & large missiles	0.694	0.386	0.362
		All glazed openings designed for pressure & small missile	0.778	0.416	0.386
		All glazed openings covered with plywood/OSB	0.870	0.450	0.413
	Brick Veneer	Unknown	1.000	0.514	0.473
		No protection	1.057	0.551	0.509
		All glazed openings designed for pressure & large missiles	0.696	0.396	0.376
		All glazed openings designed for pressure & small missile	0.780	0.427	0.400
		All glazed openings covered with plywood/OSB	0.872	0.462	0.429

Notes: Model results relative to Unknown Protection, 1985 Construction

Texas Windstorm Insurance Association Exhibit I
Residential Property - Wind & Hail Sheet 3
Wind Mitigation Analysis
Opening Protection
Notional Model Results

Model	Construction	Opening Protection	Modeled Average Annual Loss by Year Built 1985	2005	2015
AIR	Wood Frame	Unknown	138,011	53,055	44,952
		No protection	138,012	62,784	53,595
		Non-engineered shutters	124,094	51,992	44,167
		Engineered shutters	109,439	45,344	38,348
	Brick Veneer	Unknown	131,196	50,393	42,715
		No protection	131,196	59,631	50,919
		Non-engineered shutters	117,946	49,414	41,994
		Engineered shutters	104,007	43,116	36,481
RMS	Wood Frame	Unknown	142,055	71,169	64,699
		No protection	150,396	76,457	69,812
		All glazed openings designed for pressure & large missiles	98,538	54,780	51,450
		All glazed openings designed for pressure & small missile	110,482	59,058	54,764
		All glazed openings covered with plywood/OSB	123,638	63,920	58,687
	Brick Veneer	Unknown	126,498	65,016	59,775
		No protection	133,739	69,744	64,420
		All glazed openings designed for pressure & large missiles	88,104	50,138	47,572
		All glazed openings designed for pressure & small missile	98,631	54,027	50,619
		All glazed openings covered with plywood/OSB	110,247	58,428	54,227

Notes: Model results as provided by Aon based on notional portfolio shown on Exhibit III, Sheet 1

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 1
Wind Mitigation Analysis
Roof Characteristics
Indicated Rating Factors

		Uncapped Indicated Roof Rating Factors				Capped at ± 10%			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
Unknown	Unknown	0.02	0.06	(0.12)	0.06	**0.02**	**0.06**	**(0.10)**	**0.06**
	Normal Shingle	0.04	0.09	(0.10)	0.09	**0.04**	**0.09**	**(0.10)**	**0.09**
	Rated Shingle	(0.03)	0.02	(0.14)	0.01	**(0.03)**	**0.02**	**(0.10)**	**0.01**
	Metal	(0.07)	(0.03)	(0.18)	(0.03)	**(0.07)**	**(0.03)**	**(0.10)**	**(0.03)**
	Concrete / Clay Tiles	0.03	0.09	(0.11)	0.08	**0.03**	**0.09**	**(0.10)**	**0.08**
0-5 years	Unknown	(0.14)	(0.10)	(0.25)	(0.10)	**(0.10)**	**(0.10)**	**(0.10)**	**(0.10)**
	Normal Shingle	(0.08)	(0.03)	(0.20)	(0.04)	**(0.08)**	**(0.03)**	**(0.10)**	**(0.04)**
	Rated Shingle	(0.14)	(0.10)	(0.24)	(0.10)	**(0.10)**	**(0.10)**	**(0.10)**	**(0.10)**
	Metal	(0.16)	(0.12)	(0.26)	(0.13)	**(0.10)**	**(0.10)**	**(0.10)**	**(0.10)**
	Concrete / Clay Tiles	(0.09)	(0.03)	(0.21)	(0.04)	**(0.09)**	**(0.03)**	**(0.10)**	**(0.04)**
6-10 years	Unknown	(0.10)	(0.05)	(0.22)	(0.06)	**(0.10)**	**(0.05)**	**(0.10)**	**(0.06)**
	Normal Shingle	(0.03)	0.02	(0.17)	0.01	**(0.03)**	**0.02**	**(0.10)**	**0.01**
	Rated Shingle	(0.10)	(0.06)	(0.21)	(0.06)	**(0.10)**	**(0.06)**	**(0.10)**	**(0.06)**
	Metal	(0.12)	(0.08)	(0.23)	(0.08)	**(0.10)**	**(0.08)**	**(0.10)**	**(0.08)**
	Concrete / Clay Tiles	(0.04)	0.02	(0.17)	0.02	**(0.04)**	**0.02**	**(0.10)**	**0.02**
11-20 years	Unknown	0.04	0.08	(0.10)	0.08	**0.04**	**0.08**	**(0.10)**	**0.08**
	Normal Shingle	0.12	0.18	(0.04)	0.17	**0.10**	**0.10**	**(0.04)**	**0.10**
	Rated Shingle	0.05	0.10	(0.08)	0.10	**0.05**	**0.10**	**(0.08)**	**0.10**
	Metal	0.00	0.05	(0.13)	0.05	**0.00**	**0.05**	**(0.10)**	**0.05**
	Concrete / Clay Tiles	0.13	0.20	(0.03)	0.19	**0.10**	**0.10**	**(0.03)**	**0.10**
21 years	Unknown	0.05	0.10	(0.09)	0.10	**0.05**	**0.10**	**(0.09)**	**0.10**
	Normal Shingle	0.08	0.14	(0.07)	0.13	**0.08**	**0.10**	**(0.07)**	**0.10**
	Rated Shingle	0.01	0.06	(0.11)	0.06	**0.01**	**0.06**	**(0.10)**	**0.06**
	Metal	(0.03)	0.02	(0.15)	0.01	**(0.03)**	**0.02**	**(0.10)**	**0.01**
	Concrete / Clay Tiles	0.08	0.14	(0.08)	0.14	**0.08**	**0.10**	**(0.08)**	**0.10**

