

THE SPACE INSURANCE MARKET

**The 6th Annual International Conference
“Aviation and Space Insurance in Russia”**

**26th February 2015, Moscow
Gareth Morgan, Willis Inspace**

The Willis logo is displayed in white serif font on a dark blue rectangular background. The logo is positioned in the bottom right corner of the slide, which is part of a horizontal bar that also includes a light grey section on the left.

2014 Space Insurance Market Review

- **Premium income for 2014 was originally estimated at +/-USD 750m**
 - Final figure closer to USD700m based upon launch delays and declining premium rates
 - Grounding of Proton following AM4R launch failure, plus delays to Ariane manifest (Optus 10 return to manufacturer), negatively impacted income
- **Market became volatile and reported a loss in 2013**
 - 2014 currently only marginally profitable to insurers
 - Claims to date +/- USD 650million (last 2014 in orbit policy will not expire until December 2015)
- **Insurers' continued concerns about Proton reliability**
 - Significant premium rate increases for future Proton launches in short/medium term
- **Market overcapacity and sustained sector profitability in recent years**
 - 'Supply & Demand'; conditions remained very attractive to the insurance buyer despite claims quantum
- **Retraction of in orbit capacity from some insurers based upon low premium rates**
 - Some other insurers also now offering in orbit capacity more conservatively

2014 Major Launches

LAUNCH VEHICLE	LAUNCH DATE	SATELLITE NAME	SATELLITE TYPE / MANUFACTURER	RESULT	SUM INSURED
Falcon 9 V1.1	06/01/2014	Thaicom 6	Orbital Star 2	Success	USD156.2m
Antares	09/01/2014	CRS-1	Orbital	Success	USD50m
Atlas V (401)	24/01/2014	TDRS 12(L)	Boeing 601HP	Success	
Ariane 5ECA	06/02/2014	ABS 2 Athena-Fidus	LS-1300 Spacebus 4000B2	Success (ABS2 In Orbit Anomaly)	USD475m (Partial Loss)
Proton M Breeze M	15/02/2014	Turksat 4A	MELCO DS2000	Success	USD290m
Ariane 5ECA	16/03/2014	Astra 5B Amazonas 4	Eurostar 3000 Orbital GEOSTar 2	Success (Amazonas In Orbit Anomaly)	EUR284m EUR145m (Partial Loss)
Proton M Breeze M	17/03/2014	Ekspress AT1 Ekspress AT2	Ekspress 1000NTB Ekspress 1000NTB	Success	USD108m USD90m
Falcon 9 V1.1	18/04/2014	Dragon CRS-3	Dragon	Success	
Proton M Breeze M	28/04/2014	Kazsat-3 Luch 5A	Ekspress 1000NTA Ekspress 1000A	Success	USD176m
Proton M Breeze M	15/05/2014	Express AM4R	Eurostar 3000	FAILURE	USD217m
H-IIA	24/05/2014	ALOS 2	JAXA SAR	Success	
Zenit 3SL Sea Launch	26/05/2014	Eutelsat 3B	Eurostar 3000	Return to Flight Success	EUR165m
PSLV	30/06/2014	SPOT 7	AstroSat 500	Success	Eur130m (TLO)
Soyuz Fregat MT	10/07/2014	O3b (x4)	EliTeBus	Success	USD245m
Antares	13/07/2014	Cygnus CRS-2	Cygnus	Success	USD50m
Falcon 9 V1.1	14/07/2014	Orbcomm (x6)	SN-100A	Success	USD80m

2014 Major Launches

LAUNCH VEHICLE	LAUNCH DATE	SATELLITE NAME	SATELLITE TYPE / MANUFACTURER	RESULT	SUM INSURED
Ariane 5ES	29/07/2014	ATV	ATV	Success	N/A
Falcon 9 V1.1	05/08/2014	AsiaSat 8	LS-1300	Success	USD245m
Atlas V (401)	13/08/2014	WorldView 3	BCP-5000	Success	USD340m
Soyuz Fregat	22/08/2014	Galileo	OHB/SSTL	Failure	N/A
Falcon 9 V1.1	07/09/2014	Asiasat 6	LS-1300	Success	USD160m
Ariane 5 ECA	11/09/2014	MEASAT 3B Optus 10	Eurostar 3000 LS-1300	Success	USD380m USD260m
Proton M Breeze M	27/09/2014	Luch		Return to flight - Success	N/A
Ariane 5ECA	16/10/2014	Intelsat 30 Arsat 1	SSL 1300 INVAP	Success	USD433m USD230m
Proton M Breeze M	21/10/2014	Express AM6	Express 2000	Success* *Possible launch vehicle underperformance	USD140m
Antares	28/10/2014	Cygnus Orb-3		FAILURE	USD48m
H-IIA	03/12/2014	Hayabusa 2	NEC	Success	N/A
Ariane 5 ECA	06/12/2014	DirectTV-16/ GSAT 16	LS-1300 I-3K	Success	
Proton M Breeze M	15/12/2014	Yamal 401	Express 2000	Success	
Soyuz Fregat	18/12/2014	O3b (x4)	Thales EliteBus	Success	
Proton M Breeze M	27/12/2014	Astra 2G	Eurostar 3000	Success	