Notes: Credits calculated by applying Fixed Expense Ratios and Permissible Loss Ratios from 2022 Residential Rate Adequacy Analysis, rescaled to no overall change
Off-Balance factor of 1.026 applied to maintain 0% overall impact

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 2
Wind Mitigation Analysis
Roof Characteristics
Combined Hurricane and Non-Hurricane Loss & LAE Ratios

			Indicated Hurricane and Non-Hurricane Loss & LAE Ratios			
Roof Age		Roof Covering	Unknown	Flat	Hip	Gable
Unknown	Unknown	Unknown	0.547	0.583	0.444	0.580
		Normal Shingle	0.564	0.603	0.458	0.600
		Rated Shingle	0.513	0.546	0.423	0.544
		Metal	0.480	0.512	0.393	0.510
		Concrete / Clay Tiles	0.556	0.600	0.447	0.596
0-5 years	2010	Unknown	0.425	0.455	0.338	0.453
		Normal Shingle	0.471	0.508	0.376	0.505
		Rated Shingle	0.423	0.455	0.345	0.453
		Metal	0.406	0.437	0.331	0.435
		Concrete / Clay Tiles	0.467	0.508	0.374	0.505
6-10 years	2010	Unknown	0.460	0.492	0.366	0.490
		Normal Shingle	0.506	0.546	0.406	0.544
		Rated Shingle	0.455	0.490	0.372	0.488
		Metal	0.438	0.472	0.356	0.469
		Concrete / Clay Tiles	0.506	0.550	0.404	0.547
11 years	2000	Unknown	0.560	0.598	0.453	0.595
or more		Normal Shingle	0.624	0.671	0.506	0.668
		Rated Shingle	0.568	0.610	0.468	0.607
		Metal	0.533	0.572	0.436	0.570
		Concrete / Clay Tiles	0.633	0.687	0.508	0.683
11 years	1990	Unknown	0.575	0.613	0.464	0.610
or more		Normal Shingle	0.598	0.640	0.483	0.637
		Rated Shingle	0.544	0.581	0.445	0.578
		Metal	0.510	0.545	0.414	0.543
		Concrete / Clay Tiles	0.594	0.642	0.473	0.638

Notes: Relativities applied to Hurricane and Non-Hurricane Loss & Loss Adjustment Ratios from 2022 Residential Rate Adequacy Analysis, rescaled to no overall change
Off-Balance factor of 1.026 applied to maintain 0% overall impact

Texas Windstorm Insurance Association
Residential Property - Wind & Hail
Wind Mitigation Analysis
Roof Characteristics
Combined Modeled Relativities

			Rescaled Combined Adjusted Modeled Relativities by Roof Shape			
Roof Age		Roof Covering	Unknown	Flat	Hip	Gable
Unknown	Unknown	Unknown	1.000	1.086	0.752	1.079
		Normal Shingle	1.041	1.135	0.787	1.129
		Rated Shingle	0.918	0.998	0.702	0.993
		Metal	0.896	0.973	0.687	0.967
		Concrete / Clay Tiles	1.079	1.184	0.817	1.175
0-5 years	2010	Unknown	0.880	0.951	0.670	0.946
		Normal Shingle	0.989	1.078	0.762	1.072
		Rated Shingle	0.873	0.951	0.686	0.946
		Metal	0.860	0.934	0.678	0.929
		Concrete / Clay Tiles	1.007	1.104	0.783	1.097
6-10 years	2010	Unknown	0.924	1.002	0.699	0.996
		Normal Shingle	1.036	1.133	0.794	1.126
		Rated Shingle	0.913	0.997	0.712	0.991
		Metal	0.904	0.985	0.708	0.980
		Concrete / Clay Tiles	1.068	1.174	0.824	1.166
11 years	2000	Unknown	1.032	1.123	0.775	1.116
or more		Normal Shingle	1.185	1.300	0.902	1.291
		Rated Shingle	1.050	1.151	0.809	1.143
		Metal	1.024	1.118	0.791	1.113
		Concrete / Clay Tiles	1.263	1.395	0.963	1.384
11 years	1990	Unknown	1.068	1.160	0.801	1.153
or more		Normal Shingle	1.122	1.224	0.846	1.216
		Rated Shingle	0.993	1.082	0.753	1.075
		Metal	0.969	1.053	0.737	1.047
		Concrete / Clay Tiles	1.171	1.285	0.879	1.275

Notes: Modeled relativities from Exhibit II, Sheet 5
Combined using weights from Exhibit III, Sheet 2
Adjusted using factors from Exhibit II, Sheet 4
Rescaled using Unknown / Unknown as base

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 4
Wind Mitigation Analysis
Roof Characteristics
Adjustment for Existing Building Code Credits