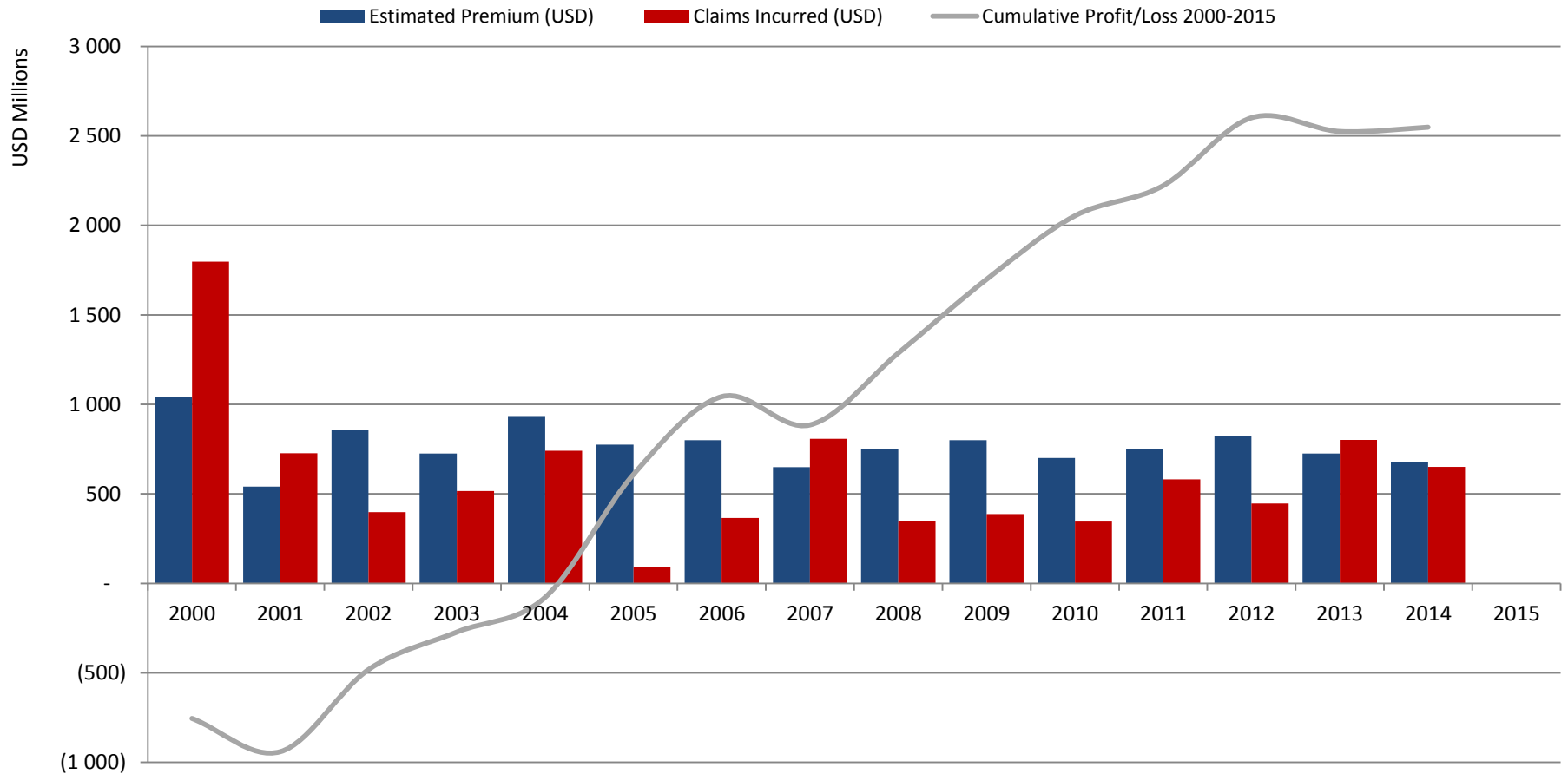
2014 Claims

- **Amazonas 4A (launched March 2014) reported an anomaly**
 - Power problem relating to the solar array, partial loss claim estimated at approximately USD 135m
- **Express-AM4R launch failure (launched May 2014)**
 - Proton third stage failure, total loss of USD217m,
- **Proton successful return to flight September 2014**
 - However, launch vehicle 'underperformance' reported on subsequent Express AM6 launch (October)
- **Yamal 201 (launched November 2003)**
 - In orbit anomaly reported in June 2014, potential claim of EUR 16m
- **ABS-2 (launched February 2014)**
 - Failure of 6 Russian Ku-band beam transponders, claim estimated ~ USD 215m
- **Orb 3 (launched October 2014)**
 - Failure of Antares rocket at lift-off, total loss claim estimated at USD 48m