			Average Building Code Credit Factor by Year Built and Roof Shape											
			1985				2005				2015			
Roof Age		Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
Unknown	Unknown	Unknown	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Normal Shingle	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Rated Shingle	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Metal	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Concrete / Clay Tiles	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0-5 years	2010	Unknown	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.954	0.954	0.954	0.954
		Normal Shingle	0.999	0.999	0.999	0.999	0.873	0.873	0.873	0.873	0.703	0.703	0.703	0.703
		Rated Shingle	0.999	0.999	0.999	0.999	0.841	0.841	0.841	0.841	0.698	0.698	0.698	0.698
		Metal	0.992	0.992	0.992	0.992	0.848	0.848	0.848	0.848	0.699	0.699	0.699	0.699
		Concrete / Clay Tiles	0.998	0.998	0.998	0.998	0.873	0.873	0.873	0.873	0.691	0.691	0.691	0.691
6-10 years	2010	Unknown	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.030	1.030	1.030	1.030
		Normal Shingle	0.999	0.999	0.999	0.999	0.917	0.917	0.917	0.917	0.698	0.698	0.698	0.698
		Rated Shingle	0.999	0.999	0.999	0.999	0.898	0.898	0.898	0.898	0.696	0.696	0.696	0.696
		Metal	0.990	0.990	0.990	0.990	0.871	0.871	0.871	0.871	0.695	0.695	0.695	0.695
		Concrete / Clay Tiles	1.000	1.000	1.000	1.000	0.900	0.900	0.900	0.900	0.695	0.695	0.695	0.695
11 years	2000	Unknown	1.000	1.000	1.000	1.000	1.030	1.030	1.030	1.030	1.043	1.043	1.043	1.043
or more		Normal Shingle	0.999	0.999	0.999	0.999	0.833	0.833	0.833	0.833	0.717	0.717	0.717	0.717
		Rated Shingle	1.000	1.000	1.000	1.000	0.806	0.806	0.806	0.806	0.710	0.710	0.710	0.710
		Metal	0.995	0.995	0.995	0.995	0.814	0.814	0.814	0.814	0.717	0.717	0.717	0.717
		Concrete / Clay Tiles	0.999	0.999	0.999	0.999	0.773	0.773	0.773	0.773	0.716	0.716	0.716	0.716
11 years	1990	Unknown	1.002	1.002	1.002	1.002	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
or more		Normal Shingle	0.998	0.998	0.998	0.998	0.963	0.963	0.963	0.963	1.000	1.000	1.000	1.000
		Rated Shingle	0.999	0.999	0.999	0.999	0.951	0.951	0.951	0.951	1.000	1.000	1.000	1.000
		Metal	0.997	0.997	0.997	0.997	0.956	0.956	0.956	0.956	1.000	1.000	1.000	1.000
		Concrete / Clay Tiles	0.999	0.999	0.999	0.999	0.973	0.973	0.973	0.973	1.000	1.000	1.000	1.000

Notes: Average building code credit factors based on written premium

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 5
Wind Mitigation Analysis
Roof Characteristics
Notional Model Relativities

		Modeled Relativities by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
AIR / Frame													
Unknown	Unknown	1.000	0.998	0.758	1.000	0.384	0.425	0.343	0.426	0.326	0.359	0.293	0.360
	Normal Shingle	1.000	0.998	0.758	1.000	0.468	0.527	0.420	0.528	0.394	0.442	0.356	0.443
	Rated Shingle	0.868	0.861	0.690	0.868	0.365	0.406	0.330	0.407	0.311	0.344	0.282	0.345
	Metal	0.893	0.891	0.703	0.893	0.387	0.432	0.350	0.433	0.328	0.365	0.298	0.365
	Concrete / Clay Tiles	0.894	0.892	0.705	0.894	0.388	0.433	0.351	0.434	0.329	0.366	0.300	0.366
2010	Unknown	0.951	0.949	0.731	0.951	0.369	0.407	0.331	0.407	0.326	0.359	0.293	0.360
	Normal Shingle	0.951	0.949	0.731	0.951	0.446	0.501	0.403	0.502	0.394	0.442	0.356	0.443
	Rated Shingle	0.810	0.809	0.667	0.810	0.351	0.389	0.319	0.390	0.311	0.344	0.282	0.345
	Metal	0.832	0.831	0.680	0.832	0.371	0.413	0.337	0.414	0.328	0.365	0.298	0.365
	Concrete / Clay Tiles	0.834	0.832	0.681	0.834	0.373	0.414	0.338	0.415	0.329	0.366	0.300	0.366
2000	Unknown	0.992	0.990	0.755	0.992	0.383	0.424	0.343	0.425	0.326	0.359	0.293	0.360
	Normal Shingle	0.992	0.990	0.755	0.992	0.465	0.523	0.419	0.524	0.394	0.442	0.356	0.443
	Rated Shingle	0.857	0.856	0.687	0.857	0.365	0.405	0.331	0.406	0.311	0.344	0.282	0.345
	Metal	0.886	0.880	0.701	0.886	0.386	0.430	0.349	0.431	0.328	0.365	0.298	0.365
	Concrete / Clay Tiles	0.887	0.886	0.702	0.887	0.387	0.431	0.351	0.432	0.329	0.366	0.300	0.366
1990	Unknown	1.066	1.064	0.807	1.066	0.383	0.424	0.343	0.425	0.326	0.359	0.293	0.360
	Normal Shingle	1.066	1.064	0.807	1.066	0.465	0.523	0.419	0.524	0.394	0.442	0.356	0.443
	Rated Shingle	0.932	0.930	0.726	0.932	0.365	0.405	0.331	0.406	0.311	0.344	0.282	0.345
	Metal	0.961	0.960	0.741	0.961	0.386	0.430	0.349	0.431	0.328	0.365	0.298	0.365
	Concrete / Clay Tiles	0.966	0.964	0.742	0.966	0.387	0.431	0.351	0.432	0.329	0.366	0.300	0.366

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 5
Wind Mitigation Analysis
Roof Characteristics
Notional Model Relativities