Total Claims 2014 year to date: Estimated at +/- USD 650million

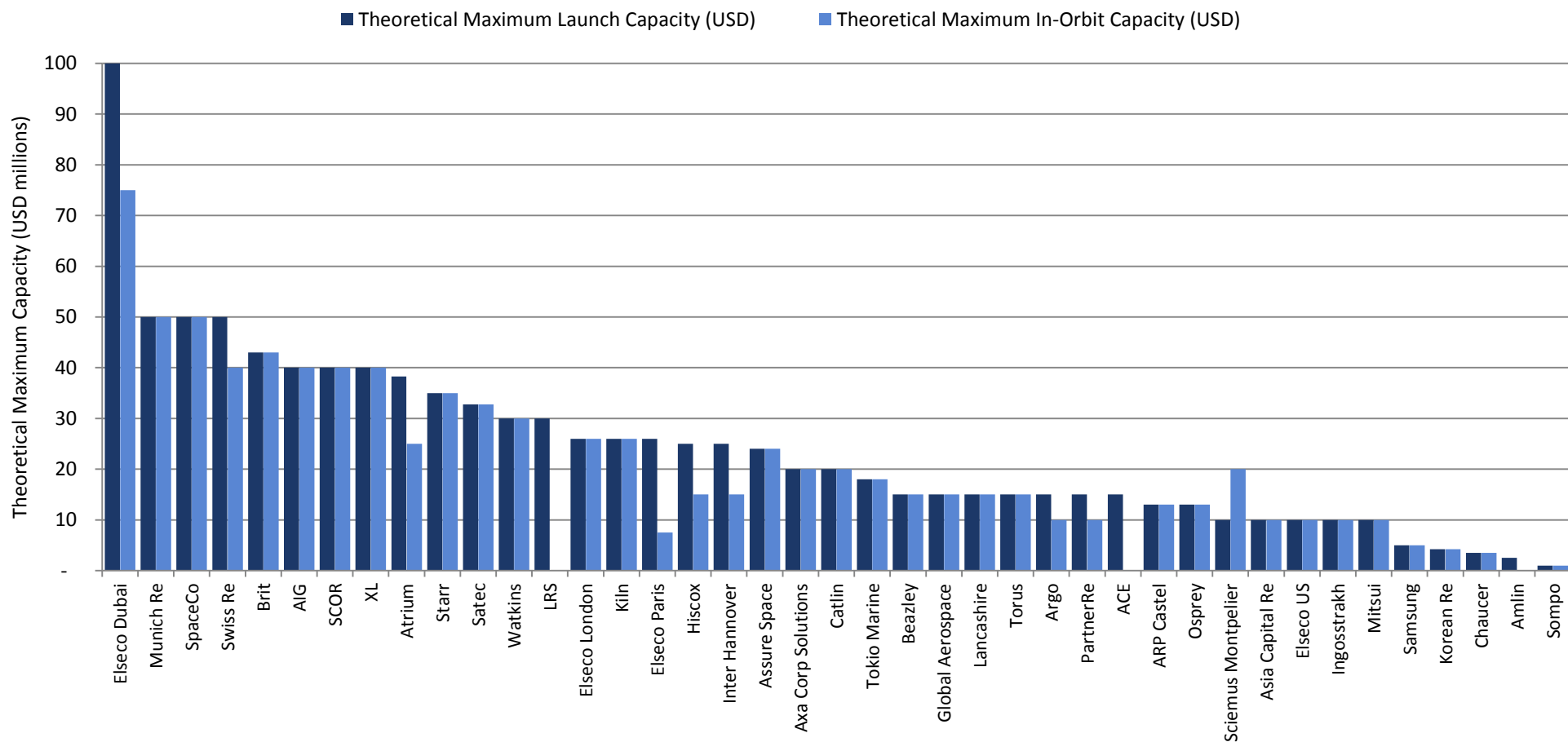
Space Market Premium & Claims History

Space Insurance Market Premium and Claims 2000 - 2015



2015 International Space Insurance Theoretical Market Capacity

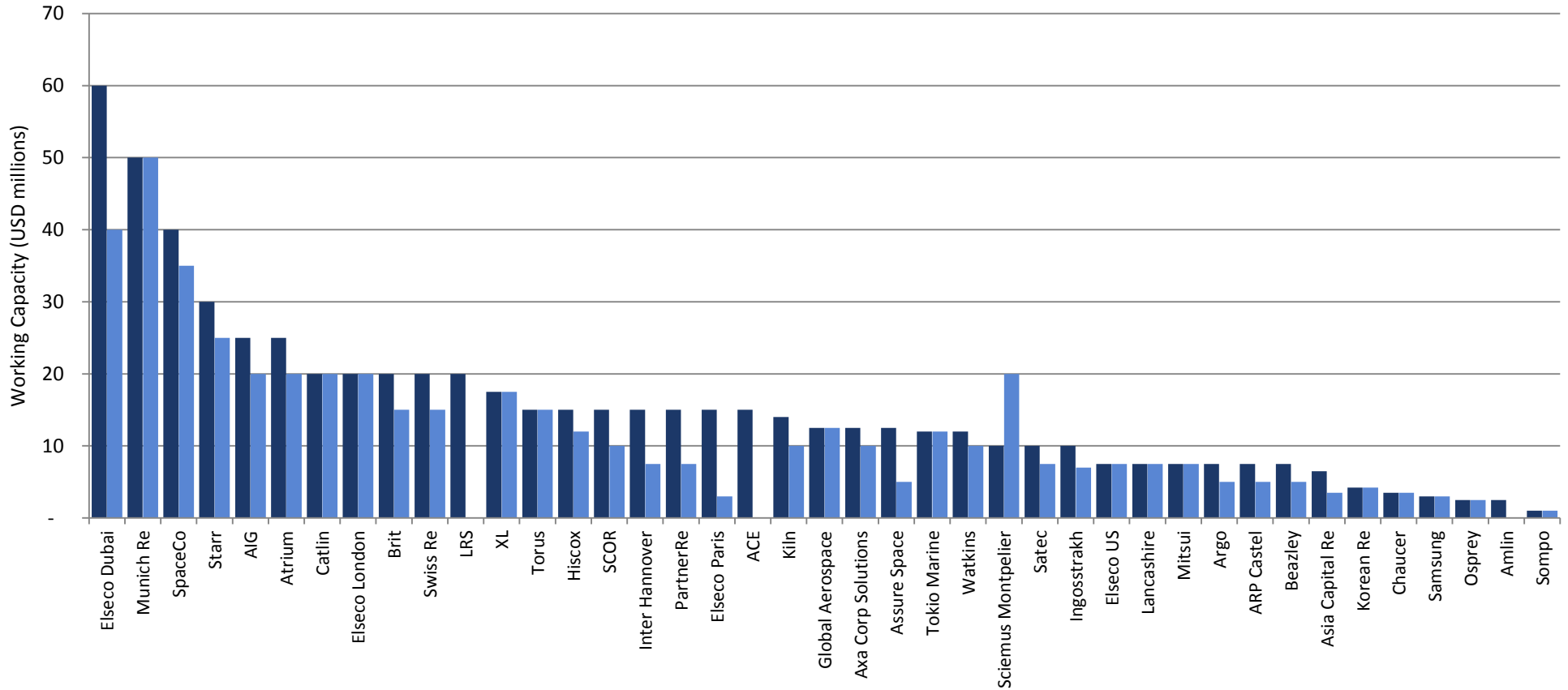
2015 Space Insurance Market Capacity