		Modeled Relativities by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
AIR / Brick Veneer													
Unknown	Unknown	1.000	0.998	0.758	1.000	0.384	0.425	0.343	0.426	0.326	0.359	0.293	0.360
	Normal Shingle	1.000	0.998	0.758	1.000	0.467	0.526	0.420	0.527	0.393	0.441	0.356	0.442
	Rated Shingle	0.868	0.862	0.690	0.868	0.365	0.406	0.330	0.407	0.311	0.344	0.283	0.344
	Metal	0.893	0.891	0.703	0.893	0.387	0.431	0.349	0.432	0.328	0.364	0.298	0.365
	Concrete / Clay Tiles	0.894	0.892	0.705	0.894	0.388	0.432	0.351	0.433	0.329	0.365	0.300	0.366
2010	Unknown	0.951	0.949	0.731	0.951	0.368	0.406	0.331	0.407	0.326	0.359	0.293	0.360
	Normal Shingle	0.951	0.949	0.731	0.951	0.445	0.500	0.403	0.501	0.393	0.441	0.356	0.442
	Rated Shingle	0.811	0.810	0.667	0.811	0.351	0.389	0.319	0.390	0.311	0.344	0.283	0.344
	Metal	0.833	0.831	0.680	0.833	0.371	0.412	0.337	0.413	0.328	0.364	0.298	0.365
	Concrete / Clay Tiles	0.834	0.833	0.681	0.834	0.372	0.414	0.338	0.414	0.329	0.365	0.300	0.366
2000	Unknown	0.992	0.990	0.755	0.992	0.383	0.423	0.343	0.424	0.326	0.359	0.293	0.360
	Normal Shingle	0.992	0.990	0.755	0.992	0.464	0.522	0.418	0.523	0.393	0.441	0.356	0.442
	Rated Shingle	0.858	0.856	0.688	0.858	0.365	0.405	0.331	0.406	0.311	0.344	0.283	0.344
	Metal	0.887	0.880	0.701	0.887	0.386	0.430	0.349	0.430	0.328	0.364	0.298	0.365
	Concrete / Clay Tiles	0.888	0.886	0.702	0.888	0.387	0.431	0.351	0.431	0.329	0.365	0.300	0.366
1990	Unknown	1.066	1.064	0.807	1.066	0.383	0.423	0.343	0.424	0.326	0.359	0.293	0.360
	Normal Shingle	1.066	1.064	0.807	1.066	0.464	0.522	0.418	0.523	0.393	0.441	0.356	0.442
	Rated Shingle	0.933	0.931	0.726	0.933	0.365	0.405	0.331	0.406	0.311	0.344	0.283	0.344
	Metal	0.962	0.960	0.741	0.962	0.386	0.430	0.349	0.430	0.328	0.364	0.298	0.365
	Concrete / Clay Tiles	0.966	0.964	0.742	0.966	0.387	0.431	0.351	0.431	0.329	0.365	0.300	0.366

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 5
Wind Mitigation Analysis
Roof Characteristics
Notional Model Relativities

		Modeled Relativities by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
RMS / Frame													
Unknown	Unknown	1.000	1.128	0.679	1.115	0.501	0.580	0.384	0.573	0.455	0.533	0.361	0.524
	Normal Shingle	1.024	1.156	0.695	1.142	0.516	0.597	0.394	0.590	0.469	0.549	0.371	0.540
	Rated Shingle	0.936	1.057	0.635	1.044	0.478	0.553	0.365	0.546	0.437	0.511	0.345	0.503
	Metal	0.855	0.964	0.581	0.952	0.449	0.519	0.344	0.512	0.414	0.483	0.327	0.476
	Concrete/ Clay Tiles	1.200	1.355	0.813	1.338	0.625	0.725	0.478	0.716	0.576	0.675	0.455	0.664
0-5 years	Unknown	0.777	0.876	0.527	0.866	0.422	0.488	0.323	0.482	0.393	0.460	0.311	0.452
	Normal Shingle	0.794	0.895	0.538	0.885	0.434	0.501	0.331	0.495	0.404	0.472	0.319	0.465
	Rated Shingle	0.733	0.826	0.497	0.817	0.404	0.467	0.309	0.461	0.378	0.442	0.299	0.435
	Metal	0.670	0.754	0.455	0.746	0.380	0.439	0.291	0.433	0.358	0.418	0.283	0.412
	Concrete/ Clay Tiles	0.924	1.044	0.626	1.031	0.523	0.606	0.399	0.598	0.493	0.578	0.390	0.569
6-10 years	Unknown	0.890	1.005	0.602	0.993	0.462	0.535	0.353	0.528	0.424	0.496	0.334	0.488
	Normal Shingle	0.911	1.028	0.615	1.016	0.475	0.550	0.362	0.543	0.436	0.510	0.344	0.502
	Rated Shingle	0.837	0.945	0.565	0.934	0.441	0.511	0.337	0.504	0.407	0.476	0.321	0.468
	Metal	0.764	0.862	0.517	0.852	0.415	0.480	0.317	0.474	0.385	0.450	0.304	0.443
	Concrete/ Clay Tiles	1.064	1.202	0.718	1.187	0.574	0.666	0.438	0.658	0.533	0.626	0.421	0.616
11 years	Unknown	1.081	1.220	0.734	1.205	0.550	0.637	0.421	0.628	0.503	0.589	0.398	0.579
or more	Normal Shingle	1.108	1.251	0.751	1.235	0.567	0.656	0.434	0.648	0.519	0.607	0.410	0.597
	Rated Shingle	1.009	1.139	0.684	1.125	0.523	0.605	0.400	0.598	0.481	0.563	0.380	0.554
	Metal	0.921	1.038	0.626	1.026	0.491	0.568	0.376	0.561	0.455	0.532	0.360	0.524
	Concrete/ Clay Tiles	1.302	1.471	0.883	1.453	0.690	0.800	0.528	0.790	0.639	0.750	0.506	0.737

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 5
Wind Mitigation Analysis
Roof Characteristics
Notional Model Relativities