2015 International Space Insurance Working Market Capacity

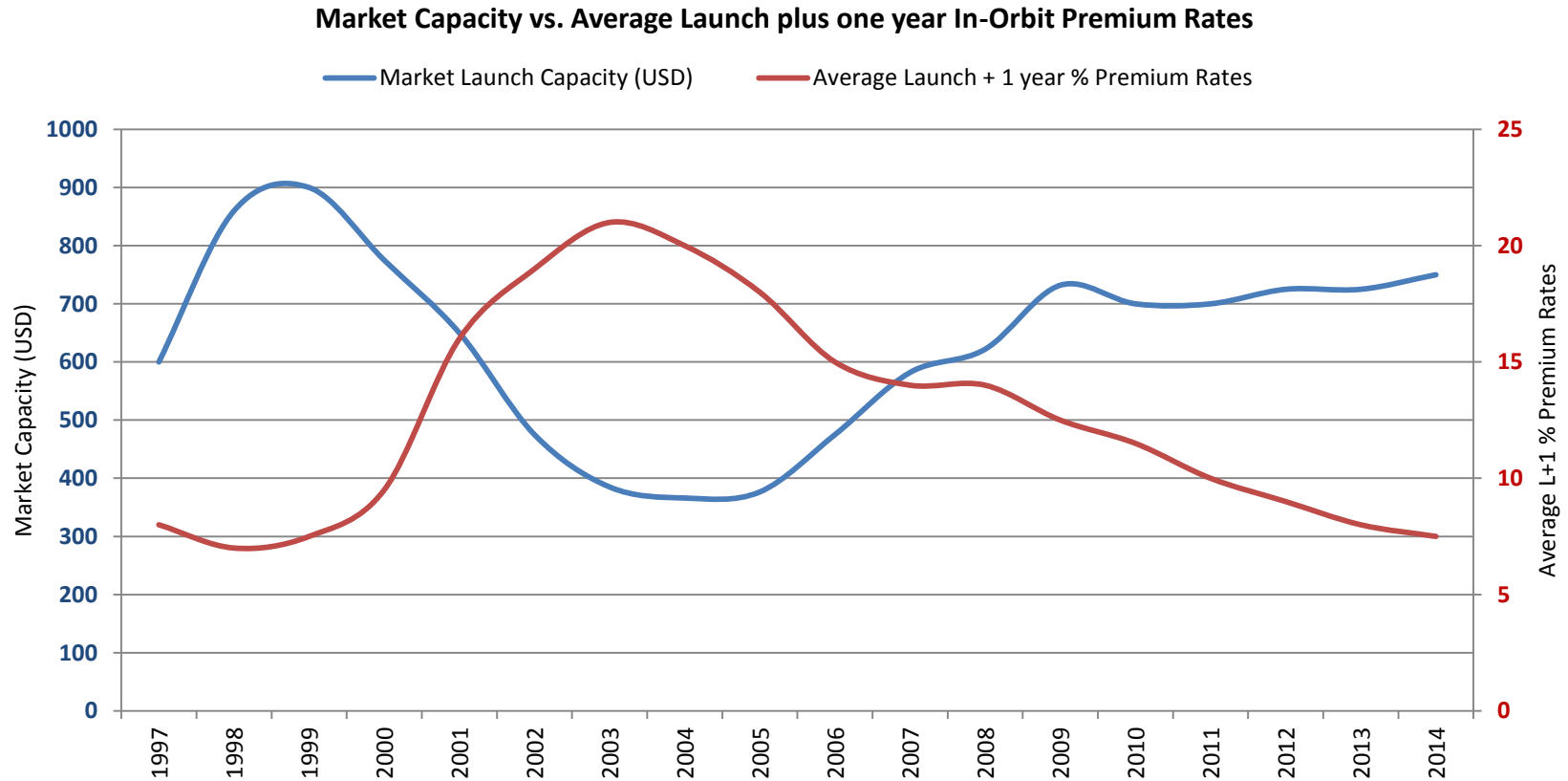
2015 Space Insurance Market Capacity

■ Working Launch Capacity (USD) ■ Working In-Orbit Capacity (USD)