		Modeled Relativities by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
RMS / Brick Veneer													
Unknown	Unknown	1.000	1.127	0.680	1.114	0.514	0.594	0.393	0.587	0.473	0.552	0.374	0.544
	Normal Shingle	1.024	1.154	0.695	1.140	0.529	0.612	0.405	0.604	0.487	0.569	0.385	0.560
	Rated Shingle	0.935	1.054	0.634	1.041	0.490	0.566	0.374	0.559	0.453	0.529	0.358	0.521
	Metal	0.853	0.961	0.580	0.949	0.460	0.531	0.352	0.525	0.429	0.501	0.339	0.493
	Concrete/ Clay Tiles	1.201	1.356	0.814	1.339	0.642	0.744	0.491	0.735	0.598	0.701	0.472	0.689
0-5 years	Unknown	0.772	0.870	0.523	0.859	0.431	0.498	0.330	0.492	0.407	0.475	0.321	0.468
	Normal Shingle	0.789	0.889	0.534	0.878	0.443	0.512	0.338	0.506	0.418	0.488	0.330	0.481
	Rated Shingle	0.727	0.819	0.493	0.809	0.413	0.476	0.315	0.471	0.391	0.456	0.308	0.449
	Metal	0.664	0.748	0.451	0.739	0.388	0.448	0.296	0.442	0.370	0.432	0.292	0.425
	Concrete/ Clay Tiles	0.920	1.037	0.622	1.025	0.535	0.619	0.408	0.611	0.511	0.598	0.403	0.589
6-10 years	Unknown	0.886	1.000	0.599	0.988	0.473	0.547	0.361	0.540	0.438	0.513	0.346	0.505
	Normal Shingle	0.907	1.023	0.612	1.010	0.486	0.562	0.370	0.555	0.451	0.528	0.356	0.519
	Rated Shingle	0.832	0.939	0.562	0.927	0.451	0.522	0.344	0.515	0.421	0.492	0.332	0.484
	Metal	0.759	0.856	0.514	0.845	0.424	0.490	0.323	0.484	0.398	0.466	0.314	0.458
	Concrete/ Clay Tiles	1.060	1.197	0.716	1.183	0.588	0.682	0.448	0.673	0.553	0.648	0.436	0.637
11 years	Unknown	1.083	1.221	0.735	1.206	0.565	0.653	0.433	0.645	0.522	0.611	0.413	0.601
or more	Normal Shingle	1.110	1.251	0.753	1.236	0.583	0.674	0.445	0.665	0.539	0.630	0.426	0.620
	Rated Shingle	1.009	1.137	0.684	1.123	0.537	0.620	0.410	0.612	0.499	0.583	0.394	0.574
	Metal	0.920	1.037	0.626	1.024	0.504	0.582	0.386	0.575	0.472	0.552	0.374	0.543
	Concrete/ Clay Tiles	1.306	1.474	0.885	1.456	0.710	0.822	0.543	0.811	0.665	0.779	0.526	0.766

Notes: Model results relative to Unknown Age, Unknown Covering, Unknown Shape

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 6
Wind Mitigation Analysis
Roof Characteristics
Notional Model Results

		Modeled Average Annual Loss by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
AIR / Frame													
Unknown	Unknown	138,011	137,732	104,636	138,012	53,055	58,719	47,378	58,843	44,952	49,556	40,462	49,657
	Normal Shingle	138,012	137,732	104,636	138,012	64,531	72,715	57,983	72,874	54,312	60,957	49,126	61,086
	Rated Shingle	119,801	118,856	95,174	119,801	50,438	56,094	45,592	56,208	42,871	47,471	38,985	47,563
	Metal	123,200	122,962	97,052	123,200	53,408	59,599	48,243	59,723	45,287	50,320	41,163	50,420
	Concrete/ Clay Tiles	123,346	123,109	97,257	123,346	53,574	59,734	48,416	59,858	45,460	50,467	41,338	50,566
2010	Unknown	131,252	130,991	100,866	131,252	50,859	56,108	45,726	56,223	44,952	49,556	40,462	49,657
	Normal Shingle	131,252	130,991	100,866	131,252	61,534	69,126	55,596	69,274	54,312	60,957	49,126	61,086
	Rated Shingle	111,848	111,657	92,020	111,848	48,486	53,730	44,048	53,835	42,871	47,471	38,985	47,563
	Metal	114,886	114,685	93,780	114,886	51,238	56,979	46,524	57,092	45,287	50,320	41,163	50,420
	Concrete/ Clay Tiles	115,051	114,850	93,982	115,051	51,415	57,127	46,703	57,240	45,460	50,467	41,338	50,566
2000	Unknown	136,846	136,572	104,154	136,846	52,923	58,474	47,379	58,595	44,952	49,556	40,462	49,657
	Normal Shingle	136,846	136,572	104,154	136,846	64,177	72,197	57,780	72,353	54,312	60,957	49,126	61,086
	Rated Shingle	118,286	118,069	94,871	118,286	50,364	55,908	45,624	56,020	42,871	47,471	38,985	47,563
	Metal	122,320	121,457	96,715	122,320	53,275	59,343	48,227	59,464	45,287	50,320	41,163	50,420
	Concrete/ Clay Tiles	122,467	122,233	96,917	122,467	53,442	59,479	48,399	59,600	45,460	50,467	41,338	50,566
1990	Unknown	147,169	146,872	111,365	147,169	52,923	58,474	47,379	58,595	44,952	49,556	40,462	49,657
	Normal Shingle	147,169	146,872	111,365	147,169	64,177	72,197	57,780	72,353	54,312	60,957	49,126	61,086
	Rated Shingle	128,668	128,418	100,203	128,668	50,364	55,908	45,624	56,020	42,871	47,471	38,985	47,563
	Metal	132,684	132,422	102,205	132,684	53,275	59,343	48,227	59,464	45,287	50,320	41,163	50,420
	Concrete/ Clay Tiles	133,292	133,027	102,415	133,292	53,442	59,479	48,399	59,600	45,460	50,467	41,338	50,566

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 6
Wind Mitigation Analysis
Roof Characteristics
Notional Model Results

		Modeled Average Annual Loss by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
AIR / Brick Veneer													
Unknown	Unknown	131,196	130,929	99,465	131,196	50,393	55,759	45,026	55,876	42,715	47,078	38,467	47,174
	Normal Shingle	131,196	130,929	99,465	131,196	61,257	69,003	55,067	69,153	51,582	57,869	46,679	57,992
	Rated Shingle	113,932	113,046	90,492	113,932	47,917	53,275	43,333	53,383	40,743	45,104	37,066	45,191
	Metal	117,143	116,917	92,272	117,143	50,729	56,594	45,845	56,711	43,033	47,802	39,131	47,896
	Concrete/ Clay Tiles	117,281	117,055	92,468	117,281	50,894	56,728	46,017	56,845	43,204	47,948	39,304	48,042
2010	Unknown	124,769	124,520	95,886	124,769	48,319	53,291	43,464	53,400	42,715	47,078	38,467	47,174
	Normal Shingle	124,769	124,520	95,886	124,769	58,427	65,612	52,812	65,752	51,582	57,869	46,679	57,992
	Rated Shingle	106,397	106,214	87,496	106,397	46,073	51,040	41,873	51,140	40,743	45,104	37,066	45,191
	Metal	109,277	109,085	89,164	109,277	48,679	54,117	44,220	54,224	43,033	47,802	39,131	47,896
	Concrete/ Clay Tiles	109,434	109,241	89,358	109,434	48,854	54,264	44,398	54,370	43,204	47,948	39,304	48,042
2000	Unknown	130,087	129,827	99,006	130,087	50,268	55,527	45,027	55,642	42,715	47,078	38,467	47,174
	Normal Shingle	130,087	129,827	99,006	130,087	60,922	68,513	54,875	68,660	51,582	57,869	46,679	57,992
	Rated Shingle	112,503	112,296	90,203	112,503	47,847	53,099	43,363	53,205	40,743	45,104	37,066	45,191
	Metal	116,306	115,498	91,951	116,306	50,603	56,351	45,829	56,466	43,033	47,802	39,131	47,896
	Concrete/ Clay Tiles	116,444	116,222	92,145	116,444	50,768	56,486	46,000	56,601	43,204	47,948	39,304	48,042
1990	Unknown	139,920	139,637	105,894	139,920	50,268	55,527	45,027	55,642	42,715	47,078	38,467	47,174
	Normal Shingle	139,920	139,637	105,894	139,920	60,922	68,513	54,875	68,660	51,582	57,869	46,679	57,992
	Rated Shingle	122,356	122,118	95,273	122,356	47,847	53,099	43,363	53,205	40,743	45,104	37,066	45,191
	Metal	126,164	125,914	97,171	126,164	50,603	56,351	45,829	56,466	43,033	47,802	39,131	47,896
	Concrete/ Clay Tiles	126,740	126,488	97,371	126,740	50,768	56,486	46,000	56,601	43,204	47,948	39,304	48,042

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 6
Wind Mitigation Analysis
Roof Characteristics
Notional Model Results

		Modeled Average Annual Loss by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
RMS / Frame													
Unknown	Unknown	142,055	160,287	96,478	158,333	71,169	82,370	54,478	81,331	64,699	75,708	51,229	74,506
	Normal Shingle	145,467	164,163	98,699	162,156	73,280	84,845	56,039	83,768	66,622	77,990	52,713	76,745
	Rated Shingle	133,026	150,115	90,207	148,285	67,864	78,535	51,905	77,546	62,039	72,583	49,078	71,432
	Metal	121,434	136,900	82,532	135,249	63,770	73,716	48,831	72,795	58,767	68,680	46,520	67,602
	Concrete / Clay Tiles	170,440	192,498	115,531	190,132	88,848	103,010	67,903	101,680	81,780	95,904	64,661	94,344
0-5 years	Unknown	110,334	124,441	74,821	122,964	59,967	69,317	45,832	68,464	55,859	65,290	44,146	64,274
	Normal Shingle	112,734	127,176	76,366	125,659	61,609	71,239	47,052	70,357	57,405	67,116	45,340	66,066
	Rated Shingle	104,092	117,382	70,554	115,999	57,404	66,353	43,835	65,536	53,704	62,772	42,410	61,794
	Metal	95,120	107,173	64,637	105,928	53,979	62,331	41,270	61,570	50,875	59,412	40,210	58,499
	Concrete / Clay Tiles	131,318	148,260	88,873	146,472	74,255	86,026	56,681	84,946	70,079	82,118	55,342	80,808
6-10 years	Unknown	126,469	142,819	85,500	141,070	65,611	75,958	50,092	75,000	60,160	70,408	47,511	69,288
	Normal Shingle	129,350	146,101	87,363	144,305	67,471	78,151	51,469	77,159	61,872	72,447	48,834	71,286
	Rated Shingle	118,902	134,287	80,300	132,652	62,706	72,575	47,826	71,664	57,774	67,613	45,585	66,539
	Metal	108,518	122,436	73,461	120,961	58,921	68,128	44,990	67,280	54,714	63,978	43,199	62,970
	Concrete / Clay Tiles	151,105	170,774	102,007	168,665	81,587	94,666	62,169	93,449	75,748	88,897	59,749	87,445
11 years	Unknown	153,625	173,356	104,233	171,230	78,152	90,424	59,815	89,270	71,450	83,601	56,562	82,266
or more	Normal Shingle	157,425	177,684	106,705	175,497	80,554	93,234	61,605	92,033	73,673	86,227	58,281	84,841
	Rated Shingle	143,385	161,809	97,169	159,825	74,296	85,975	56,799	84,880	68,312	79,937	54,024	78,660
	Metal	130,824	147,483	88,889	145,694	69,780	80,661	53,413	79,643	64,683	75,613	51,206	74,418
	Concrete / Clay Tiles	185,017	208,958	125,366	206,375	98,026	113,666	74,981	112,171	90,818	106,492	71,871	104,739

Texas Windstorm Insurance Association Exhibit II
Residential Property - Wind & Hail Sheet 6
Wind Mitigation Analysis
Roof Characteristics
Notional Model Results