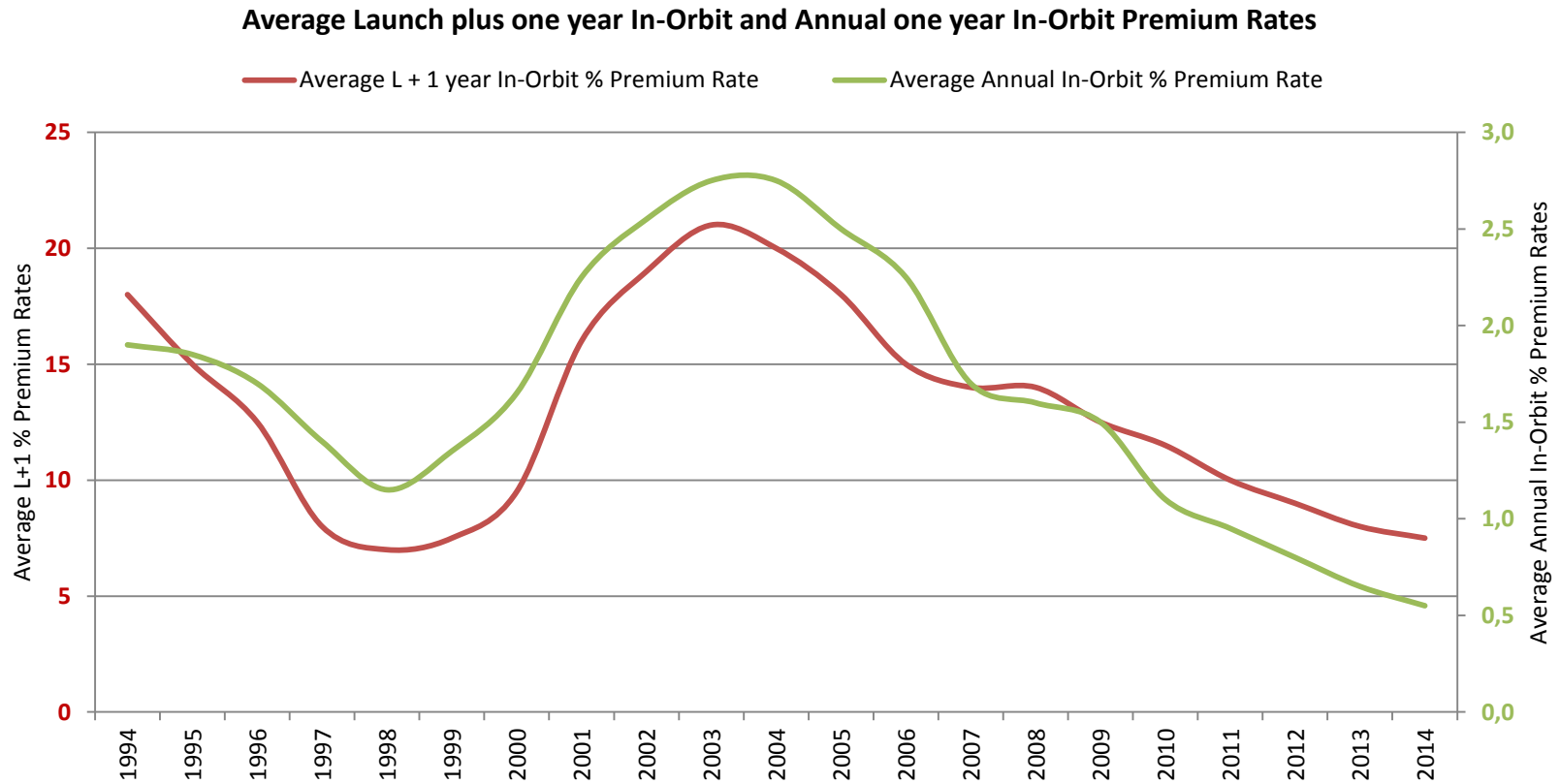
Space Market Capacity vs. Average Premium Rates

- Capacity has not evolved much since 2012, yet premium rates continue to fall...



Premium Rate Evolution

- Launch + 1 year rates and annual in orbit rates have followed a similar trend...