		Modeled Average Annual Loss by Year Built and Roof Shape											
		1985				2005				2015			
Roof Age	Roof Covering	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable	Unknown	Flat	Hip	Gable
RMS / Brick Veneer													
Unknown	Unknown	126,498	142,596	85,971	140,864	65,016	75,173	49,757	74,225	59,775	69,884	47,299	68,779
	Normal Shingle	129,532	146,041	87,945	144,261	66,939	77,425	51,177	76,443	61,545	71,984	48,666	70,840
	Rated Shingle	118,233	133,294	80,208	131,674	61,923	71,588	47,342	70,687	57,264	66,938	45,266	65,881
	Metal	107,936	121,555	73,397	120,095	58,189	67,195	44,545	66,356	54,245	63,343	42,907	62,351
	Concrete / Clay Tiles	151,975	171,491	103,030	169,382	81,264	94,127	62,079	92,913	75,634	88,626	59,760	87,191
0-5 years	Unknown	97,635	110,016	66,208	108,716	54,581	63,037	41,689	62,258	51,463	60,111	40,636	59,177
	Normal Shingle	99,746	112,419	67,563	111,084	56,071	64,774	42,792	63,972	52,882	61,786	41,728	60,820
	Rated Shingle	91,944	103,608	62,317	102,391	52,184	60,266	39,825	59,523	49,430	57,737	39,001	56,843
	Metal	84,028	94,586	57,096	93,485	49,075	56,618	37,500	55,928	46,827	54,649	36,977	53,810
	Concrete / Clay Tiles	116,332	131,220	78,711	129,639	67,654	78,307	51,610	77,322	64,630	75,672	50,994	74,467
6-10 years	Unknown	112,128	126,507	75,801	124,964	59,773	69,132	45,609	68,261	55,463	64,863	43,762	63,834
	Normal Shingle	114,674	129,404	77,442	127,817	61,462	71,117	46,856	70,215	57,037	66,729	44,974	65,663
	Rated Shingle	105,230	118,741	71,057	117,298	57,058	65,982	43,490	65,153	53,214	62,235	41,945	61,248
	Metal	96,049	108,251	65,019	106,953	53,620	61,940	40,917	61,166	50,394	58,885	39,751	57,957
	Concrete / Clay Tiles	134,133	151,477	90,535	149,602	74,404	86,257	56,658	85,147	69,900	81,973	55,090	80,637
11 years	Unknown	137,014	154,435	93,028	152,548	71,510	82,648	54,716	81,596	66,087	77,256	52,285	76,028
or more	Normal Shingle	140,398	158,286	95,205	156,343	73,705	85,206	56,346	84,115	68,140	79,677	53,870	78,402
	Rated Shingle	127,620	143,872	86,547	142,114	67,890	78,477	51,880	77,479	63,118	73,795	49,889	72,622
	Metal	116,440	131,128	79,190	129,543	63,763	73,629	48,804	72,702	59,768	69,804	47,293	68,705
	Concrete / Clay Tiles	165,223	186,450	111,977	184,146	89,801	104,009	68,677	102,639	84,106	98,521	66,514	96,905

Notes: Model results as provided by Aon based on notional portfolio shown on Exhibit III, Sheet 1

Wind Mitigation Analysis
Roof Characteristics
Non-Hurricane Relativities

			Scaled Non-Hurricane Relativities by Roof Shape			
Roof Age		Roof Covering	Unknown	Flat	Hip	Gable
Unknown	Unknown	Unknown	1.000	1.000	1.000	1.000
		Normal Shingle	1.000	1.000	1.000	1.000
		Rated Shingle	1.000	1.000	1.000	1.000
		Metal	0.820	0.820	0.820	0.820
		Concrete / Clay Tiles	0.820	0.820	0.820	0.820
0-5 years	2010	Unknown	0.455	0.455	0.455	0.455
		Normal Shingle	0.455	0.455	0.455	0.455
		Rated Shingle	0.455	0.455	0.455	0.455
		Metal	0.373	0.373	0.373	0.373
		Concrete / Clay Tiles	0.373	0.373	0.373	0.373
6-10 years	2010	Unknown	0.577	0.577	0.577	0.577
		Normal Shingle	0.577	0.577	0.577	0.577
		Rated Shingle	0.577	0.577	0.577	0.577
		Metal	0.473	0.473	0.473	0.473
		Concrete / Clay Tiles	0.473	0.473	0.473	0.473
11 years	2000	Unknown	1.000	1.000	1.000	1.000
or more		Normal Shingle	1.000	1.000	1.000	1.000
		Rated Shingle	1.000	1.000	1.000	1.000
		Metal	0.820	0.820	0.820	0.820
		Concrete / Clay Tiles	0.820	0.820	0.820	0.820
11 years	1990	Unknown	1.000	1.000	1.000	1.000
or more		Normal Shingle	1.000	1.000	1.000	1.000
		Rated Shingle	1.000	1.000	1.000	1.000
		Metal	0.820	0.820	0.820	0.820
		Concrete / Clay Tiles	0.820	0.820	0.820	0.820

Notes: Non-Hurricane relativities from Exhibit II, Sheet 8
Using Roof Age and Roof Material variables
Scaled using Unknown / Unknown as base

Wind Mitigation Analysis
Roof Characteristics
Non-Hurricane Generalized Linear Model Results