Launch Vehicle Statistics

	All Time			Since Jan 2000			Since Jan 2005			Since Jan 2010		
	Attempts	Successes	Success Rate	Attempts	Successes	Success Rate	Attempts	Successes	Success Rate	Attempts	Successes	Success Rate
Angara 5	1	1	100.00%	1	1	100.00%	1	1	100.00%	1	1	100.00%
Antares	5	4	80.00%	5	4	80.00%	5	4	80.00%	5	4	80.00%
Ariane 5 ECA	48	47	97.92%	48	47	97.92%	47	47	100.00%	25	25	100.00%
Ariane 5 ES	5	5	100.00%	5	5	100.00%	5	5	100.00%	4	4	100.00%
Ariane 5G Standard	16	13	81.25%	12	11	91.67%	0	0	n/a	0	n/a	n/a
Ariane 5G+	3	3	100.00%	3	3	100.00%	0	0	n/a	0	n/a	n/a
Ariane 5GS	6	6	100.00%	6	6	100.00%	6	6	100.00%	0	n/a	n/a
Atlas V	52	51	98.08%	52	51	98.08%	48	47	97.92%	33	33	100.00%
Cosmos 3M	448	430	95.98%	25	24	96.00%	12	12	100.00%	1	1	100.00%
Delta II	154	152	98.70%	66	66	100.00%	35	35	100.00%	6	6	100.00%
Delta IV	28	26	92.86%	28	28	100.00%	24	24	100.00%	17	17	100.00%
Dnepr	20	19	95.00%	19	18	94.74%	16	15	93.75%	7	7	100.00%
Falcon 1	5	2	40.00%	5	2	40.00%	5	2	40.00%	0	n/a	n/a
Falcon 9	14	13.5	96.43%	14	13.5	96.43%	14	13.5	96.43%	14	13.5	96.43%
GSLV	8	3	37.50%	8	3	37.50%	5	1	20.00%	3	1	33.33%
H-2A	26	25	96.15%	26	26	100.00%	20	20	100.00%	10	10	100.00%
H-2B	5	5	100.00%	5	5	100.00%	5	5	100.00%	5	5	100.00%
Long March 3B/E	24	22	91.67%	21	20	95.24%	21	20	95.24%	14	14	100.00%
Pegasus XL	32	28	87.50%	13	13	100.00%	6	6	100.00%	1	n/a	n/a
Proton K/DM	223	207	92.83%	41	40	97.56%	9	9	100.00%	1	1	100.00%
Proton M/Blok DM	8	6	75.00%	8	6	75.00%	8	6	75.00%	4	2	50.00%
Proton M/Breeze M	79	72	91.14%	79	72	91.14%	73	66	90.41%	45	41	91.11%
PSLV	28	26	92.86%	23	23	100.00%	20	20	100.00%	12	12	100.00%
Rocket KM	21	19	90.48%	21	19	90.48%	15	13	86.67%	8	7	87.50%
Soyuz	973	946	97.23%	181	176	97.24%	137	133	97.08%	82	79	96.34%
Taurus	9	6	66.67%	5	2	40.00%	2	0	0.00%	1	0	0.00%
Vega	3	3	100.00%	3	3	100.00%	3	3	100.00%	3	3	100.00%
Zenit 3 Sea Launch	36	32	88.89%	34	30	88.24%	22	20	90.91%	6	5	83.33%
Zenit 3 SLB Land Launch	6	6	100.00%	6	6	100.00%	6	6	100.00%	2	2	100.00%
Total:	2,280	2,174	95.33%	757	719	94.91%	564	535	94.77%	304	289	94.90%

Launch Vehicle Analysis

- **Ariane 5 rates remain the most competitive in the market**
 - Ample capacity exists even for dual launches with large sums insured
- **Several other vehicles remain popular with insurers but limited commercial opportunities to date**
 - Atlas V
 - H-IIA (H-IIB)
 - Long March 3BE
- **Falcon 9 now quickly gaining successful flight heritage**
 - Premium rates expected to improve rapidly
- **Proton premium rates now markedly higher than other launch vehicles**
 - Poor loss experience, quality control and reliability over the last 5 years
- **Insurers now have an increasing appetite for other smaller and emerging launch vehicles:**
 - Dnepr, PSLV, Rokot, and Vega

Satellite Platform Statistics

Manufacturer	Satellite Type	Number of satellites successfully launched	Satellites with in orbit claims	Aggregate in orbit incurred claims	Percentage of satellites with claims	Loss quantum per in orbit satellite	1st Flight Record
Boeing	601	44	10	\$1,056,850,000	22.73%	\$24,019,318	OK
Boeing	601HP	24	5	\$507,030,000	20.83%	\$21,126,250	OK
Boeing	376	56	4	\$88,000,000	7.14%	\$1,571,429	OK
Boeing	702	21	6	\$815,340,000	28.57%	\$38,825,714	Failure
Lockheed Martin	A2100	43	3	\$427,650,000	6.98%	\$9,945,349	OK
CAST	DFH-4	11	3	\$213,900,000	27.27%	\$19,445,455	Failure
MELCO	DS2000	8	0	\$0	0.00%	\$0	OK
EADS Astrium	Eurostar 2000/3000	60	6	\$209,619,561	10.00%	\$3,493,659	OK
ISS Reshetnev (ex NPO-PM)	Express A/AM	20	2	\$57,960,687.00	10.00%	\$2,898,034	OK
INSAT	I2K	8	0	\$0	0.00%	\$0	OK
INSAT	I3K	5	1	\$156,709,150	20.00%	\$31,341,830	OK
Astrium/ISRO	I3K	3	1	\$156,709,150	33.33%	\$52,236,383	OK
INSAT	Insat 2/3	11	3	\$107,320,000	27.27%	\$9,756,364	OK
SS/Loral	LS-1300	97	7	\$991,465,190	7.22%	\$10,221,291	Failure
Alcatel/Thales	Spacebus 3000/4000	46	10	\$1,151,672,096	21.74%	\$25,036,350	Failure
Orbital Sciences	Star 2	30	2	\$288,312,257	6.67%	\$9,610,409	OK
Krunichev	Yahkta	3	2	\$65,858,500.00	66.67%	\$21,952,833	Failure

Satellite Platform Analysis

- **In orbit reliability of all the mainstream satellite manufacturers has dramatically improved in the last decade**
 - No recurrence of the 'generic failures' of the late 1990s/early 2000s
 - However random failures do seem to be on the increase!
- **Insurers now showing very little (if any) in orbit premium rate differentiation between the major satellite platforms**
 - SSL-1300 (SS/Loral)
 - Boeing 702 (Boeing)
 - A2100 (Lockheed Martin)
 - Star 2 (Orbital)
 - Eurostar 3000 (EADS Astrium)
 - Spacebus 4000 (Thales Aleniaspace)
 - DS2000 (MELCO)
- **Other 'newer platforms' also now gaining successful in orbit heritage**
 - DFH-4 (CAST)

Satellite Platform Analysis

- **With a limited number of commercially insured GEO satellites in any given year, insurers increasingly broadening their portfolios with imaging/earth observation satellites**

- **Smaller sums insured balanced by insurers generally offering smaller capacity**
 - Technically complex satellites
 - Less heritage than GEO satellites
 - Shorter in orbit lifetimes

- **Major insured manufacturers include:**
 - Astrium
 - Ball Aerospace
 - CAST
 - OHB
 - Orbital (through buying General Dynamics)
 - SSTL

- **Emerging companies include:**
 - Planet Labs
 - SkyBox

Space Insurance Market Outlook

■ The trend of increased capacity continued in 2014

- Three 'new' underwriting entities entered the market in 2014; aggregate capacity of USD 40m+
 - Altitude Risk Partners (Tim Wright)
 - Beazley (Denis Bensoussan)
 - Osprey (Chris Gibbs)
- Allstate now writing in orbit business again
- Sciemus now writing launch business again (USD10m) and increased in orbit capacity (USD 20m)
- CV Starr capacity increased from USD 25m to USD 35m
- Tokio Marine capacity increased from USD 16m to USD 18m
- ElseCo capacity expanding through ElseCo Paris (and more recently New York) operations

■ Increasing number of carriers now offering multi-year launch and in orbit coverage

- Collectively, over USD 250m of long term capacity now available for select risks
 - Swiss Re
 - Munich Re
 - Allstate
 - Partner Re
 - Global Aerospace
 - Inter Hannover
 - Catlin
 - CV Starr

Space Insurance Market Outlook

- **Premium rates have continued to fall for vast majority of launch and in orbit risks**
 - Overcapacity and long term sector profitability; simple laws of 'supply and demand'
- **The most 'technically attractive risks' at all-time records lows**
 - L+1 Ariane 5 rates +/- 5.00%
 - Select annual GEO in orbit rates less than 0.50%
- **Conversely, premium rates have increased dramatically for Proton**
- **2015 market capacity largely unchanged from 2014**
 - ElseCo now offering additional USD 10m capacity from US operation
- **Space market remains extremely volatile; aggregate sums insured for some Ariane 5 launches now in excess of total annual premium income**
- **Space market is also increasingly vulnerable to 'non-space related' losses**
 - Natural disasters / Catastrophic losses / Aviation losses
 - Space risks part of a much larger aviation portfolio for a number of space insurers

Space Insurance Market Outlook on Russia

- **The market continues to be nervous of Russian hardware and in particular the Proton launch vehicle**
 - Underwriters now expect at least one Failure per year and are rating the risk accordingly.
 - This is in direct opposition to their view of the Ariane 5 and more recently the Falcon 9.
 - Although the Falcon 9 is still a relative newcomer to the market, due to its excellent PR Departmentt and willingness to be offer full transparency to underwriters, it is now viewed very favourably in terms of rating.
 - Reliability is still a major concern with regard to the Proton LV
 - Quality Control – is it robust enough ?
 - Is the experience and intellectual capital still there ?

- **Conversely, premium rates have increased dramatically for Proton**
 - The Proton usually provides around 1/3 of the market income per year.
 - RSCC have placed major launch programmes into the international market in recent years and are now seen as one of the major insurance buyers in the Space market.
 - 5 Satellite Launch pack in 2014 was the largest by any single operator in that year
 - We believe that differentiation will continue in the short term but memories are short and if the Proton can demonstrate its long term reliability once again then it is very likely that rates will improve quickly.