			Coef	Std Err	Z	P>|Z|	[0.025	0.975]
Intercept		const	-2.6219	0.034	-76.836	0	-2.689	-2.555
Constr_Brick	0.62	x1	-0.4717	0.109	-4.328	0	-0.685	-0.258
Constr_Brick_Veneer	1.12	x2	0.1149	0.026	4.385	0	0.064	0.166
Year_Built_2017orLater	0.08	x3	-2.4857	0.272	-9.134	0	-3.019	-1.952
Year_Built_2015to2016	0.36	x4	-1.0145	0.172	-5.893	0	-1.352	-0.677
Year_Built_2010to2014	0.42	x5	-0.8652	0.071	-12.215	0	-1.004	-0.726
Roof_age_0to2	**0.39**	**x6**	**-0.9479**	**0.051**	**-18.426**	**0**	**-1.049**	**-0.847**
Roof_age_3to5	**0.49**	**x7**	**-0.7091**	**0.038**	**-18.449**	**0**	**-0.784**	**-0.634**
Roof_age_6to10	**0.58**	**x8**	**-0.5507**	**0.029**	**-18.770**	**0**	**-0.608**	**-0.493**
Terri_Seaward	0.44	x9	-0.8222	0.046	-17.724	0	-0.913	-0.731
Terri_InlandII	0.73	x10	-0.3203	0.030	-10.567	0	-0.380	-0.261
BC_WRC	1.44	x11	0.3613	0.047	7.671	0	0.269	0.454
WPI8_Y	1.20	x12	0.1815	0.035	5.212	0	0.113	0.250
PY2011	2.44	x13	0.8916	0.046	19.527	0	0.802	0.981
PY2012	3.50	x14	1.2518	0.043	29.245	0	1.168	1.336
PY2014	4.07	x15	1.4036	0.041	33.890	0	1.322	1.485
PY2015	2.83	x16	1.0393	0.043	23.936	0	0.954	1.124
PY2016	1.39	x17	0.3258	0.048	6.724	0	0.231	0.421
PY2018	1.23	x18	0.2034	0.054	3.801	0	0.099	0.308
PY2019	1.17	x19	0.1544	0.055	2.784	0.005	0.046	0.263
PY2020	1.34	x20	0.2907	0.055	5.304	0	0.183	0.398
Roof_Tile_Slate_Metal	**0.82**	**x21**	**-0.2034**	**0.049**	**-4.137**	**0**	**-0.300**	**-0.107**

Model assumes Tweedie distribution
Base class: Residential Frame, Built <= 1998, Roof Age >= 11, Shingle Roof, Inland I, no building code credit, no WPI-8 waiver

Texas Windstorm Insurance Association Exhibit III
Residential Property - Wind & Hail Sheet 1
Wind Mitigation Analysis
Notional Risk Portfolio

					Modeled Values			
Occupancy	Construction	Stories	Year Built	Sq Ft	Building	Contents	Loss of Use	Deductible
Single Family	Wood	1	1985	2,000	250,000	70,000	30,000	2%
Single Family	Wood	1	2005	2,000	250,000	70,000	30,000	2%
Single Family	Wood	1	2015	2,000	250,000	70,000	30,000	2%
Single Family	Masonry Veneer	1	1985	2,000	250,000	70,000	30,000	2%
Single Family	Masonry Veneer	1	2005	2,000	250,000	70,000	30,000	2%
Single Family	Masonry Veneer	1	2015	2,000	250,000	70,000	30,000	2%

Notional portfolio built by allocating each location above to all postal codes contained in designated catastrophe area
Risk modifier analysis utilizes all available combinations of modifiers with "unknown" as base risk

Notes: Model results as provided by Aon based on notional portfolio shown on Exhibit III

Texas Windstorm Insurance Association Exhibit III
Residential Property - Wind & Hail Sheet 2
Wind Mitigation Analysis
Risk Parameter Weights

Risk Parameters		Weights
Year Built	1985	48.9%
	2005	30.8%
	2015	20.4%
Construction	Wood Frame	44.3%
	Brick Veneer	55.7%
Model	AIR	50.0%
	RMS	50.0%
Protected (AIR)	Non-engineered shutters	50.0%
	Engineered shutters	50.0%
Protected (RMS)	All glazed openings designed for pressure & large missiles	33.3%
	All glazed openings designed for pressure & small missiles	33.3%
	All glazed openings covered with plywood/OSB	33.3%
Unprotected	Unknown	100.0%
	No Protection	0.0%

Notes: Year Built and Construction assigned based on TWIA exposure distribution
All other parameters assigned judgmentally

Wind Mitigation Analysis
Roof Characteristic Weights

Roof Age		Roof Covering	Roof Shape Unknown	Flat	Hip	Gable
Unknown	Unknown	Unknown	0.0%	0.0%	0.0%	0.0%
		Normal Shingle	0.0%	0.0%	0.0%	0.0%
		Rated Shingle	0.0%	0.0%	0.0%	0.0%
		Metal	0.0%	0.0%	0.0%	0.0%
		Concrete / Clay Tiles	0.0%	0.0%	0.0%	0.0%
0-5 years	2010	Unknown	0.0%	0.0%	0.0%	0.0%
		Normal Shingle	5.1%	0.4%	5.1%	6.1%
		Rated Shingle	1.9%	0.2%	1.9%	2.2%
		Metal	0.5%	0.0%	0.5%	0.6%
		Concrete / Clay Tiles	0.2%	0.0%	0.2%	0.2%
6-10 years	2010	Unknown	0.0%	0.0%	0.0%	0.0%
		Normal Shingle	3.6%	0.3%	3.6%	4.3%
		Rated Shingle	0.8%	0.1%	0.8%	1.0%
		Metal	0.2%	0.0%	0.2%	0.3%
		Concrete / Clay Tiles	0.1%	0.0%	0.1%	0.1%
11 years	2000	Unknown	0.0%	0.0%	0.0%	0.0%
or more		Normal Shingle	9.8%	0.8%	9.8%	11.7%
		Rated Shingle	1.9%	0.2%	1.9%	2.3%
		Metal	0.4%	0.0%	0.4%	0.4%
		Concrete / Clay Tiles	0.4%	0.0%	0.4%	0.5%
11 years	1990	Unknown	0.0%	0.0%	0.0%	0.0%
or more		Normal Shingle	4.5%	0.4%	4.5%	5.4%
		Rated Shingle	0.5%	0.0%	0.5%	0.6%
		Metal	0.2%	0.0%	0.2%	0.2%
		Concrete / Clay Tiles	0.3%	0.0%	0.3%	0.4%

Notes: Weights assigned based on TWIA exposure distribution